March 2014

ESSENTIALS OF LOCAL VISUALIZATION
A Control Essentials Guide, by the editors of Control

About the Control Essentials Series
The mission of the Control Essentials series is to provide process industry professionals with an up-to-date, top-level understanding of a range of key process automation topics. Our intent is to present essential engineering concepts in a practical, non-commercial fashion, together with a review of the latest technology and marketplace drivers—all in a form factor well suited for onscreen consumption. Check in at ControlGlobal.com/Essentials for other installments in the series.
—The Control Editorial Team

Pro-face
for the best interface

This Control Essentials guide made possible by Pro-face. See page 7 for more information on Pro-face and its full range of HMI solutions.
A foundational component of any automation solution is the human-machine interface (HMI). And while many plant operators work from a console in the relative comfort of a centralized, air-conditioned control room, others often need on-the-go display and visualization of process conditions, and must interact with processes on the plant floor and out in the field. Indeed, in today’s typical plant, a variety of local and mobile HMI platforms are used in concert with centralized visualization solutions.

Local visualization brings with it a unique set of challenges. Permanent, stationary HMI solutions must first be designed to withstand the often harsh environments in which they operate. Options range widely in sophistication, price and necessary integration effort: all of which depend largely on how much interaction and information exchange is required between the human operator and the process in question. Further, because the HMI often doubles as a data collection and supervisory communications hub, these computation-intensive tasks also must be taken into account when selecting an HMI solution.

A relatively simple, standalone process may need only a few hardwired lights and pushbuttons for local HMI. At the other end of the spectrum, however, a fully functional, industrially hardened PC may be required. In between these two extremes are a range of microprocessor-based operator panels or operator interface terminals (OITs) that provide a configurable graphical operator display and interface in a more compact, less expensive package than a typical industrial PC. In short, the need for increased application flexibility and the need to handle more complex information management and communication tasks will typically drive system designers to more capable solutions.

Touchscreens, too, are now ubiquitous in the HMI marketplace; some three-quarters of all local HMIs now include one. Configurable keys, trackballs and sealed or protected keyboards have their place, but from an ergonomic standpoint the touchscreen is uniquely suited to plant-floor environments: it has no moving parts, takes up no incremental space and is readily accessible by a standing operator. Further, in those cases where auxiliary discrete device functionality is to be maintained, a range of modular HMI solutions now provide plug-and-play functionality for devices ranging from shutdown switches to tower lights to biometric scanners. The increasing need to integrate production data with plant-wide information systems also is driving the movement toward more communications-capable industrial PCs on what were once standalone machines and processes.

Mobile HMI solutions—whether run on devices purpose-built for industrial use or smartphones and tablets brought from home—provide an elegant solution to the “last mile” of visualization, but still require integration with the control system via some sort of wireless communication and application infrastructure. Not surprisingly, options for providing wireless HMI connectivity vary widely, from local ad hoc implementations to more ambitious, plant-wide solutions. Some stationary HMIs and “blind” controllers now include Wi-Fi modems to locally broadcast process data to mobile devices. Other plants are opting for a comprehensive wireless infrastructure approach that provides on-the-go access to operational data together with other information on the plant network, such as process schematics and maintenance work orders. Add in secure connectivity over the public Internet and cellular networks, and “local” visualization begins to have truly global implications.
A foundational component of any automation solution is the human-machine interface (HMI). And while many plant operators work from a console in the relative comfort of a centralized, air-conditioned control room, others often need on-the-go display and visualization of process conditions, and must interact with processes on the plant floor and out in the field. Indeed, in today’s typical plant, a variety of local and mobile HMI platforms are used in concert with centralized visualization solutions (Figure 1).

Local visualization brings with it a unique set of challenges. Permanent, stationary HMI solutions must first be designed to withstand the often harsh environments in which they operate. They range widely in sophistication, price and necessary integration effort: all of which depend largely on how much interaction and information exchange is required between the human operator and the process in question. Further, because the HMI often doubles as a data collection and supervisory communications hub, these computation-intensive tasks also must be taken into account when selecting an HMI solution. Mobile HMI solutions—whether run on devices purpose-built for industrial use or smartphones and tablets brought from home—provide an elegant solution to the “last mile” of visualization, but still require integration with the control system via some sort of wireless communication and application infrastructure.

