How Programmable Automation Controllers are meeting the demands of modern industrial applications

Introduction

In the competitive process control and automation market of today, there is an increasing need to utilise hardware that pushes the boundaries of traditionally used equipment such as remote I/O, relay systems, panel meters, data loggers and distributed control system (DCS); industrial applications require improved reliability, efficiency, accuracy and profitability. There is also the additional challenge of end customers with a real need to deliver cost effective solutions within constrained budgets.

Equipment like programmable logic controllers (PLCs) and industrial personal computers (IPCs) are no exemption to this rule. In the past, there has always been a clear definition for the functionality of a PLC and IPC in the automation environment – a PLC to perform monitoring and control tasks while the IPC runs the supervisor control and data acquisition (SCADA) software package, stores data for record keeping purposes and acts as a local display (interface) for the PLC operator.

Most PLCs are programmed using ladder logic but for applications that deviate from or expand beyond this architecture they have become increasingly difficult to program. An example of this would be complex applications such as proportional-integral-derivative (PID) loops utilised for temperature measurement and control require floating-point arithmetic that PLCs do not support.

Innovative Technology

To meet the demand of modern industrial applications, programmable automation controllers (PACs) were launched in 2001 to enable automation engineers to better define their application requirements.

PAC combines the functionality and openness of an IPC, the reliability and robustness of programmable logic controller (PLC) and the intelligence of I/O modules all housed in a single box. This innovative technology offers a flexible, versatile and cost effective solution to a wide range of industrial applications from data acquisition, process control, motion control to energy and building management.

Image 1 - A PAC unit offers the capabilities found in a PLC plus the benefits of an IPC

PACs are equipped with the latest generation of Intel® Atom™ processors and versatile operating systems providing powerful and efficient performance. PACs allow users to choose from Windows Embedded Standard 2009 (WES 2009), Windows CE, Linux, MiniOS7 (DOS) or Android platforms to meet the increasing demands of complex applications where PLCs are just not able to provide the flexibility required by the marketplace

The open architecture and modular design of PACs facilitates communication and interoperability with other devices, networks, and enterprise systems. A PAC unit can seamlessly be utilised for communicating, monitoring, and control across various networks and devices because they are equipped with standard protocols and network technologies including RS232, RS485, USB, Ethernet, OPC, SQL, Modbus, CAN/CANopen/DeviceNet, PROFIBUS and FRnet bus for deterministic control system. PACs also support GPRS/GSM connectivity to expand the communication bus to wireless applications.

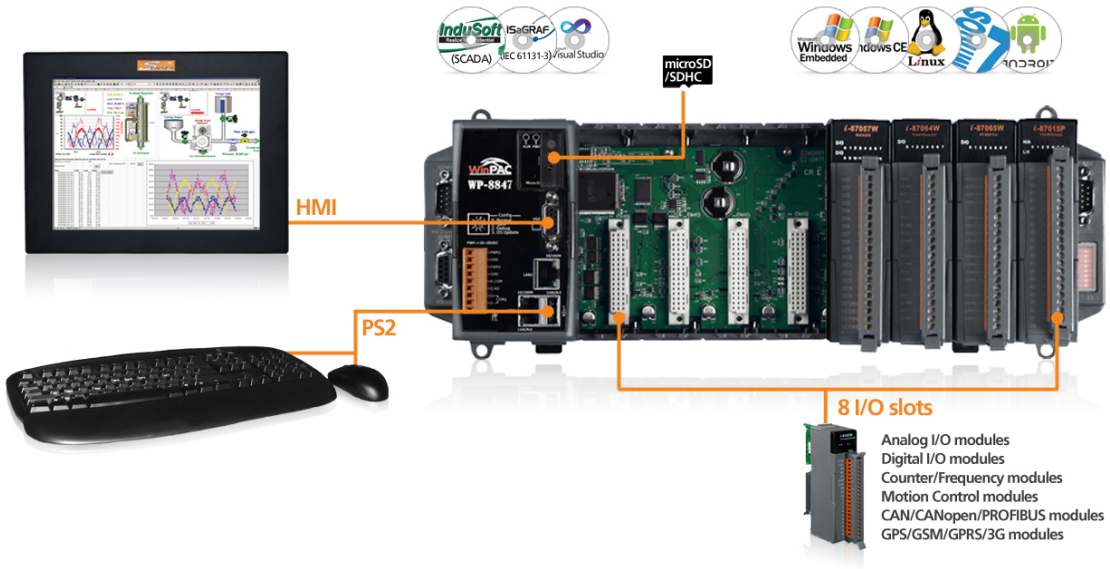

Image 2 - Overview of the functionality and versatility of a Programmable Automation Controller

PACs offer a single unique architecture for multiple applications including process control, motion control, and industrial automation. The modularity of PACs simplifies system expansion and with the availability of a comprehensive range of I/O modules, making it easy and cost effective to connect sensors directly into a PAC device; enhancing measurement accuracy and performance. In the Amplicon range there are over one hundred cost effective I/O modules available, some with unique features such as hot swappable design, auto-configuring, easy maintenance and wide operating temperature (-25°C ~ +75°C).

PACs support powerful and flexible development software platforms such as Visual Studio, Visual Basic, C/C++, Delphi, eLogger (data logger), SCADA, LabVIEW, MATLAB and softlogic (IEC 61131-3) to allow the seamless implementation of real-time data acquisition and data/device control via wired or wireless networks

High-end PACs are equipped with video graphics array (VGA) port to integrate LCD monitors which enable users to locally visualise and interact with a PAC device or alternatively, a PAC that combines human machine interface (HMI), data acquisition and control in one unit called ViewPAC; resulting in a neat and tidy solution for automation applications.

