DFI | WHITE PAPER

How to select the best HMI?

Insights into criteria and evaluation of a cost-effective industrial panel PC

Abstract

Industrial panel computers are utilized widely in all vertical markets where human-machine interactions would be a part of an operating process or an aid to complete a task. As the IIoT (Industrial Internet of Things) or IoT (Internet of Things) advances, the interconnected devices have proliferated and so have HMI panel PCs.

Solution providers and system integrators face numerous tasks that require a sound platform solution according to the project-specific requirements. To help companies get a head start on their projects, this article provides some insight into the evaluation of a cost-effective industrial panel PC by presenting the following criteria:

- Scalability and Upgradability
- Flexibility and Expandability
- Robustness
- Reliability, Availability, and Serviceability

This article describes each one of these criteria in detail. It also introduces the modular design approach and explains how it can reinforce the design of industrial panel PCs in those areas.

Design For Innovation

The Growing Use of HMIs in IIoT

A Human-machine interface (HMI) device can be basically interpreted as a machine that enables users to better understand a process or operational performance and respond through display and control or input devices. Integrating touch technologies is a trend in the development of human-machine interfaces as IoT or IIoT brings bout transformation across market sectors. The industrial viability of touch-enabled displays has been proven by their wide adoption and growing sophistication in systems ranging from industrial process control to self-service stations. With multi-core compute and advanced graphics capabilities of modern operating systems, more complicated functionalities encompassing data analytics and acquisition, for example artificial intelligence and RFID, are developed and employed in an HMI system. In industrial applications, an HMI system may also incorporate functions such as reporting, surveillance and monitoring, communications, and predictive maintenance, which is a valuable and forward-looking feature for IIoT applications.

To address the demand for a growing number and variety of systems, an emerging and innovative approach to industrial panel PC design—modularization—is gaining significant traction amongst panel PC designers and manufacturers. The building blocks of a modular panel computer comprise a box PC (the box module) and a display panel (the panel module). The box module houses all CPU, memory, and I/O requirements for a vertical application, whereas the panel module facilitates human input and display. The combination of a computing unit and a display (with or without touch capability) provides a complete platform for any panel PC product development.

This article describes four must-have criteria to evaluate industrial panel PCs for total cost of ownership (TCO) optimization and explains how modularization can bring benefits in these areas. It also demonstrates DFI's state-of-the-art family of modular panel PCs, built on Intel® processors and based on the ADP (adaptive display platform) innovation, offers flexible, future-proof, and cost-effective solutions for a diverse range of applications.

Scalability and Upgradability

As IoT technologies continue to evolve, IoT device developers need a scalable platform on which they can port applications to help create smart and interconnected devices for rapid deployment. Scalability makes it simpler for developers to design a host of products based on common middleware or software. Middleware solutions or even user applications may be directly ported on a selected hardware platform offering the appropriate computing power and communication capabilities with no requirement to recode application programs. Scalability also makes it possible to upgrade platforms to benefit from more powerful processors when they become available.

Scalability is imperative for the adoption of industrial panel PCs whose utilization in HMI continues to grow because of their intuitiveness and ease of use. For example, an industrial monitoring and controlling solution usually includes a SCADA (supervisory control and data acquisition) system, programmable logic controllers (PLCs), HMIs, and perhaps an IoT gateway. Companies in factory automation or other vertical markets seeking to maximize the benefits of IoT usually do not want to excessively invest in a solution for the expected growth at some time in the future. They would prefer a solution that fulfills their current needs and expands economically as demands arise.

Traditional approach of panel PC integration builds all-in-one touch panel computers from the ground up with a limited selection of components and few combinations of configurations. This approach hinders scalability and upgradability to accommodate advancing technologies in CPU, flash memory, etc.

