WHITE PAPER

A New Brain for Your Machine
Consider an All-in-One Unit to Replace Separate HMI and PLC Approaches

The all-in-one machine control system has finally arrived. If your perception of the combined human-machine interface (HMI) plus controller unit is that the HMI is the leading character and the programmable logic controller (PLC) is but supporting actor, know that today's advanced units have built-in controllers that can handle tasks that once required a stand-alone PLC. Some can even be run "blind" – simply remove the display, mount to a DIN rail and they are quite capable PLCs all by themselves.

Importantly, the all-in-one, HMI+controller solution combines the HMI and PLC functions into an integrated piece of hardware and a unified software development environment. No more separate HMI and logic development tools or tedious mapping between disparate databases required. As a result of these compelling advantages, some automation suppliers are seeing these units show up in 30% to 40% of new applications and retrofits.

This white paper examines in greater detail the HMI+controller solution, and how its tightly integrated hardware and software packages works well in many applications whether as the brain of a standalone machine or as part of a larger system.

Unified Control and HMI
The integrated HMI+controller is often called an all-in-one control solution for a reason. To start, it includes the controller/CPU, digital and analog input/out (I/O) signal processing, network communications and touchscreen display in a single hardware platform. This type of configuration typically saves panel space and both wiring and programming time.

The typical HMI+controller hasa fixed amount of I/O built in. A common configuration is 20 digital inputs and 14 outputs. Smaller digital I/O counts are found on units that include built-in analog I/O. A typical analog unit includes four analog inputs and two analog outputs, with current, voltage and temperature signal types.

Many of these systems also have a built-in CANopen master port, or similar, intended to scan remote I/O if needed. A variety of CANopen compatible remote I/O can be used for expansion, and a wide range of I/O types is available.

Some all-in-one units have no limit for remote I/O other than the number of drops the network allows. However, the real limit is when performance starts to degrade – too many I/O and the unit can become overwhelmed. Of course, you probably didn't select the correct controller if several hundred or more I/O points are needed. These all-in-one units really fit best in small to medium-small applications.

In some HMI+controller platforms, additional I/O is stacked directly on the device's built-in I/O rather than networked remotely. Another configuration, typically with a larger HMI screen, uses a remote-I/O scanner for all I/O connectivity. In this case, the HMI+controller connects exclusively to distributed I/O. Placing these remote I/O modules nearer to the devices on the machines can certainly reduce control cabinet size and wiring.

Some HMI+controllers includes two or four axes of basic motion control functionality suitable for controlling stepper motors. With high speed counter inputs, encoders can be added and pulse-width modulated. Or, pulse and direction outputs can digitally control the stepper drive. These all-in-ones are more than capable of controlling OEM equipment and custom machines and process.

When to Specify an All-in-one Solution

The new all-in-one solutions work well in systems where a small stand-alone HMI and a small to medium-size micro, or "brick," PLC often are specified. The same control capability can be had in an all-in-one hardware package. Now the HMI and PLC can be programmed in a tightly integrated software package, a single program and a single piece of software to purchase and maintain. And it's a single download to one device.

Table 1: The HMI plus controller simplifies design, programming and integration
• Good replacement for a small stand-alone HMI and small "brick" PLC.
• Tightly integrated graphic and logic program
• Single software to purchase and maintain
• Only download one program
• Single hardware package
• One power connection
• Shared communication
• Single device to remotely access

The all-in-one control solution, as the name connotes, is single piece of hardware and some users like or require that approach for all suitable applications. Of course, it can also be a way to save money and some like it for just its cost advantage. And some like it for both reasons. It's a single hardware platform. There's one power connection, forboth HMI and PLC, shared communication ports and they talk to each other out of the box.

If data collection is needed, and the HMI and PLC are separate system elements, where should the data collection be done? Where is it easier? It could be either. But with the all-in-one approach, data collection is done in the tightly integrated environment and can be seamlessly programmed along with the control logic and HMI functionality.

The same is true for remote access to the machine. In a traditional, separate HMI and PLC architecture, both can offer that functionality, and it will likely be necessary to access both – two connections – if more than just monitoring is required. With the all-in-one unit platform, it's a single connection and easier to manage remote monitoring, control and programming.

