![congatec logo]

Maritime HMIs for Yachts and Ocean Vessels

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SÜTRON develops and manufactures human machine interfaces (HMIs) for use at sea and in automation. Maritime HMIs can be found in many places on a ship – from the bridge down to the engine room; on a yacht just as likely as on a super tanker, container vessel or cruise ship. Wherever they are used, they display and record values, alert operators or send instructions to the connected control unit. However, depending on where the HMI is used, the requirements differ. On board of ships strict rules apply that are governed by standards and approval processes. SÜTRON HMIs come with the required certificates to prove they are fit for maritime use. In addition, OEM ship suppliers can choose from a variety of display sizes, touch technologies, processor performance and operating systems to build an HMI that integrates perfectly into their overall system. SÜTRON achieves scalable computing power through the use of Qseven COM modules. Due to its positive experiences working with congatec, SÜTRON uses congatec's Qseven module with the Intel® Atom processor in conjunction with the Microsoft® Windows® Embedded Standard 7 (WES7) operating system for its P Line HMIs.

Bridge access requires EN 60945 approval

SÜTRON HMIs are EN60945 approved and meet the compass safe distance requirements – both of which are mandatory for use on the ship's bridge. But, what else is important in an HMI under these circumstances? If you put yourself in the shoes of the user, the requirements become clear.

The user's point of view

Blazing sunshine

Screens need to display information clearly, even when the sun shines directly on the HMI. Bonded optical displays achieve particularly good results under such circumstances. In optical bonding, the touchscreen is laminated to the LCD to remove any air gap. Without an air gap, there is no refraction or reflection as light passes through a homogeneous optical medium. As a result, the display is perfectly readable even at relatively low light intensities of 300 to 400 cd and in direct sunlight. The HMI uses energy more efficiently and the backlight ages more slowly resulting in a longer life for the device. These are great advantages for the user. The anti-reflective coating on the front panel also absorbs unwanted reflections – an important benefit when used on the open flying bridge.

Pitch-black nights

The bridge is manned around the clock. Bright sunlight is followed by the darkest nights. The screen glows. The HMI features two buttons with which the officer can dim the brightness to a comfortable level. If necessary, he can also completely turn the screen off. The buttons can also be safely and easily operated while the user is wearing gloves.

Alarm under deck

The duty officer knows that he will not miss an alarm even when the screen is turned off – a buzzer built into the HMI makes sure of that. If the crew or ship's engineer is needed for an especially important alarm, they are woken up by an alarm device in their cabins. For this purpose, the HMI is equipped with a floating output that can be connected to an external alarm device.

Typical applications

Once around the world - ballast water management

A ship usually performs best when fully loaded. It is easier to manoeuver and can move faster. Since vessels don't always carry a full load, ballast water from the local port is added to compensate. This ballast water contains typical local bacteria, microorganisms and small sea creatures that are transported to distant ports by the ship. Until recently, these microorganisms were pumped out together with the ballast water when the ship reached its destination. The unwanted maritime invaders harm the native flora and fauna, with incalculable economic consequences, as the example of the Chinese mitten crab showed. It came to Europe from Eastern China in the early 20th century. To prevent similar environmental damage, the International Convention for the Control and Management of Ships' Ballast Water and Sediments, for short the Ballast Water Management (MWM) Convention, was adopted in 2004. It stipulates how the ballast water must be cleaned and treated before it may be discharged. The convention regulates ballast water management, its implementation and monitoring. HMI ballast water purification systems log these processes and store the resulting data in a tamper proof format. They are usually placed in the machine or control room; the HMI devices of the SÜTRON P Line master the prevailing conditions of this environment effortlessly. Critical properties include an operating temperature range of minus 20° C to plus 60° C, optional additional CAN or RS232/RS485 interfaces, as well as a redundant communication system consisting of two independent Gigabit Ethernet interfaces. Because data needs to be stored long-term, SD cards or USB sticks are used as removable storage. To be suitable for use in ballast water management systems, the HMI also needs high performance. Devices running Windows® CE are therefore currently being phased out in favour of Microsoft® Windows® Embedded Standard 7 devices.