Unlike the traditional approach, the modular approach can be leveraged to rapidly deploy systems across the plant floor with reduced development time. Not only can a box module scale to meet application requirements, the touch panel can also upgrade to a larger screen or to accommodate a new touchscreen technology without a complete redesign of the entire panel PC. Modularization delivers the ability to keep pace with the evolving IoT requirements using a scalable architecture with interchangeable box modules for many years to come.

Flexibility and Expandability

The Internet of Things (IoT) has ushered in an era in which nearly every object or device will be connected to the Internet and those objects will also become more intelligent. New connection media and communications protocols are burgeoning to reach this goal of ubiquitous connectivity.

Expandability offers the flexibility for adaptation to new connectivity media without much additional effort. An ideal platform should be versatile and encompass a set of essential inputs and outputs suitable for myriad industrial markets, plus the opportunity for future extensibility. A panel PC built on this ideal platform assists in enhancing connectivity with other IoT devices and avoids replacing the existing infrastructure regardless of the application field, which may be Industry 4.0, healthcare, smart homes and cities.

As an illustration for an IoT deployment, suppose a vending machine is located outside a mass transit station. The vending machine may equip an IP camera with anonymous video analytics (AVA) to analyze customer demographics and a touch panel for customer interactivity. Internal sensors should be built into the system to monitor its health, such as temperature and humidity measuring instruments of a freezer installed within the enclosure, to keep commodities fresh. The solution provider in this example must also decide the modality of transmission—LAN, cellular, or the emerging low-power WAN—by considering the type and the amount of data being transmitted and the current network environment and weighing those factors against the advantages and disadvantages of each transmission method.

The connectivity requirement from the above scenario can be implemented through the incorporation of a Mini PCIe expansion slot. The Mini PCIe expansion slot can support connectivity with industry standard protocols such as Wi-Fi, Bluetooth, LTE, GNSS, and the LoRA or NB-IoT protocols, which are promising technologies for low-bandwidth and wide area geared to IoT communications.

Consider another example from factory automation. Flexibility eases configuration and communications across different types of networks, no matter a local communication network (e.g. Modbus over Ethernet and serial connections) or cloud connectivity (e.g. mobile communications), by sparing the need for third-party servers or external gateways. This will in turn simplify installation whether your goal is to collect production information for process or quality tracking with visual presentation while transmitting a subset of the information to the cloud in a production line or to provide a centralized HMI for an operator to monitor and control the automated devices in a control system. And if the HMIs are OPC UA compliant in a large system implementing smart manufacturing, they can directly and safely communicate to each other (machine-to-machine communications) across different platforms and architecture layers by acting as a client or server or both. Being OPC UA compliant further extends the flexibility of information exchange and expandability of functions.

The modular design model, which combines two discrete commodities: a box PC and a display panel, has the distinct advantage of flexibility and expandability over the traditional all-in-one model. Customizing I/O ports for a project is very inefficient with the traditional model that has two parts closely coupled by a wrapper chassis. Consider the above example of a vending machine again; I/O expansion may be required when there is a need to renew surveillance equipment or sensor and control devices.

Specifically, it is cumbersome to reposition the display connector on the motherboard to reroute the connecting cable and even a redesign of the entire panel PC may be necessary, so ultimately results in longer time to market. Now with modularization that decouples a box PC and a display panel, I/O customization could be a lot less hassle. Furthermore, mounting or replacing an industrial panel PC has never been easier as the modular design offers the unprecedented compatibility among panel and box modules.

CASE STUDY

Quality Inspection System for Manufacturing Electronic Appliances

Manufacturing productivity starts with proactive maintenance of manufacturing equipment. A solid monitoring system is especially critical to maintain the health of manufacturing equipment. A home appliance manufacturer stands out through its comprehensive product lines. To remain competitive, it requires an ongoing effort to improve accuracy and efficiency in quality control.

The customer planned to have a dedicated HMI for every quality inspection line to show measured values from the sensors used to detect defective products as well as data to measure the health of conveyor systems. The existing solution would directly send values from sensors connected to PLCs of various vendors to a SCADA or workstation in a control room for defect alarms and belt systems monitoring. This induced impact on productivity and inspection performance due to miscommunication via telephone between the inspector in the control room and the people working on the production floor.

