PC vs. PLC: Comparing Control Options

To choose between a PLC or PC, analyze and compare characteristics that could differentiate the two technologies, such as operation, robustness, serviceability, hardware integration, security, safety, programming, and cost.

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One of the most crucial decisions in the initial design phase of a machine is the selection of the control system. Since programmable logic controllers (PLCs) were first introduced in the 1970s, they have dominated the process and automation markets. For years, the PLC has led the way for advances in machine automation control. From small controls used in the automotive industry to large-scale controllers running entire factories, the PLC was the primary controller of choice.

However, starting from the early 1990s, the PC has been successfully working its way into those markets as processor speed and range increases and the cost of those components decreases. Applications using a PC are on the rise, accelerating development, and blurring the line between the two technologies. Ten years ago, deciding controller type might have been a clear choice; today, that is no longer the case.

The PLC was developed as a more streamlined, flexible, and reliable alternative to switch boxes and relay panels. It was dedicated only to specific tasks in the factory, and its language and structure were modeled around the switches and relay panel circuits it was replacing. Furthermore, it had to maintain its robustness and consistent performance in challenging environments that contained relatively high levels of electromagnetic interference (EMI), contamination, and vibration. As time passed, the PLC evolved to include the capabilities of motion control, advanced proportional-integral-derivative (PID) process control, and integrated safety, while also adopting some PC features, such as a web server and networking utilities.

The PC, on the other hand, served a higher level role in the scope of the machine. It was used primarily for complex calculations, monitoring, measuring, and factory networking as well as a user-interface to the PLC. It was usually housed in a more environmentally controlled location because it couldn’t operate as reliably as a PLC in harsh factory conditions.

The PC eventually evolved to include PLC functionality, while still containing its core capabilities. Also, the PC has become a more robust controller, allowing it to operate in the harsh environments where once only PLCs could operate. Further convergence of the technologies is evident in an analysis of their control architectures. With the addition of a PCI card, hardware drivers, and software, a PC can serve as a PLC. Furthermore, the addition of a real-time kernel can enable the PC to support more critical tasking and control algorithms. On the other hand, there are PLCs with a built-in PC that only require a keyboard and mouse to begin.

So, how does one choose between PLC or PC-based architecture? To simplify the decision-making process, it is important to first analyze and compare differentiating characteristics. Seven major areas to consider are:

- Operation
- Robustness
- Serviceability
- Hardware integration
- Security
- Safety
- Programming
- Operation

When analyzing system operation, focus on how the system will run and how instructions and tasks are processed. The standard PLC has an embedded real-time operating system (RTOS) with a dedicated processor that ensures a high...

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degree of control system reliability. Furthermore, since the PLC handles only automation and/or a process, it does not need to run other utilities, such as antivirus programs or system updates.

A PC with a real-time kernel or real-time operating system (OS) can accomplish the same reliability of control as a PLC. From earlier experiences with PCs at home and in the office, users might be wary of lock-ups of the PC (the so-called “blue screens”). However, these lock-ups could occur on any OS, including a PLC, if the OS software is not handling priorities properly. For industrial use, the software running the PC is dedicated to automation and will therefore have a minimal chance of lock-ups. Even if a lock-up would occur, the real-time kernel is not affected and continues operation. Real-time operation means any task is guaranteed to be handled within a certain time. Synchronized motion and/or advanced PID control requires a high level of real-time determinism, while non-critical supervisory controller operations, such as monitoring error messages or sending noncritical controller commands or queries, would not.

Robustness

Robustness of the controller refers to its durability in various environments. The standard off-the-shelf PLC has no moving parts, so it can withstand harsh environments for millions of cycles. A standard PC contains moving parts, such as fans or hard disk drives, and is less suitable for environments with high vibration levels.

However, industrial PCs (IPC) offer options such as solid-state drives, fanless cooling, and in-cabinet mounting. These options make a PC just as durable as a PLC, able to withstand the toughest industrial or environmental conditions. PLCs and PCs have converged in this area, but the PC requires additional options to equal a standard PLC.

Serviceability

Another factor is ease and cost of serviceability, which can be measured by the repair and replacement costs over the life of the controller. For a PLC, external devices can be replaced with ease while the system is in operation. Compact modular design makes replacing a PLC an easy job. This saves cost by reducing machine downtime. It’s also possible to perform a hot swap with a PC, but only for USB or other external peripheral devices. If the PC has a more modular design, such as a rack or panel-mount system, replacement time is closer to that of a PLC.

It is helpful to be able to effortlessly change out a system or its components and have a resource pool of replacement parts with long-term availability. In some industries, “copy exact” policies require this long-term availability. It is easier to implement copy-exact with a PLC since the hardware and firmware don’t change as rapidly as for a PC. Trying to find parts for a PC (even after a year or two) can be more challenging than for a PLC. (Ask the vendor about such policies, availabilities, and costs.)

Hardware integration

Every engineer appreciates a wide choice of options when selecting control system hardware, since peripherals, memory, and a user interface often are needed. Both the PLC and PC have the ability to control a multitude of devices using industrial communication networks. Some of the well-known networks are SERCOS, Profinet, DeviceNet, and CANbus, as well as their Ethernet-based counterparts such as SERCOS III, Profinet, EtherNet/IP, and EtherCAT.

Although the PLC and PC can offer an array of fieldbus options, the PLC has many of these options built in, whereas PCs and some IPCs need additional cards and drivers to provide a comparable offering. Besides the typical fieldbus networks, the PC is equipped with a more open and flexible array of interfaces, such as USB, FireWire, serial, wireless Ethernet, among others.

This gives the user access to more off-the-shelf devices to handle tasks that a PLC usually could not handle, such as an advanced high-resolution imaging system, where the images would be stored, analyzed, compared, and possibly archived. A PC would be well suited for this advanced task because of the amount of memory required; a PLC would have limited storage and processing capabilities.

A user interface is a crucial in some applications. The PC has a built-in user interface; the PLC could need switches, operator panel(s), or an industrial PC. So while the PLC can interface with devices over fieldbus and perform complex operations, it still needs a PC to handle memo-