EAO – Your Expert Partner for
Human Machine Interfaces

Technical Article

Designing Effective Human Machine Interface Systems

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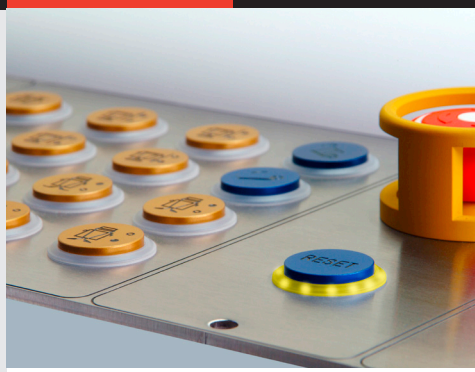
As technology systems grow more complex, issues of end-product equipment safety, ease of operation and reducing the risk of human error are becoming extremely important. Designers today know that the operational performance, efficiency, and safety of a wide range of systems — from semiconductor fabrication equipment to mass transit vehicles — are closely related to the interaction between humans and machines, the human machine interface (HMI).

The selection and seamless integration of HMI components, such as switch controls, actuators and indicators, are critical to the success of equipment designed for human operation. Doing it right provides the “human touch” so desirable in modern controls. Design engineers who develop HMI solutions with this in mind will deliver applications with additional market advantage and greater sales potential.

Secrets of HMI success

The development of a successful HMI solution for integration into a complex system relies to some extent on a balancing act. Front-end consideration must be given to the engineering and financial constraints placed on a project while the cost rewards to be gained from the investment also must be assessed. Employing high-quality design, best practices and proven techniques result in reliable HMI systems, such as complete control panel inserts, that reduce end-product assembly costs and extend service life.

Designing and integrating HMI control systems is a task often undertaken by specialized suppliers like EAO to complement the core capabilities of end-product manufacturers. Such manufacturers use an HMI supplier as an extension of their design team, a knowledgeable partner that provides



The selection and seamless integration of components into ergonomic HMI systems like these are critical to the success of equipment designed for human operation.

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added design capacity and quick turnaround.

Know your industry standards

The starting point for HMI solutions is a thorough knowledge of technical ergonomic, design, and manufacturing standards. These include Human Engineering standards, such as MIL-STD-1472F, which establishes human engineering design criteria for military systems, subsystems, equipment and facilities; federal standards set by the Americans With Disabilities Act; and industry guidelines such as those from SEMI, the global semiconductor industry association, covering HMI for semiconductor manufacturing equipment. Additional HMI specifications are set out by ANSI, IEEE, ISO, and others.

Depending on the ultimate product application, observing appropriate standards assures that a product will meet industry criteria. This includes placement of components, legend size and color, emergency stop switch configuration and guards, and other ergonomic factors that improve usability, efficiency, and safety.

Build HMI systems from standard components

Component selection should always be based on cost effectiveness, quality, and reliability according to the requirements of the application.

HMI “plug-and-play” products add significant value to end products and applications. The HMI product range of switch controls, actuators and indicators is available in modular designs that fulfill most requirements. Products can be flush mounted, providing protection against accidental operation, or raised for viewing from the side.

Additional lens protection can be achieved with extended or sealed rings and lens caps. Lenses are available in a variety of colors together with film inserts for legends or symbols, and can be illuminated with high-intensity, long-life LEDs or incandescent lamps.

The latest laser engraving technology makes it possible to incorporate intricate designs, such as corporate logos and fonts, into products. One of the main advantages of laser engraving over traditional molding and mechanical engraving methods is the precision and positional control afforded by the laser beam. Characters and images are crisp and sharp, even when reproduced in the smallest sizes and they are resistant to wear, a significant benefit in applications subject to harsh environments.

Working with an HMI supplier

In today’s competitive environment, designing for improved human performance is a prerequisite for industrial ergonomic success. The future development of HMI systems and products therefore necessitate an end-application, solutions-orientated approach. HMI suppliers need to work in full partnership with clients to deliver consultation and an application-engineering approach to production.

HMI suppliers cannot work in isolation. An important consideration in the selection of an HMI supplier is the strength of the relationships that it has with its own suppliers, including plastics vendors, toolmakers, electrical and electronics engineers, industrial designers, and ergonomics experts.

At the consultation stage, the HMI supplier should be tasked to include

These rugged panels incorporate human engineering concepts to improve safety, efficiency and control in buses and other transit vehicles.

full concept, design and feasibility studies in any proposal. During application engineering, using the latest technologies — such 360º detailed CAD drawings, the HMI team will help the product manufacturer verify concepts and create prototypes.