Image 3 - ICP DAS Programmable automation controllers

Limitations of Conventional PLCs

Programmable logic controllers (PLCs) were invented the 1960's to replace relay control systems. Since then, PLCs have been universally embraced by the automation and process control industry for controlling outputs (based on inputs). PLCs are robust, and able to withstand harsh conditions such as extreme temperatures or dust in the air. They also switch quickly without over heating, in contrast to conventional relay control systems.

On the downside, PLCs are not so good at handling large amount of data or complex data as well as databases or at displaying data. Programmable Automation Controllers (PACs) offer a better solution in this case as they combine the functionality of a PC and the ruggedness of a PLC.

One of the main disadvantages of the PLC is the lack of standardisation and flexibility. In contrast the PAC unit has an open architecture, most PLCs manufactures offer only close architectures for their products, which imply that hardware and software from one manufacturer can not easily be used in combination with hardware of another manufacturer; this limits the design and can in some instances significantly increase installation costs.

The sequential program execution used in a conventional PLC takes about 10 ms or more to complete. At this rate, the PLC is not suitable for control applications where the input signal frequency is above 100 Hz. The scanning time is also limited by the length of the program. For instance, if you want to read a speed senor input to measure a speed at around 15000 rotations per minute (15000/60 = 250 Hz signal frequency), a microcontroller-based PLC can not measure the speed correctly using this input.

A PLC is more specialised in digital functions with some added capability for analog processing; whereas a PAC is specialised in analog processing capability with additional functions for digital and logic control. It is ideal and advantageous to deploy a PAC unit in industrial applications where the user needs stronger process control over the digital I/O functions of a PLC.

Benefits of PACs

The PAC can offer vast benefits when deployed in a variety of industrial applications. These benefits include the ability to independently meet complex process control and automation application needs where conventional PLCs require extra components to handle the same process

A PLC will require multiple hardware components for machine control, where a single PAC device can handle PLC logic, motion control, drive control, motion safety, robotics, and PID control. Utilising a PAC device greatly reduces valuable cabinet space, sensor and actuator wiring, and simplifies field-bus configuration.

PAC software choices are wider as programmers can select from IEC 61131-3, Visual Studio.NET, Embedded Visual C++, and many other third party development environments. The PAC can provide more tools to integrate various aspects of the application including versatile network connectivity, high performance CPU, and easy enterprise integration with open standard technologies.

Another benefit to selecting a PAC is how easily systems can be upgraded with the ability to directly connect sensors or actuators without the need of additional signal conditioning circuitry. The modular architecture and comprehensive array of hot swappable I/O modules makes it easy to expand and replace faulty modules without the need of re-configuration or re-programming; this shortens time to market and dramatically reduces the labour costs and time spent on system development.

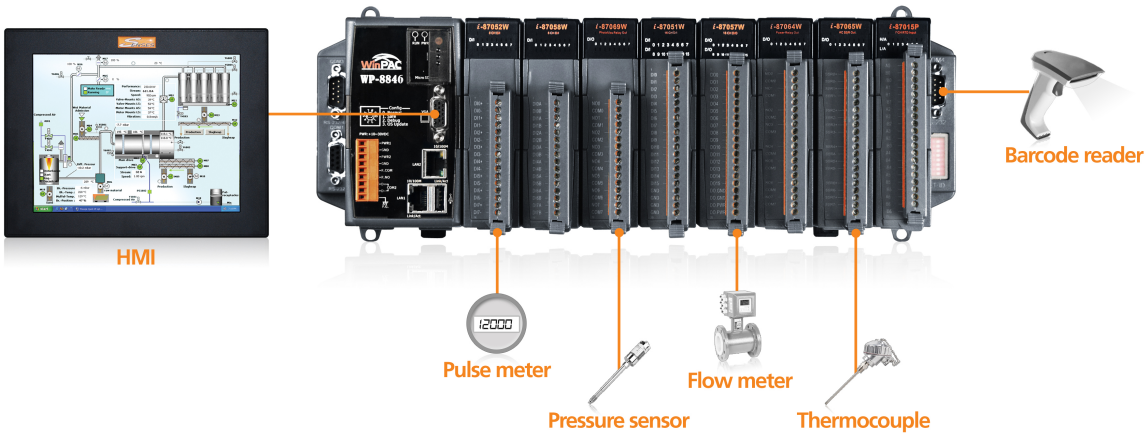

Image 4 - Diagram of a typical PAC set-up in an industrial application

PAC integrates control, information processing, and networking in a single platform to address different tasks with deterministic performance. All these unique features and benefits make the PAC a more reliable, scalable, and flexible platform for complex process control and automation applications.

Conclusion

PAC is a compact controller with advanced features such as network connectivity, device interoperability and data integration capabilities found in a PLC plus the additional benefits of an IPC in a DIN rail or panel mount form factors. All of these unique features position the PAC as a real solution for meeting the diverse requirements demanded in modern industrial applications.

This innovative technology also improves the amount of data that can be exchanged between the control and supervisory layers, while allowing more control strategies to be executed. This capability helps boost system performance while enhancing access to real-time data for improved productivity.

The best way to take advantage of PAC architecture is to standardise on a product from one particular PAC vendor. This will allow you to leverage their in-house experience in the process control and automation market and will give you access to a strong product knowledge and offering, delivering versatile interfaces to open networks vital for the application.