

A foundation platform for smart HVAC control

Paul Philips, Nick Kesteven, and Craig Langley describe the development of the IQView display panel designed especially for heating and ventilation control in intelligent buildings.

The IQView display panel is designed especially for intelligent buildings and is making use of Microsoft Windows CE .NET, to deliver advanced functionality to users, as well as the familiar Windows-style environment. The use of both Windows CE .NET and application development Visual Studio .NET for development has accelerated time to market, and shipping with the low-cost Windows CE .NET core licenses helps maintain competitive pricing for Trend Control Systems IQView.

Both the hardware and software of this device have set the foundation for future designs soon to be introduced both by Trend Control Systems and sister companies serving the building management and fire and security markets.

Internet functionality

Building management systems can be subdivided into three main categories: field devices, such as sensors, motor control equipment, and valves and actuators; intelligent controls that are the brains behind controlling building environments; and PC-based supervisors and embedded displays. In the building controller realm, new devices such as Trend's IQ3xcite have brought a new level of versatility to building management systems. Its built-in Web server enables access to the system from anywhere in the world, without the need for proprietary software.

Modular hardware means extra points can be quickly and easily added, and flexible strategy modules provide opportunities for customising control to each application. IQ3xcite uses Ethernet/TCP-IP local area networking to communicate, which brings financial and system performance benefits and also facilitates the integration of building management with IT and other services.

The IQView display panel not only com-

plements these advanced controllers, it provides a software and hardware platform for future controller and building network products.

Its quarter-VGA (320x240 pixels) 120 x 89mm touch screen provides a self-configuring user interface to the IQ system. The IQView software presents users with the familiar Windows operating environment; access is provided via a navigation tree, enabling controller selection and hence access to modules, graphs, alarms and time zones. There is a simple version with a mono screen and RS-232 communications, and a more fully featured version has a colour screen with RS-232, Ethernet and current-loop networking.

Scott Horn, marketing director for the Embedded Devices Group at Microsoft, said, "We are seeing both mobile and handheld devices increasingly used in a wide range of commercial applications to provide more convenient access to local and network information. As demonstrated by Trend Control, Windows CE .NET is the preferred Windows Embedded family platform for rapidly building mobile handheld devices that easily integrate into enterprise network infrastructures, providing rich and configurable access to information."

Nick Kesteven, strategic business manager at Trend Control, was in charge of the software development for the IQView panel. "C++ and Visual Basic .NET programmers worked in parallel starting April 2003. By July/August we realised that productivity with Visual Basic .NET was much better and performance was more than adequate."

Paul Philips, research & development technology manager at Trend Control, added, "There were a number of reasons for choosing Windows CE .NET as the implementation platform, but one of the significant drivers for the choice was the ready

availability of ready-to-use components. We were able to implement Web servers, WiFi and other components quickly, with confidence that they would work. We found that start-up costs were also low compared to other RTOS. The core license offers low price per box, which is very attractive for us."

User interface

Windows Embedded platforms leverage the attributes of Microsoft desktop operating systems while preserving design flexibility. Windows Embedded features are delivered as a set of components, beginning with a highly reliable kernel and core operating system services.

User software for the IQView runs under the Windows CE .NET 4.2 operating system and has been built using the .NET Compact Framework. Once started it explores and automatically learns the structure of the Trend building management system to which it is connected. Users log in through a familiar Windows dialogue box and are then shown all areas of the network they are authorised to view. Administrators can configure up to eight users, assigning privileges for the objects they are entitled to view and the actions they can perform on each object.

Once logged in, the user is presented with a standard display consisting of a toolbar along the top, a central display area and a status bar along the bottom. The toolbar contains menu icon buttons, which change according to the context of the display. Touching a menu icon normally produces a drop-down list of options.

The central display area represents the site. It shows all the site's network structure displayed in tree-like directories using Windows Explorer.

Network segments with controllers have an adjacent plus sign that, when clicked,

expands the network and shows all the controllers with specific icons to represent the controller types. From there the user is able to drill down to summaries such as display directories, time zones, alarms and adjustable modules.

In the directory display, users select display and various directory from configurable lists of functionally related modules, enabling them to monitor and adjust specific items programmed into the controller. Time zone display allows monitoring and adjustment of occupation times, identification of time master, and synchronisation of the outstation time. Selecting the alarm display shows the alarms in the controller, either current or historical, and the IQView provides comprehensive management of alarm conditions. The fourth option, Modules, allows users to choose a summary page of selected data – sensors, knobs, digital inputs, drivers or switches – then allows them to monitor and adjust each individual module. Selected items can be logged by the controller, and these can be displayed as timelines either in real time or as historical graphs.

Two printed circuit boards form the hardware platform for the panel: a CPU board with an Intel PXA255 XScale processor, and a board carrying a range of communications and I/O options, along with the unit's 24 volt power supply. The hardware platform is designed for a range of future enhancements including CANbus, a dial-up or GSM/GPRS modem option, and USB connection. Sister companies are developing new BMS products for their marketplaces based on these hardware platforms.