How DFI Helped

We offered a fanless touch panel computer, KS057R-FS, to the customer. It provides a multitude of connectors including USB, RJ45, and serial ports to connect to a PLC depending on the PLC's connectivity requirement. The system can be mounted on a DIN rail inside an electrical cabinet in which PLCs are usually installed, saving the cost of cabling and provides convenience of access. In this HMI solution operation, the on-site personnel are now able to respond to faulty situations and monitor conveyor operations by looking at HMI screens. Furthermore, the measured data is collected and sent to on-premises servers or over the cloud for predictive analytics of conveyor assets.

Robustness

Solution providers look for efficient, optimized IoT device development platforms that accelerate time to market, but more importantly, help satisfy environmental constraints. To withstand harsh environments, enhanced thermal management and rugged enclosures are vital. Industrial practices for attaining these two measures include corrugated aluminum casing and front bezels that prevent water and dust ingress and strong impact. Depending on the application field of a system, the support for a wide range of input voltages is difficult to overestimate since a stable supply of power may not be accessible. Extra protection mechanisms such as electrostatic discharge protection, vibration and shock resistance, and rugged storage all contribute to the robustness of a system.

Industrial appliances need to last for many more years than their consumer counterparts. But can a touch panel live up to the production life of the touch panel PC as a whole? Strengthening the endurance of a panel that will match the lifetime of the touch panel PC requires system designers to take stock of several factors such as the availability and essential quality of key components and operating conditions.

The backlight plays an important role in an LCD's operating life. Studies have shown that switching off or dimming the backlight saves power and helps achieve the desired lifetime. The backlight technology also determines the quality of brightness and readability.

It is good practice to compare the advantages of touch technologies while taking the operation's needs and circumstances into account for the effectiveness of an application. The two most common types of touchscreens used today in many industries are resistive and projected capacitive touchscreens. In general, projected capacitive technology natively supports multi-touch and has high endurance. On the other hand, resistive technology has a limitation on touches and lower impact resistance, but is more precise in touch responsiveness and usually cheaper.

Reliability/ Availability/ Serviceability

Robustness in a system operation merits no less attention than the robustness to withstand exposure to harsh environments. The three terms—reliability, availability, and serviceability—describes the characteristics of a trustworthy system from both hardware and software perspectives.

Reliability

With the growing complexity of vast numbers of devices connected by the Internet of Things (IoT), it is inevitable that virus, back-door programs, and threats will continue to run rampant in a connected world. To ensure data integrity, an industrial panel PC, no matter as an edge device for real-time data analysis or a gateway for data and traffic aggregation, should implement security in every part, including device security, communications security, and lifecycle security.

Another point concerning reliability is the design integrity and manufacturing quality. On the board level, the employment of industrial-rated electrical components with high MTBF and a schematic arrangement of these components for maximum heat dissipation will help achieve the required operation reliability. Reliability of the equipment can be better assured if a panel PC supplier has the comprehensive capability to research, develop, and manufacture motherboards as well as displays.

Availability

High-availability systems would express themselves as having a 99.999 or even eight-nines level of availability. To achieve a high percentage of availability, system designers and manufactures opt for the use of industrial-grade components and the elimination of failure-prone components such as fans and hard disks. The less moving parts and dangling cables the system has, the better the availability. The provision of a fanless and cableless embedded system for attaining high availability requires a comprehensive plan and thoughtful attention to every aspect of the design—from the choice of high-quality PCB components to industrial-grade I/O connectors to the electrical features of the interface connecting the box and panel modules—at early stages of project development. Above all, an industrial panel PC could now be built as completely cableless based on the modular design principle.

