Figure 1: HMIs with different touch screen technologies

Differences between IPCs and HMIs

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Introduction

Today, many industrial applications utilize industrial PCs (IPC) and Human Machine Interfaces (HMI) to acquire, process, store, or visualize data. While both are a common sight on the factory floor, the design of an IPC or HMI is often indistinguishable from each other. More than likely, you cannot even tell them apart at first glance. Many users even call an IPC an HMI, which adds to potential confusion.

INSIDE:

There are, however, technical differences between the two that go beyond their outward physical appearance. These differences include feature set, connectivity, levels of flexibility to modify or add functionality to the system, and, last but not least, overall performance.

This white paper explores the main differences between HMIs and IPCs and points out which criteria you need to consider before equipping a new machine with one or the other.

HMIs

Let's take a look at the HMI operator panel first. HMIs are purpose-built pieces of hardware, intended to talk via a predefined communication protocol to a programmable logic controller (PLC). You can think of them as a monitor for the PLC, but there are other use cases. Older HMIs utilized serial communication protocols like MODBUS RTU, PROFIBUS, or DeviceNet. In new HMIs, the main communication interface is more than likely an RJ45 Ethernet port talking protocols such as MODBUS TCP, EtherNet/IP, Profinet, or OPC DA/UA, just to name a few.

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HMIs are often proprietary, as they are designed to work seamlessly only with select PLCs and devices from the same vendor. Third-party connectivity can be a challenge, depending on how good or restricted a given communications driver was integrated into the HMI's firmware. It is certainly not a given that all PLC models and/or communication protocols are seamlessly supported in the required HMI design software.

In addition, traditional HMIs usually are only compatible with manufacturer-specific HMI design software. This locks users into one manufacturer. While a captive audience is certainly good for the manufacturer, it may not be that advantageous for the user.

In addition, the multitude of HMI design software packages available on the market are typically not compatible with each other. This means you cannot transfer HMI visualization projects from vendor A to vendor B. If you want to move your HMI project, you typically will have to recreate your visualization application from scratch. That, in turn, increases development cost and time; not to mention, it complicates the support aspect after deployment of the automation system.

Figure 2: If your HMI has a capacitive-touch screen, you can use gesture control, like swiping or pinch-zooming.

HMIs often cover small screen sizes from about 4 to 12 inches, but some manufacturers also offer larger screen sizes, such as 18.5-inch wide-screen units. Traditional HMIs mostly use the older resistive-touch technology that only enables single-touch operation. If you like gesture control like swiping or pinch-zooming or multi-touch capabilities, you need to look at HMIs that feature a capacitive-touch screen.

Keep in mind that the more features you add to an HMI, the closer it edges to the feature set and price of an IPC. In this case, the cost advantage of an HMI over the Industrial PC diminishes to a point where it might be better to switch the visualization concept to an IPC-based system.

Traditional HMIs are purpose-built pieces of hardware that have a closed, small footprint operating system. The disadvantage is that you cannot install any software on them, as the manufacturer locked down the OS at the factory and usually only provides a runtime for the visualization software. The advantage is that you cannot introduce viruses or malware on a closed HMI that easily. In addition, they do not require a formal shutdown like a traditional PC. More on that when we take a look at IPCs next.

HMIs also usually utilize slower processors, as they do not need much "reserve" to accommodate other tasks or software packages. The HMI manufacturer needs to balance the manufacturing costs with the needed performance and, as such, must find an acceptable compromise in their hardware design to get the job done.

Some newer open HMIs, such as HTML5 web panel, try to blur the line between HMIs and IPCs even more, as they no longer rely on specific communication protocols or PLC models (Figure 3). They utilize the open HTML5 protocol and simply connect to a web server via an IP address, the same way a web browser on a computer would connect to a website. This allows connection of these web panels not only to a PLC, but also to other devices with an integrated web server. An example would be a configuration or diagnostics page in an IIoT-enabled variable frequency drive.

Figure 3: HTML5 web no longer rely on specific communication protocols or PLC models, so they blur the line between HMIs and IPCs even more.

IPCs

Now let's look at an IPC in comparison. Computers on the factory floor are nothing new anymore, and many can altogether replace a traditional PLC and HMI (Figure 4). One benefit of an IPC: It can serve multiple purposes within one system – so the one IPC device can act as a logic controller, data concentrator, and/or visualization interface for the operator – all in one piece. This reduces cost and increases performance and capability.

IPCs have more processing power, more system memory (RAM), and usually much more mass storage space. Their biggest advantage is also their biggest potential disadvantage: They have an open operating system. Today's OS of choice for the factory floor is Windows 10 IoT, which is the industrial-grade version of Windows 10. While it may look like the

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Figure 4: IPCs have more processing power, more system memory (RAM), and usually much more mass storage space.

home or office-grade Windows 10 version, it takes out some of the components that are normally not needed on the factory floor, such as games, the Microsoft store, or Cortana.

Windows 10 IoT, therefore, has the benefit of coming with a smaller footprint/size for the OS, allowing it to fit on smaller and lower-priced mass storage devices. This is an important aspect, as industrial applications often require more rugged, but also more expensive, solid-state mass storage devices. The IoT version also offers other conveniences. It can be pre-licensed from the IPC manufacturer, eliminating the need to connect the IPC to the internet to complete the Windows registration process. Another advantage of the IoT version is that it gives the user full control over updates or to turn them off permanently altogether.

Older IPC systems may still run Windows 7; however, this is not recommended for new systems because the Windows 7 OS is no longer receiving updates, patches, or security fixes from Microsoft. This would make such systems vulnerable to malware or ransomware if left connected to the internet without proper precautions like additional hardware firewalls.

Like with any open operating system, you are free to install any kind of software from any kind of vendor on an IPC. Again, this can pose security risks if malicious software or a virus would find its way into an IPC via USB stick or the internet. So, a good software and hardware protection should be in place and regularly reviewed and updated.

IPCs use higher performance CPUs – think Intel Core i-series – and more RAM. IPCs often feature bigger screen sizes than traditional HMIs. Larger screens allow more data to be displayed at one time, or can make it easier for the operator to see the data. Plentiful interfaces, such as dual Ethernet ports, multiple USBs, and/or serial ports allow connection of more hardware and help future-proof applications more easily compared to a traditional HMI.

Typically, you do not have to rewrite your software much when upgrading or changing your IPC hardware, as they all utilize a common Windows-based operating system. Obviously, changes in the display sizes, resolution, or aspect ratio need to be taken into consideration as they can impact how data is being displayed on the screen.

With the advent of portable devices such as tablets, you may ask yourself, "Why do I need an HMI or IPC in my machine at all?" While a tablet IPC is great for personal use, they are not industrial grade, and due to their mobile nature, could be easily misplaced or stolen. While some analytical data certainly could be displayed via the cloud, any critical machine data needs to be displayed on a dedicated, industrial-grade HMI or IPC that is permanently installed and in view of the operator. This increases machine uptime and is also a safety feature to protect the machine and its operator. Tablets and other mobile devices can, however, be used in addition to the fixed HMI/IPC, e.g. for remote operation.

Industrial hardware, whether it's an HMI or IPC, is also designed for harsher environments and offers more mechanical protection against shock, vibration, or temperature extremes.

Conclusion: A place for both

HMIs and IPCs may look the same, but they have fundamental differences in capability, performance, and flexibility. Both have their pros and cons, and both are still viable for use in automation systems. In the end, weighing each specific application's needs, based on factors such as performance, cost, size, and feature set, will determine which is the better fit.

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