Bilge and fluid management

In the bilge, the lowest compartment on a ship, it remains cool even when temperatures outside are soaring. Therefore, condensation tends to gather in the area, especially from the air conditioner. This bilge water is often contaminated with oil and fuel. Before it may be pumped into the sea, it requires professional treatment. Bilge management systems also contain HMI terminals, with similar requirements to ballast water management systems. Next to ballast and bilge water, other liquids such as hydraulic oil are also monitored.

Anti-heeling-system

Cranes load several hundred tons of weight onto a ship in a single sweep. To prevent the ship from tilting as a result of uneven cargo loading or unloading, an anti-heeling system compensates any list through a complex system of ballast tanks and pumps. This ensures that the ship remains horizontal and stable. The horizontal alignment is particularly important when loading containers because they are hooked together for safe transport – a process that is only possible in a horizontal position. The advantages of the HMI include easy-to-find keys and a touch panel that allows safe operation, even with gloves.

Thruster control system

Thrusters are steering systems such as bow or stern thrusters or rudder propellers. They make ships and even oil rigs more manoeuvrable. The overall system includes a complex control system that communicates with the operator via an HMI device. The HMI is often mounted in a protected outdoor area where conditions can be rather rough – a case for scratch-resistant Glass-Film-Glass (GFG) touch panels. The touch-sensitive analogue-resistive panels have a surface made of thin and extremely resistant glass which protects against moisture and serves as a vapour barrier. This scratch resistance is also a valuable characteristic for industrial applications. The HMI P Line is popular in new maritime

systems because the display looks razor sharp. This is a result of running the Microsoft® Windows® Embedded Standard 7 operating system, which enables excellent graphics and smooth edges.

The OEM ship supplier's point of view
Chronic lack of space

While the bridge staff cherishes features such as high readability in bright sunlight, anti-glare protection for working at night, full screen dimming and razor-sharp graphics, ship suppliers are after additional properties in an HMI. On the bridge space is tight, so every installation millimetre counts. While the dimensions of display and touch cannot be changed, SÜTRON uses all imaginable design flexibility for the frame and seal. Instead of a wide flat seal, a narrow round seal is pressed into the frame. Viewed from the rear, the splash proof IP65 frame is only 6mm wide and barely protrudes from the installation cut-out. This is a key advantage in tight spaces. Using custom front panel designs with logo and colour, the

Fig 1:
    The frame is only slightly wider than the cut-out

OEM ship supplier can integrate the HMI elegantly into the design of the overall system.

Communicative team player in the engine room

An HMI is integrated into an overall system. Via Ethernet or CAN, it is in contact with the controller, while serial interfaces connect it to actuators, sensors and other devices. Because interfaces are a particularly important factor in the engine room, the P Line provides redundant optional Ethernet and CAN interfaces.

Long-term seaworthiness

HMIs are found in the engine and control room, on the bridge, in protected outdoor areas, as a remote display in the cabin, built into a control unit, inside the ship's cockpit or on the open flying wing. Wherever it is used, the HMI needs to be low-maintenance and have a long service life. Moving parts are prone to failure. This is why maritime HMIs don't have any kind of fans and use flash memory instead of hard disks. These are basic requirements for safe operation despite vibrations and shocks. Other features such as background dimming also increase operating life.

A tough start to life

Before an HMI device goes into production, the prototypes are tested thoroughly and extensively, including extreme conditions. During their actual service life, the series product will not be confronted with such extreme challenges, but during the product qualification process prototypes are operated far beyond their specifications. At times they are stress-tested to the point of complete failure. The analysis of the obtained data shows what stress reserves remain for each point of the specification. Before delivery, the series products go through a burn-in test in the climatic chamber.

Summa cum laude

To prove their suitability for maritime life, the HMIs need to conform to bridge standard EN 60945 and require the following certifications: AMERICAN BUREAU OF SHIPPING: ABS certificate; BUREAU VERITAS: BV certificate 1 / BV certificate 2; DET NORSKE VERITAS: DNV certificate; Germanischer Lloyd: GL certificate; Lloyds Register: LR certificate.

