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White Paper

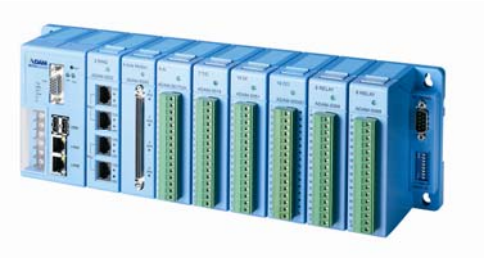
What Does an Automation Computer Look Like?

Written by: Mike Berryman, Advantech Corporation, Industrial Automation Group

Every day, without thinking about it, we use hundreds of computers in every facet of our lives. Nearly every device with a display or a control in our homes, in our offices, and in our factories, has a computer in it. In our factories this is especially true.

This is the age of embedded computing. From wristwatches to cell phones to industrial process control devices, computers control everything. But these devices do not look like computers. They look like wristwatches and cell phones, and industrial displays, controls and even robots. So what does an automation computer look like?

Well, it could look like a PLC. “They were always computers,” says Dick Morley, who developed the first programmable logic controller. “We called them controllers to keep from scaring the operators.” PLCs were developed to replace hard wired relays in factory automation. They were simple to program, relatively easy to use for simple tasks, and were extremely durable. Morley tells of taking the prototype to General Motors and, while carrying it in the front door, dropping the device to the floor. They picked it up, and set it up and it performed flawlessly. But PLCs were limited. They were essentially relay-replacement devices, and when operators and engineers tried to get them to do more sophisticated tasks, programming in ladder logic became complex and difficult. Most automation companies moved to larger capability devices, including some open devices known as PACs or Programmable Automation Controllers.



So, an automation computer could look like a PAC. Programmable automation controllers are open operating system replacements for PLCs that were supplied with closed proprietary operating systems.

Programmable automation controllers can be supplied with a wide variety of operating systems from RTOS systems to several versions of Windows, to several versions of Linux. PACs have become the system of choice for many industrial controls applications, from machine control to data logging and process control. Their ability to handle higher order programming languages, like Visual Basic or C++ make them programmable by most computer professionals, while the PLC is limited to those trained in the various proprietary PLC programming languages. PACs are remarkably versatile, and because they can run some form of the Windows operating system, are easy to use by nearly anyone.

They interface well with other PACs, and typically, a program developed to run on one vendor’s PAC will also run on another’s with little or no modification. While Windows CE, or XPe (the embedded form of Windows XP) aren’t exactly “open” systems, they have enough openness that they make working with application programs that must be ported to more than one type of PAC much easier to create than the “closed” proprietary systems of the PLC vendor companies.

PACs come in several form factors, as do PLCs, from standalone units to DIN rail mounted units, to rack mounted units. None of them looks like a personal computer, but each of them is an automation computer.

It could look like an operator interface. Each operator interface panel (HMI) contains more than just an LCD screen. They also have embedded processors that run housekeeping functions for the display, as well as embedded processors that connect the display to the network, and allow the operator to use it to enter data and control commands. The earliest operator interfaces were large hard-wired control panels. Replacing panels with video displays made it possible to give the operators more information, but it wasn't until the advent of touch screen LCD displays that the operator could use the actual display to replace all the functionality of the panel itself. In order to do that, the display became a computer driven HMI, and then, as technology improved, manufacturers began embedding an entire controller into the HMI. As Windows began to be accepted as the operating system of choice, the HMI very often used Windows as its operating system. Now you can buy an integrated HMI display, with PAC and even networking built in. Because they are usually Windows driven, they interface easily with other Windows driven HMIs and industrial computers. That's three automation computers, in a single housing that looks like a video display.

It could look like an Ethernet switch. In fact, Ethernet switches are computers. They are special purpose processors that are designed to act like "traffic cops" on the local area network. Managed Ethernet switches are very sophisticated computers that not only act as traffic cops directing packets to their destination, but can also be used as firewalls, and can be programmed with very high order policies to prevent hacking and unauthorized entry into the network. Ethernet switches operate on copper networks, and on fiber optic networks and the same embedded computers can also be used as protocol converters as well as other networking appliance functions.

It could look like a field instrument. It could be a differential pressure transmitter, or a flowmeter, or a pH analyzer, or even a tunable diode laser spectrometer. Smart field devices, and smart analyzers, are all examples of automation computers, and they don't have keyboards, mice or sometimes even displays. In order to do mathematical functions, to operate as part of Fieldbus networks, and to store and transmit data and diagnostics, field instrumentation has been made up of automation computers for two decades. Sometimes, the processor in a field transmitter can be the same or similar to those that were used in "personal computers" years ago: 80386, 80486, and 80586 (Pentium) processors. Now, these processors have been outclassed by dual core and quad core processors that operate at multi Gigahertz speeds, but they are still powerful enough to be used in transmitters and analyzers. Very often, embedded processors like ASICs and FPGAs are used for instruments when the cost of production or the limited requirements call for it.

It could look like a portable calibrator or handheld tablet. These devices too are automation computers, even though they are handheld, run on batteries, and often have special purpose programming. Many handheld tablets run Windows, or some form of the popular operating system that is designed for handhelds. This means that the same HMI screens that run on the standard HMI displays in the plant can also run on the handheld tablet.

The operator can use the handheld's display to serve as an auxiliary HMI terminal and make

changes to the control system from wherever he is located, rather than having to run to the control room in the case of an urgent change or emergency. Handheld tablets can run calibration and programming software for field devices, as well as asset management software, and can thus make the operator much more agile and able to meet all the challenges of running a modern factory or process plant. Handhelds usually include wireless capability, and are made to be robust enough to handle the jostling and dropping that tools often undergo in the industrial environment.

It could look like a field I/O module. Input/output devices have long been more than terminal strips. I/O modules often include power supplies, power conditioning, signal conditioning, signal scaling, and other important tools. I/O modules can be fully analog, with analog signal in, analog signal out; or they can also be analog to digital converters, taking analog signals in and producing digital signals like Modbus or some serial outputs. I/O devices (aka device servers) often serve as protocol converters, as serial-to-Ethernet converters, and can be configured to operate over most operating systems from Windows to Linux.

An automation computer can look like just about any device that we use in the industrial environment. They can have a common operating system environment, common programming tools, common networking functions, common storage and communications capabilities, and even share common peripherals and major sub-assemblies like video, audio, and I/O. This can make them incredibly useful for large or small facilities, system integrators, and device vendors. The same computer platform can be used literally in every part of a plant. Automation computers have benefited by the development of faster, lower power processors that give off less heat, flash storage devices, and higher order programming tools.

The chameleon-like ability of automation computers to look like many different devices is due to advances in embedded technology and the impact of embedded technology in electronics manufacturing. Originally, embedded systems were designed to provide a pre-programmed solution to a single application, but advances in operating system design have made it possible to develop monolithic kernels, such as adaptations of Windows and Linux operating systems. This gives programmers an environment similar to a desktop operating system, is very productive for development, and is easier for operators to learn how to use. This type of embedded system allows re-use of publicly available code for objects like device drivers, web servers, firewalls, and others. The development system can start with the default feature set that comes with the macrokernel operating system, and then the available features can be pared down to suit the specific application. This saves on memory, hard drive or solid state storage space, and save cost and increase reliability. So, embedded systems have become ubiquitous. We find them literally everywhere, especially in the industrial environment.

So count'em up! How many automation computers do you have? Did you overlook any?

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