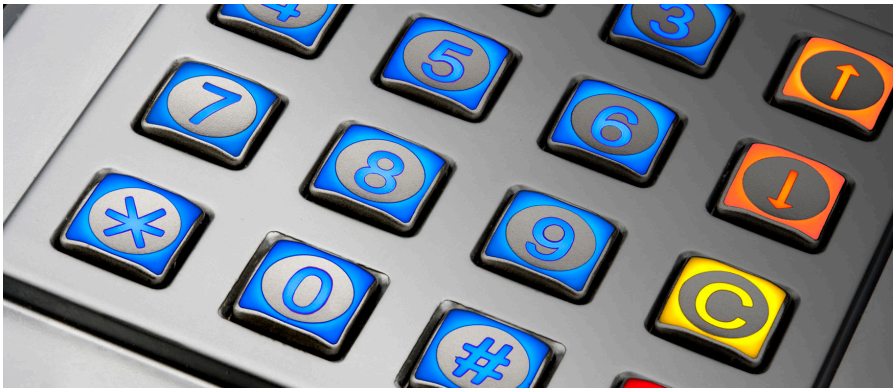
All designs must be tested for quality and certification according to international standards.

Upon completion of the project, it also is important that the HMI supplier fully records details of the project to ensure easy upgrading and remodeling of components for future projects.

Application considerations

Today, HMI-based products are used in a broad range of industries including transportation, machinery, instrumentation, process control, and telecommunications as well as in audio, video, broadcast, and multimedia applications. HMI systems are particularly important in high-stress and safety-critical operations that control processes, machinery, and transport systems.

For human engineering purposes, HMI specialists like EAO encourage the consideration of several key areas: ergonomics, health and safety, performance, and the presentation of information. That said, it is essential to look beyond purely ergonomic requirements of an application and consider any environmental demands that are likely to be placed upon the end product.



Vandal resistant keyboards and keypads are used in public access and security applications.

To address the ergonomic risks associated with harsh industrial applications, especially those situated outdoors, it is wise to consider stainless steel switches, keypads, and keyboards that operate reliably in these situations. If the environment demands, stainless steel products offer protection up to IP 67 as well as resistance to heat, shock, vibration, and vandalism. These and other durable polymer-based products require minimal maintenance and deliver long-term value in terms of lifecycle cost benefit.

For example, EAO's Series 56 pushbuttons commonly found as door openers on buses, subways, and trains meet the latest Americans With Disabilities Act and Rail Vehicle Accessibility regulations. Featuring a bright front bezel, LED "halo" illumination and a large touch surface that can be supplied with Braille text for the partially sighted, the pushbutton immediately focuses user attention on the control. Pushbuttons featuring large actuation areas are also ideal for operators wearing gloves.

Switches and control panels are used in driver compartments in mass transit vehicles.

In terms of health and safety, keylock switches protect against unauthorized access and act as additional safety controls, thus offering machinery equipment engineers and machine operators added safeguards. Keylock switches also are ideal for harsh environments and can be supplied in flush-mount designs for increased protection against vandalism.

Fully customizable keypads and keyboards meet the stringent security requirements of banks and other financial institutions. Required features of these interactive products include strength, durability, and vandal resistance. These features are also critical for self-service applications where unattended stations must remain operational.

Police cars, ambulances, and fire engines require specialized vehicle control panels that operate sirens, flashing lights, and other emergency features. Such vehicles often require adapting or upgrading and hence panel designs must be flexible and allow the HMI components to be changed without expensive alterations in the underlying electronics boards. Low-profile and shallow back-panel-depth switch elements are available for use where space is restricted. New, low-profile emergency-stop switches have a “foolproof” mono-block design, a slow-make switching system and bright LED illumination visible even from the side.

Once specifications have been approved by both the HMI supplier and the client they will form the basis for the production and supply of the right solution. Detailed drawings, parts lists, circuit diagrams, and assembly instructions are then completed and production schedules agreed upon before manufacturing commences. Companies that employ modern design-to-manufacturing methods, such as CAD/CAM and concurrent engineering, can shorten product development cycles and cut production time to market.

The role of the HMI supplier is to develop products and solutions that align equipment and task, to assure the end user and the technology work in complete harmony. For the user the benefit is clearly defined functionality and comfort of use, a critical key to reducing the likelihood of errors in operation and the dangers associated with poorly designed controls. Overall it is the quality and the reliability of people, products, and processes that combine to deliver the “human touch” that satisfies the demands of modern industrial ergonomics.

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