Fig 2:
Hardware and software functionalities of a maritime HMI

Open platform

The option to work with standard Microsoft® tools is the future. From the manufacturer's point of view, proprietary systems bind the customer to the unique product. From the customer's perspective, this prevents him from choosing the best product for a technical problem. SÜTRON has turned its back on the proprietary approach and instead of locking customers in, is giving them the freedom to opt for open programming platforms. Programming in Visual Studio, .NET or a high-level language is possible. SÜTRON provides the necessary interfaces for OEMs to program their own applications. This includes a Hardware Access Library (HAL) with different DLLs that give the programmer direct access to the hardware from the .NET or Visual Studio application and allow him to read values or activate outputs. If the OEM programmer uses this open platform, he is free and independent from the hardware vendor. The only dependency is the DLL that performs the HW access. However, this is only an estimated half a percent of the application program and can be quickly adapted . This complete control ensures the future of the OEM system.

Securing your investment

Where capital goods are concerned, the security of the investment plays a key role. A secure investment in this context means the manufacturer is still in business after many years and his delivery is reliable. The manufacturer's economic background and long-term product policy are crucial factors. SÜTRON is a wholly-owned subsidiary of Phoenix Contact and economically stable. Customers in the industry require long-term availability of ten or more years. This applies equally to applications in the automation industry and the maritime sector. This requirement is in direct contradiction to the fact that electronic components are often changed, discontinued or replaced by the next generation within a few months. Long product availability is guaranteed by a stringent design, development and procurement strategy. With the use of COM modules, the increasingly rapid change of processor generations can be exploited for continuous performance improvements of the equipment, while at the same time securing the long-term availability of the unit.

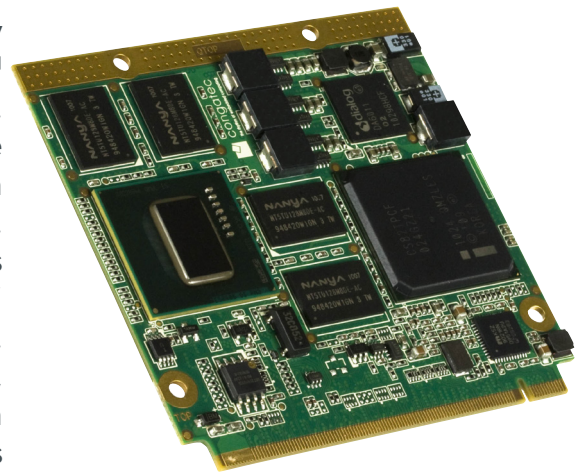## Partnership SÜTRON and congatec
Costs under control

Even the best technology will only attract buyers if it fits into the financial budget of the overall system. All constructive and strategic levers must be used to ensure the much-touted price/performance ratio is positive. The strategic decision for Qseven modules saves development costs and time. With shorter development times, it becomes possible to respond more quickly to changing market influences. In addition, the module manufacturer congatec supplies the latest modules with all technical information quickly to market, thereby helping to bring new products to production faster. The HMIs are designed for panel mounting and are therefore not fully enclosed. The front provides IP65 protection, the back fulfils protection class IP20. Even though high quality metal housings are used instead of plastic parts, the cost of building such a unit is reasonable. Since it is not a closed unit, ventilation and cooling are easier. After installation, the air circulates better, and there's a natural convection effect. This is a clear advantage in terms of higher performance because there's no need to clock back the CPU even at high processing power.

HMI trends

SÜTRON provides HMIs not only for maritime systems, but also for applications such as those found in building automation, machine visualization and industrial automation. Overall, the trend in HMI devices is going to larger displays and more interfaces. The graphics are getting more advanced, as the expectations for high-quality representation rise. As a consequence more and more powerful processors, and higher and higher memory capacities are required. Windows® Embedded Standard 7 is replacing Windows® CE as a PC-like embedded operating system. Additional serial interfaces are becoming increasingly important, as well as redundant Ethernet and CAN connections. Touchscreen operation replaces mechanical keys. Application development will increasingly move to open platforms, making applications independent of proprietary HMI or SCADA software. Long-term availability, longevity and industrial features will remain standard requirements.