A relatively simple, standalone process may need only a few hardwired lights and pushbuttons for local HMI. At the other end of the spectrum, a fully functional, industrially hardened PC may be required. In between these two extremes are a range of microprocessor-based operator panels or operator interface terminals (OITs) that provide a configurable graphical operator display and interface in a more compact, less expensive package than a typical industrial PC. In short, the need for increased application flexibility and the need to handle more complex information management and communication tasks will typically drive the machine designer to more capable solutions (up and to the right in Figure 2).
No matter the HMI platform chosen, reliable performance in an industrial environment likely necessitates an increased tolerance for vibration and temperature extremes, as well as dust, dirt, water and other potentially damaging or hazardous elements. While these measures apply to discrete HMIs devices, the need for industrial hardening is especially apparent in the context of electronic HMIs.

Indeed, only a fortunate minority (24%) of users say they can get away with a commercial-grade PC for their local HMI applications, likely because they are applied in relatively benign environments. The rest opt for industrially hardened options as a matter of course. For them, more than 80% rate extended operating temperatures, shock/vibration tolerance and harsh/dirty environmental capabilities as important or very important characteristics of their HMI solutions (Figure 3).

Because most local HMI solutions are designed to be mounted on a panel or door of an enclosure for installation in industrial environments, the HMI front panel, the enclosure and the bezel where they meet must be appropriately sealed against the elements they’re likely to encounter. Both National Electrical Manufacturers Association (NEMA) and the International Electrotechnical Commission (IEC) have developed systematized classifications that describe the overall performance requirements of the enclosure/HMI system (see Table I). For hazardous areas where explosive mixtures may be present, enclosure/HMI systems are designed to comply with either North America’s Class and Division ratings, or the IEC’s Zone system. Both methodologies are designed to differentiate risk by type of explosive mixture as well as frequency/likelihood of occurrence.

When uptime is especially critical, many system designers have embraced a “no moving parts” philosophy for their electronic HMIs. In particular, this means no disk-based hard-drives or cooling fans. Instead, solid-state (flash) memory along with low power CPUs and alternative cooling methodologies are preferred. Physical footprint is another consideration and can have a direct bearing on enclosure size and depth. For a given set of display screen dimensions, the thinner in the third dimension the better.

![Figure 3](image)

Figure 3. In a recent survey, a large majority of users value industrial hardening of their HMI solutions.

<table>
<thead>
<tr>
<th>NEMA Classification</th>
<th>Comparable IEC Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>IP 66</td>
<td>For indoor or outdoor use, providing “a degree of protection” to personnel against access to hazardous parts as well as a degree of protection of the equipment inside from solid foreign objects (falling dirt and windblown dust); ingress of water (rain, sleet, snow, splashing water, and hose directed water), and external formation of ice.</td>
</tr>
<tr>
<td>4X</td>
<td>IP 66</td>
<td>Similar to NEMA 4, with added protection against corrosion</td>
</tr>
<tr>
<td>6</td>
<td>IP 67</td>
<td>Similar to NEMA 4, with added protection against water ingress when temporarily submerged</td>
</tr>
<tr>
<td>12</td>
<td>IP 55</td>
<td>For indoor use, with protective measures oriented toward dripping and light splashing of water.</td>
</tr>
<tr>
<td>13</td>
<td>IP 65</td>
<td>Similar to NEMA 12, with added protection against splashing and spraying of oil and non-corrosive coolants.</td>
</tr>
</tbody>
</table>

Table I. While not strictly equivalent, these NEMA and IEC IP (ingress protection) ratings commonly are used for HMI panels and enclosures intended for industrial applications.
As with other aspects of industrial automation, HMI display and input technologies have followed the arc of commercial computing technology, adapting the latest consumer advances to the unique demands of the industrial environment. Indeed, for all but the simplest of applications, increased functional and performance requirements are driving industry away from simple status indicator lights toward increasingly sophisticated HMIs equipped with graphical displays.

The CRTs once widely used in HMIs long ago gave way to flat-panel LCDs, and some of the latest HMIs even tout wide-screen 16:9 aspect ratios and can be mounted in landscape or portrait orientations. Traditional 4:3 aspect ratio devices remain available, especially for those machine designers interested in bringing legacy HMI applications forward onto new devices. Also like home televisions, HMI displays are trending larger, with some 60% of machine HMIs now measuring more than 10-in (Figure 4). Smaller operator interface terminals remain suitable for those applications where space is at a premium and information display requirements less demanding.

