Technical Article

Three key considerations for the next generation of HMI

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In the past, a human machine interface (HMI) consisted of a physical control panel with push buttons, switches and indicator lights that enabled users to communicate with a machine. As the technology progressed, it became possible for users to monitor processes, see status information displays and send commands. Now, HMI applications are everywhere, including smartphone apps used to control televisions, voice commands in a vehicle, patient monitoring in hospitals or touchscreen control panels in a smart factory

We continue to see increased touchpoints with machines in our everyday life. So what does the future of HMI look like? Beyond data collection, control and display, the next generation of HMI will take applications beyond just human machine **interfaces** to methods of providing human machine **interaction** where machines can act intelligently and communicate with humans. For example, access to buildings through touchless interaction, object and gesture detection, and facial recognition, as shown in the video "Smart building access."

Moving into a new world of human-machine interaction will require interactive, smart applications with a new set of challenges for the processors that make HMI possible. Let's walk through three considerations for the next generation of HMI.

No. 1: Enabling new functions with AI at the edge

The new generation of HMI designs will rely on edge artificial intelligence (AI) to enable new functions. For example, machine vision can enable controlled access to a machine through facial recognition or enable touchless operation with gesture recognition like the example in Figure 1. Additionally, adding edge AI capabilities like machine vision to HMI designs can enable more accurate analytics for current system statuses and predictive maintenance. When creating new HMI applications, you will need to consider the effort around edge AI application development, as well as processor capabilities.

Figure 1. A medical professional uses gesture recognition to interact with an intelligent HMI system

No. 2: Balancing performance with power

High levels of integration on a single chip affect device power consumption, especially when edge AI functions are fully enabled. The small form factors typically required in smart designs, especially in harsh environments, add another layer of complexity to the power consumption of an end product. Designers will have to overcome the challenge creating a highly power-efficient design, mindful of thermal restrictions, without increasing the overall system cost. An optimized power design should include ultra-low-power and multiple low-power modes to enable a longer life of a product.

No. 3: Integrating smart connectivity and differentiated display support

The increasing number of field-level devices and sensors and emerging real-time industrial communication protocols also pose challenges to new HMI applications. For example, an HMI in a smart factory environment will need to communicate with other devices and machines, which means that the HMI design will require connectivity and control functions. Display is another design consideration for HMI and can provide unique features and ways of enhancing communication between humans and machines.

As HMI continues to evolve, the processor technology behind these applications must be ready to enable that evolution. Designed for low power with many industrial peripherals, the first devices in TI's Sitara™ AM62 processor family, the AM623, AM625 and AM625SIP processors, bring power-efficient edge AI processing to dual-display and small-form applications with considerations for the next generation of HMI.

The AM625SIP is a system-in-package (SIP) version of the AM6254 processor, with the addition of an integrated 512MB LPDDR4 SDRAM. This device directly addresses the hardware, software, power and many more challenges that engineers faces when designing a processor. A SIP processor has additional benefits such as enabling a simplified hardware design, optimized size/system bill of materials costs, and reduced engineering effort needed to layout the LPDDR4 on the chip.

Additionally, the AM62P processor enhances performance of HMI applications through integrated quad-core Arm Cortex-A53, more powerful graphics processing unit (GPU) and 32-bit LPDDR4. The increased memory bandwidth significantly reduces latency, facilitates smoother visual transitions, and enables superior multi-tasking capabilities on the processor allowing for instant responsiveness that’s essential for HMI applications. Also, key to the AM62P is its enhanced GPU and video codec, capable of rendering intricate 3D graphics, effects, and video streaming at high fidelity.

The AM62X family of processors including: AM623, AM625, AM625SIP, and AM62P enhance the implementation of edge AI functions with a scalable single- to quad-core Arm Cortex-A53 up to a 1.4-GHz platform and with mainline Linux supporting TensorFlow. Also, the on-chip resources, including universal asynchronous receiver transmitter, Serial Peripheral Interface and I2C, further simplify design by supporting connection options for popular industrial sensors or controllers.

The AM623 and AM625’s optimized power design supports multiple power modes as low as 7 mW on core power enable portable and battery-powered designs. The AM62P also optimizes power design with its dedicated video hardware accelerators enhances power efficiency as it offloads video processing from the CPU. A simplified hardware design enables a cost-effective system solution within a compact size.

AM623, AM625, and AM625SIP processors support a wide variety of display interfaces, including the cost-effective RGB888 and a low-voltage differential signaling interface supporting 2K and full high definition displays. The AM62P adds to the list of display interfaces by also including DSI, and supporting up to three displays. Multiple-display capabilities enable design flexibility and innovation.

Conclusion

The future of HMI will bring about intelligence and innovation in human and machine communication across a wide variety of environments and applications. Imagine an operating room where a medical professional can interact with a patient monitoring system with their voice instead of tapping a screen to preserve the sterile environment, or a noisy factory where a worker can use a control panel with just a gesture. Get started on your next-generation HMI design with the AM62 processor family.

Additional resources

- Find an AM62 processor for your design.
- Discover project demos and get started on your application with AM62 development resources.
- Evaluate and develop with the AM62 starter kit, AM625SIP starter kit, AM62P starter kit.

Software and out-of-box demos simplify the process of evaluating an edge AI application on AM62X processors, while edge AI development resources and academies help save design effort and time.

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