The core of the matter

The conga-QA6 Qseven Computer-on-Module used by SUTRON is based on a processor from the Intel® Atom™ E6xx Series and the Intel® Platform Controller Hub EG20T. The module is optimized for the industrial temperature range; all components of this design are specified for an ambient temperature range of minus 40° C to plus 85° C. The module provides fast, differential interfaces such as PCI Express and SATA, while support for old „legacy" interfaces such as EIDE and PCI has been dropped. Provided interfaces include 6x USB 2.0, 2x SATA, 1x SDIO, 3x PCIe, LPC bus, I²C bus, Gigabit Ethernet, as well as High Definition Audio, and now also CAN bus. The CAN bus uses previously free pins because CAN is an add-on to the Qseven® specification. Optional mass storage of up to 32

Qseven Computer-On-Module based on the Intel® Atom™ platform with block diagram

GB on-board Flash is available via the SATA interface. The conga-QA6 module can access up to 2 GB of on-board DDR2 memory. Memory access, sound and graphics are all integrated directly into the processor. The module provides an enhanced 3D-capable graphics engine and uses up to 256 MB frame buffer. The graphics supports DirectX 9.0E and OpenGL 2.0; video applications are accelerated by hardware-based MPEG2 and MPEG4 decoding. The mobile Qseven® platform uses the latest

low-power processor technology and is developed to meet the demand for small, mechanical dimensions. Existing application designs can easily be upgraded with the latest Intel Atom E3800 series modules.

Conclusion

The performance of HMIs is rising rapidly. The value-add of a maritime HMI lies in the application-specific details. The overall costs of developing, testing and certifying a maritime HMI are high. Customer requirements can be met only with market-specific know-how. The internal computer is just one part of a maritime HMI. The design of a processor card is complex, especially since the processors continually evolve. SÜTRON saves their own resources by using congatec computer modules and focuses on the application-specific hardware and software. The use of Computer-on-Modules saves time and money because there is no learning curve and production-tested, industry-proven and certified components are available in industrial quality. This gives SÜTRON a clear head start for maintaining a competitive advantage thanks to its ability to launch cost-optimized designs faster. congatec is a key partner whose motto „partnership without competition" forms a stable foundation for mutual success.

Why SÜTRON chose congatec

„We decided to use congatec modules for several reasons. congatec is a founder and member of the Qseven consortium. This means we have a supplier who drives developments and specifications and has an active finger on the pulse of technology. Another very important point for us is that congatec does not sell systems, but only provides the components to develop them. This means congatec does not act as a competitor in our market, but supports us as a reliable partner. We get early pre-production samples, along with honest information about which functions cannot be used yet. This saves us a lot of time while enabling us to maintain our development lead. An open, cooperative partnership, competent technical support and competitive prices are reasons why we feel very well cared for at congatec."

Author: Frank Schäffler, Produktmanager, Sütron

About SÜTRON:

SÜTRON is a centre of excellence of the PHOENIX CONTACT Group and wholly-owned subsidiary since 2008. Its expertise in operation and monitoring makes SÜTRON a key technology provider within the group. SÜTRON is a growing company within the PHOENIX CONTACT Group and develops, manufactures and markets open HMI (Human Machine Interface) system solutions for machine and plant automation. www.suetron.de

About congatec AG

congatec is a leading supplier of industrial computer modules using the standard form factors COM Express, Qseven and SMARC as well as single board computers and customizing services. congatec's products can be used in a variety of industries and applications, such as industrial automation, medical, entertainment, transportation, telecommunication, test & measurement and point-of-sale. Core knowledge and technical know-how includes unique extended BIOS features as well as comprehensive driver and board support packages. Following the design-in phase, customers are given support via extensive product lifecycle management. The company's products are manufactured by specialist service providers in accordance with modern quality standards. Headquartered in Deggendorf, Germany, congatec currently has entities in USA, Taiwan, China, Japan and Australia as well as United Kingdom, France, and the Czech Republic. More information is available on our website at www.congatec.com or via Facebook, Twitter, LinkedIn, Google Plus and YouTube.

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