Serviceability

It is hard to perform maintenance tasks on devices installed outdoors or in harsh environments. The situation can be a service engineer checking a touch panel PC used for monitoring and maintenance in a steel mill or in a remote oil drilling site. With the modular design, touch panel PCs will be able to compensate for either a broken touchscreen or the computing unit independently. Furthermore, service engineers no longer need to bring all the tools with them. They can uninstall either the box or the panel module and repair the faulty parts inside the comforts of an office.

DFI's Superior Family of Modular Touch Panel PCs

Leveraging the ADP (adaptive display platform) design approach, we have developed a broad offering of high-quality box modules along with panel modules scaling to meet power, performance, and cost requirements for various industrial applications. Robust features like wide temperature, rugged chassis, and industrial protection such as IP65 can also be flexibly factored into the design.

Our KSM-AL series features Intel® Atom® Processor E3900 and Celeron® processors and is particularly suitable for graphics-intensive embedded applications requiring presentation and processing of graphics and videos. For performance-demanding applications in the fields of medical imaging and industrial automation requiring responsiveness, the high-end KSM-SD (the Intel® Skylake platform) and KSM-KH (the Intel® Kaby Lake platform) series will satisfy computing requirements. Furthermore, upgrading to a new platform or replacing a worn or phased-out screen is perfectly feasible without system redesign thanks to the ADP innovation.

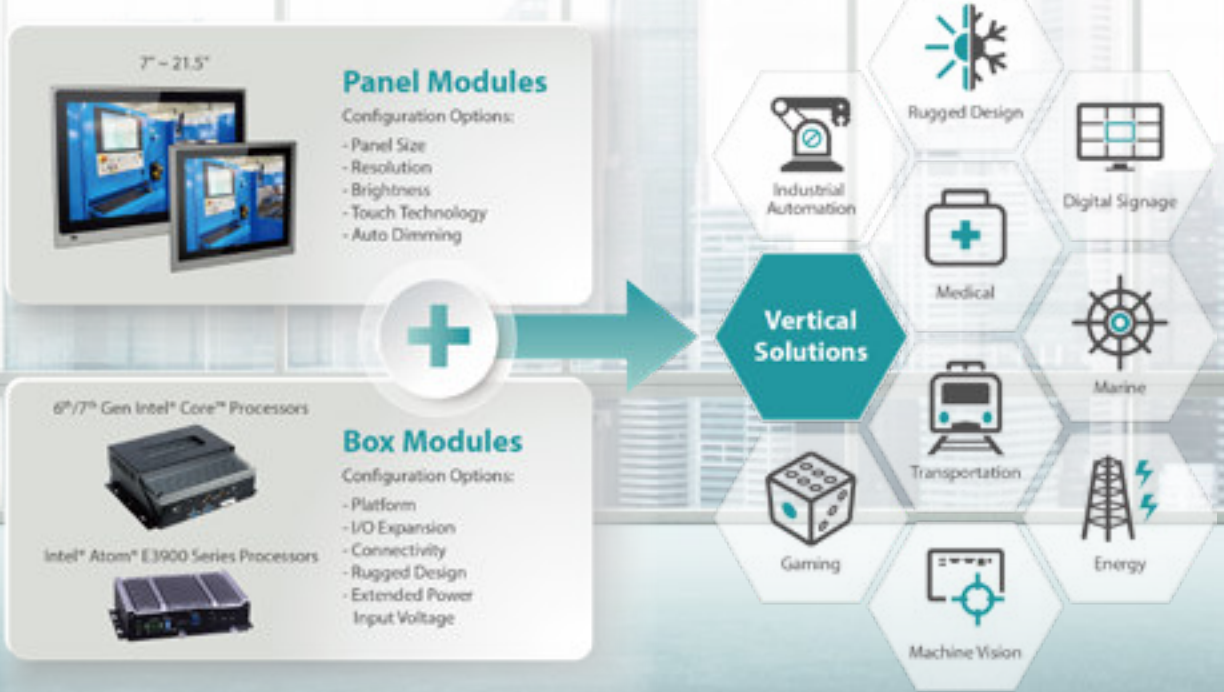
All box modules are designed with wide power input range (9~36V or 9~48V DC) as well as surge and overcurrent protection. They come with an abundance of interfaces such as display outputs, USB, I2C, SPI, PCIe, and UART, making it convenient to connect field devices and control systems for data acquisition and communications. Other application-specific interfaces like CAN bus and DIO ports as well as additional USB (on the front panel for convenient access) and LAN ports can be easily integrated too. Additionally, the dual Power-over-Ethernet (PoE) LAN configuration enables adaptors to team up and eliminate the need for connected devices to have a power supply. What's more, the KSM-AL series modules are equipped with ignition power management for in-vehicle applications.