Touchscreens, too, are now ubiquitous in the HMI marketplace; some three-quarters of all machine HMIs now include one (Figure 5). Configurable keys, trackballs and sealed or protected keyboards have their place, but from an ergonomic standpoint the touchscreen is uniquely suited to plant-floor environments: it has no moving parts, takes up no incremental space and is readily accessible by a standing operator. Further, even as costs have come down, advances in underlying technology allow capacitive devices to be calibrated for use even by gloved operators. More lately, HMI touchscreens have even added the multi-touch capabilities popularized on smart phones and tablets (for example, the “pinch” to enlarge view, and “swipe” to scroll) to the industrial feature set.

Further, in those cases where auxiliary discrete device functionality is to be maintained, a range of modular HMI solutions now provide plug-and-play functionality for devices ranging from shutdown switches to tower lights to biometric scanners. The increasing need to integrate production data with plant-wide information systems also is driving the movement toward more communications-capable industrial PCs on what were once standalone machines and processes.

Figure 4. An April 2013 study indicates a sweet spot in HMI panel size at 6 to 10-in. Some 60% of respondents, however, routinely use HMI panels that are larger than that.

Figure 5. According to a recent user survey, touchscreen-equipped graphical displays are by far the most commonly used approach for plant-floor HMIs.
Thus far in our discussion of local visualization options, we’ve focused on several physical aspects of the solution: the industrial hardening of the components, the dimensions of the graphical display (if any), and the mode of operator input. But when it comes to the digital guts of the HMI—the CPU and associated chips—a number of distinctions emerge, primarily to do with software and connectivity.

Early on we drew a line between the operator panel or operator interface terminal (OIT) and the industrial PC. It isn’t just cost and computing power that differentiates the two. The first typically is configurable to perform a relatively fixed set of HMI functions, often through a proprietary software package provided by the hardware manufacturer. The latter is programmable, bringing with it all the computing power and communications flexibility of a fully functional Wintel architecture PC.

The software that comes with an operator panel normally includes a vast array of drivers to allow the operator panel to communicate with most any programmable logic controller (PLC) on the market. Topside, however, control panels often are limited in their ability to integrate with other plant networks or systems. Industrial PCs, on the other hand, bring greater flexibility and can run a range of HMI software applications—from the hardware supplier, from other third parties or even homegrown code—and can readily communicate with PLCs as well as integrate with plant-level networks and systems to accomplish a variety of tasks (Figure 6).

Increasingly pervasive wireless communication technology, together with smartphones, tablets and other portable devices, have lately begun to redefine what’s possible and what’s practical in terms of local visualization. Field operators no longer are physically constrained to the nearest panel-mount display, but can roam about the plant with an HMI view in their pocket or on their tool-belt. This portable access, however, brings with it potential liabilities that must be properly managed. For example, if a local operator stops a machine to clear a jam, another operator cannot be allowed to restart the machine remotely.

Not surprisingly, options for providing wireless HMI connectivity vary widely, from local ad hoc implementations to more ambitious, plant-wide solutions. Some stationary HMIs and “blind” controllers now include Wi-Fi modems to locally broadcast process data to mobile devices. Other plants are opting for a comprehensive wireless infrastructure approach that provides on-the-go access to operational data together with other information on the plant network, such as process schematics and maintenance work orders. Some mobile applications are even designed to reach out into the “cloud,” relying on the public Internet and cellular communication networks as underlying transport infrastructure. Wireless connectivity clearly is with us to stay, based on its promise of improved information access and workforce productivity. But it also underscores the need for a comprehensive approach to cyber security for wired and wireless industrial networks overall.

**Figure 6.** When an industrial PC is used as an HMI, it often is recruited to perform other tasks as well.

**Figure 7.** While many users believe that the ability of workers to access data wirelessly through smartphones, tablets and other devices can boost productivity and safety while reducing costs, many remain unconvinced or uncertain.
This Control Essentials guide on Local Visualization is made possible by Pro-face, a leading global supplier of touchscreen operator interfaces and industrial computers to the automation solutions market. With over 40 years of experience, Pro-face brand products have been installed on factory floors and in field operations worldwide. Read more at ProfaceAmerica.com.