

SMART HMIs AND CAPACITIVE TOUCH TECHNOLOGY FOR MEDICAL DEVICES

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Electronic human machine interface (HMI) technology goes back as far as the 1940s with the punch card batch interfaces from IBM. Today, when you think of user interfaces, you may think of smart phones, tablet computers, ATM machines, or any other consumer device. It is certain that there have been an astounding number of technology improvements in interface technologies. These technologies are frequently used in medical applications which can make devices more flexible, easier to use, durable, and efficient.

Today's medical devices can pose a lot of challenges for designers when they are designing and specifying human interface technology and functionality. Examples of challenges that designers may face could be anything from the environment that it will be functioning in, to the warranty/maintenance programs. All must be factored into the design at a very early stage in order to create an application that is safe, reliable, and user friendly.

The advancements in technology have made it much easier and much more cost effective to incorporate new functionality into every design. Specific functionality such as touch screens, remote monitoring, capacitive touch switches, or software/firmware that can be customized at a moment's notice are all now common place in the newest HMI designs.

High Reliability Human Machine Interface Designs

As the cost of healthcare continues to rise, medical professionals are looking for devices that are rugged and can extend the life and minimize the maintenance costs of their operation. Being reliable doesn't necessarily mean the device will be overly costly as there are ways to incorporate ruggedness into a machine interface design. A few examples would be:

- Incorporating a rigid printed circuit board (PCB) into the design to attach LCDs, switches, or other components as the copper and solder joints provide much more durable connections and a solid backplane for the interface. See figure 1.

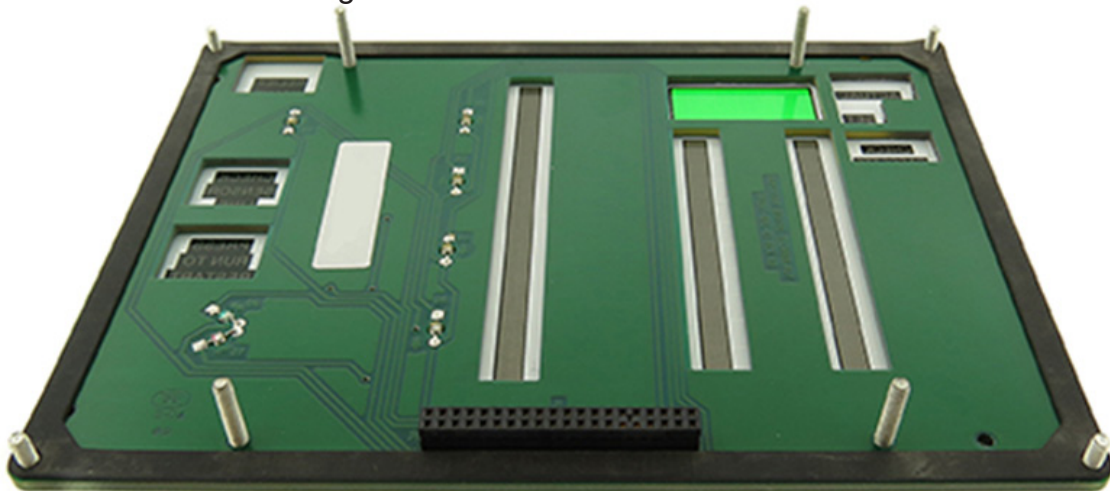


Figure 1. High reliability human-machine interface designed with a rigid circuit board.

- The use of capacitive touch membrane switches versus mechanical switches, mechanical switches can get damaged and wear out over time.
- Selecting stack-up materials that create robust designs can withstand whatever environment that they are placed in. Choice in components, touch screen types, and adhesives can dramatically add or take away from a robust design.
- Placement of the components on the interface will also affect the long term functionality of the device as the most sensitive components need to be protected from potential contamination. Working with a supplier that has significant experience in this area can save you from a redesign after the product goes into use.
- Understand the RF/Wireless/EMI aspects of your product and how to protect your machine interface from being effected. With the Internet of Things (IoT) being incorporated into almost anything, these factors need to be managed when creating a design that needs to work for years to come.

In regards to an operating environment, most medical device interfaces must have some type of IP rating as they are likely to come in contact with bodily fluids which will require the device to be cleaned and potentially sterilized. Understanding the rigors of the process will allow your design requirements to have some if not all of the attributes above.

Incorporating "SMART" Into Your Medical Device

Making something SMART can mean different things. For the purposes of this discussion, we will focus on two specific ways to make your medical HMI SMART, through programmed user guidance and remote monitoring.

These technologies have existed for years but advancements have now made it possible for wireless capabilities and the cost of manufacturing is more reasonable. It is clear that SMART devices are becoming increasingly common in medical applications.

Programmed User Guidance

This is when you incorporate functionality into the user interface where you visually guide them through the proper sequence of events to get the desired results. This will not only improve the user experience but it improves safety and reduces operator error.