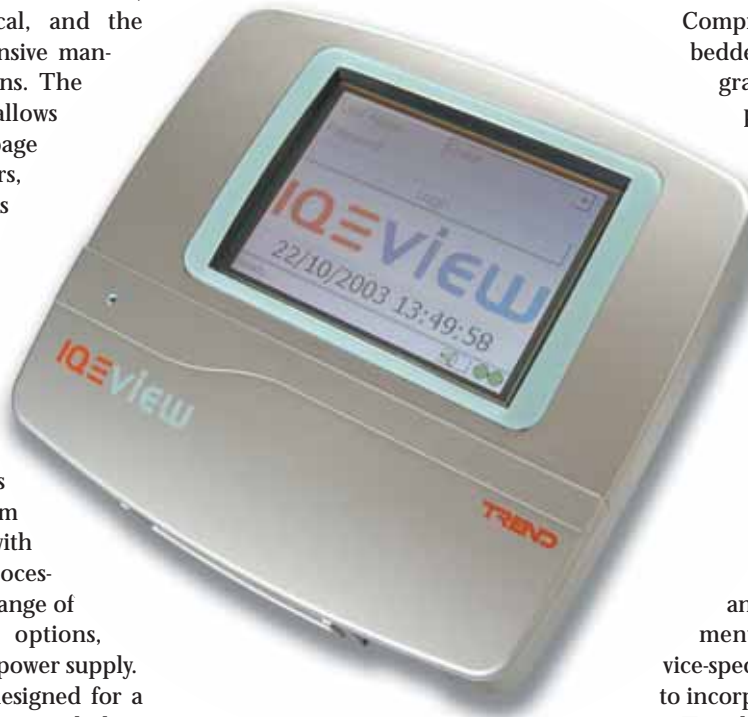
The Windows Embedded Platform Builder tool for Windows CE .NET provides an easy, GUI-based IDE that enables developers to customize operating system images and incorporate features and services into designs with point-and-click simplicity. Windows Embedded platforms also enable developers to develop applications for devices using the same skills used to develop for the desktop, and use application development tools such as Visual Studio .NET and eMbedded Visual C++ 4.0 to more efficiently develop both managed and native code.

Trend partitioned the development across a four-person team, with individual designers responsible respectively for hard-

ware, communications, the human interface and porting of applications to the Windows CE .NET Framework.

Use of Visual Studio .NET provided radical increases in programming productivity compared with Trend's previous C++ platform. Concerns over potential real-time performance issues were quickly allayed: so much so that the original 400MHz CPU prototype is replaced by a 200MHz version in the production model.

Adding future enhancements such as Web server or wireless networking will be seamless using standard Windows CE .NET



components including HTTPS, SNMP and SMTP.

Windows Embedded platforms reduce custom development requirements by providing a comprehensive set of features that are delivered as a professionally tested set of components that eliminate the need to develop capabilities missing from other platforms. With Windows CE .NET, many software components such as TCP/IP stacks may be used out of the box.

In addition, Windows Embedded provides access to source code to enable efficient debugging of the operating system, applications, and drivers and platforms leverage a standard, widely adopted programming model giving access to a large collection of prebuilt applications, services, drivers and hardware.

The development environment is comprehensive – effectively a one-stop bundle – with compilers, linkers and emulators inte-

grated into the .NET platform. It offers good time to market and, as the operating system matures and its user base grows, will provide many options and opportunities for forward-looking developments. RTOS images are created simply, using Microsoft Platform Builder as an integrated development environment to design, create, build, test and debug the Windows CE-based platform. Equally attractive for Trend is the cost structure. Start-up costs are low compared with other real-time operating systems; and the attractively-priced Windows CE .NET core license, shipped with every IQView display panel, keeps costs competitive.

Comprehensive features: Windows Embedded platforms enable users to integrate the core operating system plumbing easily so they can focus on the value-add features and services that will differentiate their device. They have instant access to their choice of advanced multimedia features such as Windows Media 9 Series codecs, world-class browsing with Microsoft Internet Explorer 6, a broad range of networking and communications protocols, and much more. Windows Embedded platforms also provide device-specific capabilities such as multiple boot and storage options, flexible deployment and management features, device-specific optimizations, and the ability to incorporate hard real-time support.

Trend Control Systems is the UK's leading manufacturer of intelligent building controls, providing control and monitoring of heating, ventilation and other building services.

Intelligent building controls save energy and ensure optimal working environments, and can deliver significant time and cost savings. With solutions ranging from intelligent optimised solutions for small premises to sitewide distributed systems, the applications run a huge number of corporate HQs, hotels, supermarket chains, airports, fast-food outlets, arts centres and museums, anywhere that intelligent control of heating, ventilation and air conditioning systems creates benefits.

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