It's All One Program

Over the past 10 years, most PLC makers have begun to integrate HMI graphics development into the logic programming environment, but many are still mostly separated. You may be able to edit both at the same time, but two software packages typically are running.

With the unified development environment of an all-in-one solution, it's straightforward to drag and drop objects back and forth between the graphics and logic editors. All the variables are shared. Some development environments literally are a single program and there is no separation between the two.

Meanwhile, PLC makers have been working to improve their integrated software environments. An example would be the HMI reaching into the PLC to grab a variable tag name. At least one PLC vendor is moving alarming functions, traditionally a big feature of HMIs, into the PLC. They are creating a tighter integration between the separate PLC and HMI which seems to highlight the importance of an all-in-one solution. In any case, true all-in-one HMI+controllers will have only one software program environment – not two programming packages, however tightly bound or able to share variables.

Not only does an HMI+controller help during the design, integration and programming phases of a project, it's capable of handling a wide variety of applications.

A Capable Choice for Control

Applications for HMI+controller solutions are not typical; they're all over the place. The evolution of the all-in-one has made it suitable for use in any machine application that would work with a separate small PLC and small HMI. And the HMI+controller is not just for one type of machine. Some good application examples include OEM baggers, shrink wrappers, motor speed control, feeders, labeling and inspection machines.

These all-in-one solutions work well on any small machine where the application isn't too demanding. Perhaps not high-level, custom automated equipment, but straightforward machines, processes and systems – where small PLCs and HMIs often are used – are squarely in the HMI+controller's wheelhouse. Typical I/O counts for these applications are 16 to 32 inputs and outputs. With the above limitations noted, all-in-one solutions can be and often are used on fairly complex machines with remote I/O and motion control requirements. They also interface well with other PLCs and HMIs as part of even larger systems.

On the larger system side, there are HMI+controller installations with 50 remote-I/O drops and that integrate with other PLCs, motion controllers and drives. These are fairly complex systems and the HMI+controller has the hardware, architecture and programming capability needed to successfully provide both visualization and control.

The HMI+controller also is showing up and performing well in applications where a single, high-end PLC might normally be used. Although there may be two all-in-one controllers doing the work of one high-end PLC, they're doing it and doing it well.

These HMI+controllers are doing the work of mid-range PLCs and providing the visualization, too. Further, they can provide visualization for other connected controllers as well.

All This, and Network Communications, Too

The HMI+controller also can connect and talk to other devices. It can monitor another PLC's variables, and in some cases bridge the data between different control systems, all from one platform. All the drivers that work with HMIs –and there are many – work with HMI+controllers.

If a side process needs to be added to an existing machine with limited PLC capacity, an HMI+controller could be installed and the data shared with the existing PLC. Again, communications drivers are available to allow HMI+controllers talk to PLCs from a range of different manufacturers. This can eliminate the need to run discrete I/O between two different controllers. For example, if dissimilar PLCs need to pass 20 integer values and 32 bits of data between them, approximately 50 wires could be required. Or, an HMI+controller and simple Ethernet connection could be used.

While this communication driver may not be considered real-time and may double or triple the update rate, for many machines it will have acceptable performance. It won't start a motor in 5-ms, but if the machine can handle 200- or 300-ms update rates, the HMI+controller, with PLC communication drivers, will provide adequate performance.

Data Collection Reality
HMI+controllers also support remote access functionality. With a secure infrastructure in place, you can view and operate screens, download, upload and monitor programs, and go online via apps on an Android or iOS device. Files can be remotely accessed via FTP to retrieve and transfer data log and alarm files created by the HMI+controller. Anything you can do locally can be done remotely, with the right infrastructure and the cloud.

The problem, of course, is how to make the physical connection to the outside world. Inside, on the plant's local area network, it's easy. To get outside the fence, the IT department needs to let it happen and often doesn't for many reasons, with security being the big one.

Security demands some type of infrastructure or service such as a virtual private network (VPN) or a remotely hosted system with proper security protocols. Don't be wooed by the coolness of the functionality: sitting on the beach and reaching the HMI+controller from your cell phone requires infrastructure at the plant to keep the data and connected machine safe and secure. This infrastructure costs money, beyond the cost of the HMI+controller hardware and software.

The all-in-one, HMI+controller is worth a look. For the appropriate application, it can reduce costs, streamline development and help you gain control of your machines and operations.

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