One of the downsides of a full touchscreen solution is the overall cost of a reliable touchscreen that can be used in harsh environments and with gloves that are used daily in the medical profession.

Some companies are developing medical devices that have a very low cost interface on the device itself and are having users connect to the device with a smartphone app which allows them to control the device. The solution has been gaining traction in nonlife-critical applications as the battery life or the smartphone of the operator can cause the device to stop working.

Improvements in Capacitive Touch and Backlighting Technologies

There was a time that to get features to light up on a machine interface you had to use LEDs that were mounted close to the feature to be lit. That required more real estate and therefore added more cost to user interface designs. It was also difficult to enhance a user experience with backlighting as it wasn't easy to keep the light from bleeding through the feature to other areas of the interface. The invention of side firing LEDs and light pipes helped counter the problem but the higher costs kept the technology from becoming main stream for medical applications.

Now, through the use of ultra-thin planar light panels where features and light channels are pressed into the film, devices can improve their functionality by utilizing lighting and capacitive touch integration. This is done by effectively developing a user experience where certain buttons light up, turn color, or turn off when certain inputs are detected. See figure 2. Using clean and isolated visual feedback allows engineers to take the user through the operation of the device with real time guidance.

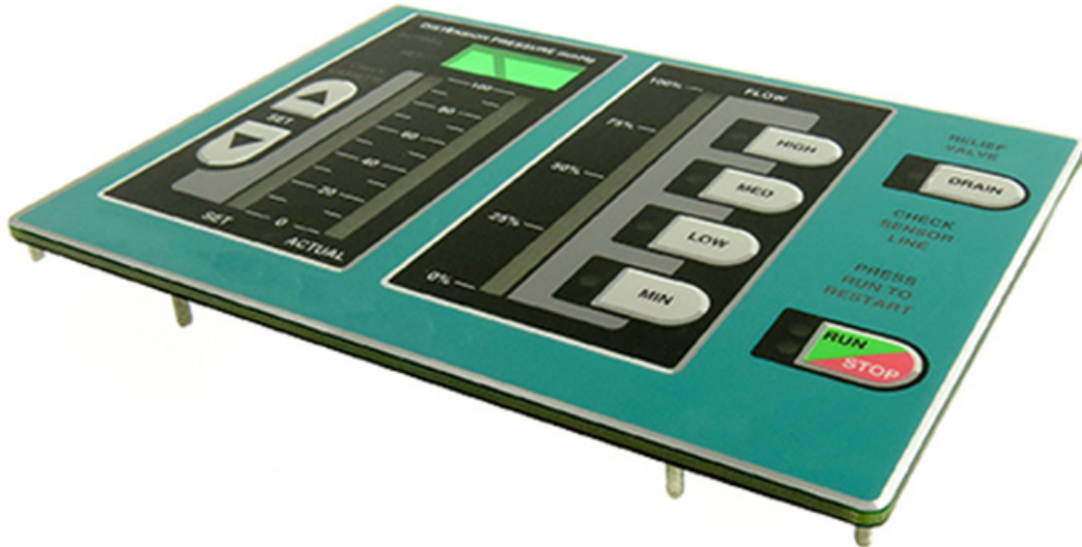


Figure 2. Medical device user interface utilizing lighting technologies.

Integrated Firmware/Software Capabilities

Most leading edge companies in HMI design and manufacturing do much more than just create low end hardware like membrane switches and graphic overlays. A big part of the vendor's responsibility is to not only develop the hardware but also most of the software/firm ware to operate the device.

The interface can take inputs from the device and trigger a message to the user. This can be anything from:

- Serial Input/Output Interface
- Bluetooth and Wireless Communications
- SD Card and USB Communication
- Pressure/Flow Switches
- TDS Meters
- Pressure Transducers
- Temperature Sensors
- Voltage/Current Sensors
- Battery Status
- Temperature/Humidity Sensors
- Valves and Mechanical Switches

Additionally, data logging can be incorporated into the interface in order to track user inputs for warranty claims and the software can be customized so that the communications can be displayed in up to 24 different languages so that the OEM don't have to have different products for multiple countries.

The device can be easily customized should any end customer have unique requirements, such as wanting to brand the device in a certain way or include certain safety messaging upon startup.

One of the easiest ways of doing this is through using a touchscreen where you create the software to lead a user through the operating of your equipment. This has several advantages such as being able to only have the user activate the controls that you want, when you want them to, thereby eliminating potential user error.

Conclusion

So what's next? Connectivity and remote motoring are becoming a big part of how a user interacts with a device. Within medical applications this will be the next frontier that we will start to see integrated into our devices. For now, we are clearly seeing a focus that creating the best hardware for applications have become much more cost effective and is able to dramatically enhance the user experience.