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White Paper

Using HMIs to Lower Your Cost of Ownership

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Thirty years ago, operator stations consisted of indicators, push-buttons, possibly a recorder, all mounted in the door of a large enclosure or on the face of a pedestal enclosure. Inside the box was the PLC, and each of the components of the operator station had to be hard-wired together by hand. Each of the terminations and each of the components was a single point of failure just waiting to happen and the cost of producing each operator station was very high.

Jump ahead to today. All of the features and functions of an operator station can now be done with a single device—the HMI. HMIs are panel mounted embedded computers which have many of the functions of a programmable controller, but which are designed to emulate the electro-mechanical controls of an earlier day, exactly like the PLC was designed to emulate and supplant the electro-mechanical relay of yesteryear. HMIs have an integral touchscreen display, usually an LCD, and can be supplied in a variety of sizes, with a variety of features, display resolutions, and programming capabilities from very simple to highly complex.

From standalone components to the HMI

The push from standalone components to the modern HMI actually began with the PLC. The PLC was developed to reduce the time it took to do automotive plant assembly line turnaround. By replacing hardwired relays with firmware and logic, it made it possible for setups to take a matter of hours rather than weeks. Unfortunately, it took more time to wire the operator panels than to download the new program into the PLC and to do what re-wiring was necessary to repurpose the PLC for the new setup.

How much time it took to build the operator panel depended on the complexity of the panel, which, in turn, depended on the application. A simple conveyor control panel, for example, might include an E-stop, a speed vernier connected to a Variable Frequency Drive, a readout (LED or analog dial) an HOA switch (Hand-OFF-Auto), and a set of contactors to operate the conveyor's motor.

Changing to a solid-state HMI panel removes all of those components *and their associated wiring* and the failure points from each of the terminations of those wires. All that's left is the VFD, the contactors and the HMI panel. Operator panel construction and installation time was reduced as much as 90 percent in cases where the panel controls were complex.

How to improve system reliability

Removing components and their associated wires not only saved construction and installation time, but also maintenance time. Fewer components resulted in less maintenance, especially when the removed components were those very electro-mechanical components that required more than half of all maintenance calls to operator panels.

Removing the majority of individually wired components improved the MTBF (mean time between failures) of the operator panels and reduced the number of potential points of failure in the panel. Removal of individual indicator lights, which were usually incandescent bulbs with MTBFs in the hundreds of hours, with a backlit HMI whose backlight was rated around 35,000 hours is an example of the impressive increase in reliability that the HMI conferred.

The HMI was itself an embedded computer with built-in diagnostic routines that could monitor the process of entire system to ensure system stability.

Faster, faster!

Using an HMI has allowed plant engineers, system integrators and machine builders to pre-design libraries of faceplates, indicators, widgets and objects that can be pulled together simply on an editing screen. This replaces the sourcing, purchasing, pulling from inventory, kitting, assembling and testing procedure that was used with hardwired operator panels in the past. Even a relatively complex batching procedure can be designed on an HMI panel in a matter of days, where the old procedure might take weeks or more. This is, itself, a large cost-saving for the engineer, integrator or machine builder.

On top of that, HMIs have been getting smaller, faster, smarter, and less costly over the last ten years. This means that they can be applied to more sophisticated control problems, can easily replace even a simple H-O-A station, and can do complex mathematics, log data, handle alarm management algorithms, and all the while producing sophisticated graphics in real-time.

HMIs have also become equipped with standard networking communications, such as Modbus, fieldbus, and industrial Ethernet versions, so that they have made the simple operator panel into a powerful communications node on the plant LAN.

Keeping it simple…

The decrease in component items on the bill of materials for an operator panel compared with the purchase price of an appropriate HMI panel and the decrease in labor necessary to program and wire the HMI compared to the labor necessary to build and wire a conventional operator station produces a dramatic decrease in cost, as much as 50% or more.

The typical 10” HMI panel retails for between $1200 and $2500, depending on features and connectivity. Add a simple enclosure for the HMI, at perhaps another $200-$300 and you’re done. Whereas a hardwired operator panel might require a much larger enclosure, itself at higher cost, plus all the individual components, buttons, indicator lights, switches, relays, and associated wiring...for a total of substantially more than $3000 before you add the labor necessary to install and connect all those components.

Doing more things…better!

Not only are the cost of construction and installation and the cost of maintenance reduced, but the costs of operation and training are also reduced when an HMI is used instead of a conventional operator panel. Every operator station in the plant or manufacturing cell can have the same operator interface, which simplifies training and reduces the learning curve. In addition, training can be enhanced by using the HMI as a training simulator, teaching both normal operational procedure and recovery procedures for dealing with abnormal or adverse situations. Better training can mean the difference between a short outage while a problem is resolved and a long rebuild because the operator caused the wrong actions to be performed. Better training, using HMIs and simulation, has been shown to even save lives.

The increases in speed and computational power of HMIs have made them much more flexible in their uses than just replacing simple operator stations. They can be used as multi-tasking devices,

which can perform quality control, data acquisition, and other tasks while serving as the operator station controlling a process.

Open architecture

One of the great benefits of the microcomputer revolution is the increasing reliance on COTS (commercial off the shelf) designs, which can be repurposed for industrial use. This includes hardware, software and firmware. Early PLCs, for example were proprietary computers with proprietary real time operating systems. The use of Microsoft Windows operating system in HMIs and programmable automation controllers (PACs) has made it possible to produce software that is portable, because it was developed for the open architecture of the PC. Standard open architecture I/O has also been adopted, both for networking and for adding components and functionality to the HMI itself. This has greatly reduced the cost, improved the availability, and also the robustness of the industrial HMI.

Software development gets simpler

There are two kinds of software that are used with an HMI. The engineering software to design the graphics and screens, and the operating program that the HMI runs that allows it to fill all the requirements of an operator station. Because most HMIs are Windows devices, standard programming languages can be used, and standard conventions for Windows-based displays can be used, including standard hot keys and mouse or joystick functions. This means that the pool of potential software development personnel, whether in the user company or in the system integrator or machine builder company is much larger, and the barrier to using HMIs instead of conventional hard-wired operator stations is much lower.

Taking over

The Windows- or Linux-based HMI is essentially replacing the standard operator panel, even as an embedded controller in devices like variable frequency drives, and PLCs or PACs, and has set the standard for operator interfaces now and in the future.

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