An open and common platform based on the Intel® processors supports a variety of frameworks or middleware and integrated software stacks to deliver greater flexibility in product development. The platform also utilizes hardware-based accelerator to improve compute-intensive workloads for certain tasks. For example, solutions providers who specialize in video intelligence built on deep learning models can utilize Intel® OpenVINO ™ no matter what method they choose to implement video analytics, i.e. CPU, Intel integrated graphics, VPU (Intel® Movidius® Vision Processing Unit), or FPGA.

Another point is the silicon-level security. For vertical applications that require security and remote management, Intel® Active Management Technology (Intel® AMT) and Intel® Trusted Execution Engine (Intel® TXE) as well as secure boot features, such as Intel® Boot Guard 2.0, can enhance your existing management and security solutions.

Aside from these rich-feature box modules, high-quality touch panels with optimized longevity are deliberately designed and developed. As the backlight is central to the longevity of the panel, the auto-dimming is a prominent feature that can contribute to power optimization and longer backlight life. Our industrial panel PC series employs a built-in light sensor, which automatically dims or turns off according to the ambient light level in the room. Furthermore, our touch panels (both resistive and projected capacitive) support glove touch and use optical bonding for better readability and endurance in intense sunlight and humid conditions, for example, a wayside Information kiosks or systems for the food processing industry.

Being in the same Qisda/BenQ Group with a renowned display company, AUO, we assure the lowest product risk backed by an in-house supply chain. We outperform our competitors with the ability to offer a wider range of panel sizes and to customize for special sizes and high brightness over 1000 nits, plus various mounting methods, including VESA, panel and open-frame mounting for seamlessly integration into any embedded application. Furthermore, as a proven designer and manufacturer of industrial motherboards, we facilitate essential tests relating to environmental variations and mechanical strain in our own labs. Finally, as an Intel® IoT Solution Alliance member, we ensure the adoption of the latest chipset technologies in the embedded systems to help our customers stay ahead of the IoT innovation.



DFI: A Proven Supplier of Industrial Panel PCs

Today enterprises are under pressure to unlock the opportunities in the Internet of Things. Traditional approach to build a panel PC for an HMI system does not address the challenge of rapid developments for an extensive range of IoT use cases. The commercial off-the-shelf (COTS) solution based on the ADP design is emerging as a promising and more-efficient alternative to the all-in-one approach. Committed to developing embedded systems adhered to the four criteria for cost-effectiveness as well as delivering configuration variety and flexibility of the ADP, we are able to assist solution providers and system integrators by offering our expertise in product design and lifecycle services.

We invite you to learn more about our Industrial panel PCs and displays at https://www.dfi.com/Category/Index/42.

Please click or scan the QR code to fill out an inquiry form if you would like us to contact you.

DFI

Founded in 1981, DFI is a global leading provider of high-performance computing technology across multiple embedded industries. With its innovative design and premium quality management system, DFI's industrial-grade solutions enable customers to optimize their equipment and ensure high reliability, long-term life cycle, and 24/7 durability in a breadth of markets including factory automation, medical, gaming, transportation, smart energy, defense, and intelligent retail.

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