The Building Blocks for Industrial IoT, AI, Machine Learning, Machine Vision and Digital Twin Technologies

intel IoT Solutions Alliance

AXIOMTEK

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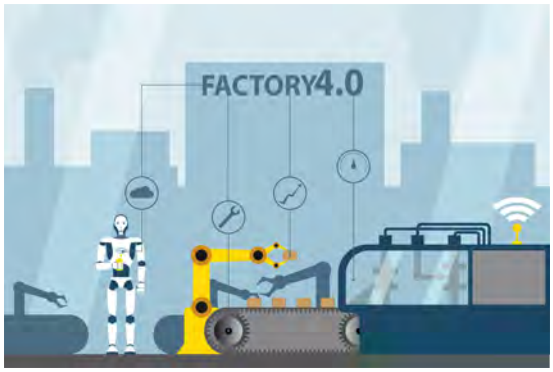
A new chapter begins in smart manufacturing, industrial robotics and other advanced manufacturing technologies at the IoT edge.



The industrial Internet of Things (IIoT) is redefining factory automation and manufacturing robotics, and this digital transformation is taking place at the intersection of connectivity and analytics. However, a closer look reveals that while industrial IoT is emerging as a key enabler in smart manufacturing, it encompasses a much bigger story by incorporating artificial intelligence (AI) and digital twin technologies.

AI technologies like deep learning and machine learning are now moving to the network edge to facilitate services such as predictive maintenance and object detection and recognition. Machine vision technology, for instance, is boosting accuracy in applications ranging from industrial inspection to vision-guided robotics.

Then, there is this new kid on the IoT block, digital twin, manifesting a dynamic software model of a physical entity or system. Digital twins are poised to transform manufacturing processes by significantly reducing the cost and machine downtime. And this replica of a physical device is intrinsically tied to the AI and its technology subsets like deep learning and machine learning.

The digital twin technology, developed by NASA to simulate conditions on Apollo 13, is now being implemented in a variety of use cases, ranging from smart factories to design prototyping to oil fields. According to market research firm Gartner, by 2021, half of the large industrial companies will use digital twins. Chevron, for example, is implementing the digital twin technology at its oil fields and refineries to save millions of dollars in maintenance costs. The energy giant is connecting its high-value equipment with sensors in the field, modeling and simulating the operation process with its digital twin technology to provide learning for predictive maintenance and thus prevent the breakdown of its mission-critical machines.

Therefore, what's needed is a revisit of computing and communication building blocks of embedded solutions, so they can effectively employ new technologies like digital twins using Ethernet backbones from edge-to-cloud. Ethernet, with its ability to facilitate each connected device its own IP address, is becoming a key ingredient in the industrial IoT's network ecosystem. The most important building block supporting these emerging technologies is industrial computer hardware. Industrial computers are now evolving with these new automation trends. Some are offering features and functionalities that incorporate key requirements for successful deployment of AI, machine vision and digital twin platforms.

Another embedded system in the eBOX series, eBOX671-517-FL with 8 CH-PoE/GbE onboard

Not surprisingly, therefore, at the intersection of AI and digital twin technologies, some computer hardware manufacturers such as Axiomtek are offering built-in Power over Ethernet (PoE) capabilities on some of their embedded systems designed for automation applications. The benefits are clear. PoE networks provide guaranteed uninterrupted service and lower operating expenses as they simultaneously deliver electrical power and transmit communication signals over standard cabling to IoT endpoints such as LED lighting, HVAC controls and surveillance cameras. For AI applications, which encompass a lot of processing and memory to carry out complex tasks like machine learning, PoE has rich interfaces to handle cameras and sensors as well as support various protocols.

Likewise, digital twin technology requires hardware with great communication capabilities to efficiently bridge the physical and virtual worlds. Here, the real-time data captured through the physical world is used in the virtual world to learn and improve. And the digital copy of the system is used to optimize performance.

The white paper will explain how hardware selection is empowering the success of the next-generation technologies like AI and digital twin. The paper will also provide a detailed treatment of how AI-enabled edge platforms are enhancing the accuracy of IoT,

factory automation and warehouse management applications.

Machine vision and its increasing popularity

The machine vision-based embedded systems address critical industrial IoT needs, including monitoring of various conditions during production process. For example, machine vision is used to detect defects and anomalies during production process in a factory environment. The results are better product quality, control as well as productivity improvements. It is also used for predictive maintenance and helps facilitate machine learning process.

Machine vision can be the key contributing factor for successful machine-to-machine (M2M) communications, quality control applications and machine and deep learning. For quality control, it supports accurate detection of measurements, inspection of parts, guidance of assembly robots and correct ID reading, all of which can be done real-time. Machine vision can also enhance machine learning process from delivering the collections of visual data and facilitate (M2M) communications.

An embedded system for machine vision

eBOX671-521-FL with 4 CH-PoE and MXM graphics module

Take, for instance, **eBOX671-521-FL**, a fanless embedded system that provides reliable high-speed connectivity for on-premise and cloud servers to host industrial machine vision systems on the fly. The embedded system is purpose-built for smart factory applications. It offers abundant I/O connectivity options for multi-camera imaging applications as well as display interfaces including DVI-I, HDMI and DisplayPort.

The industrial-grade embedded system also features enhanced storage and graphics capabilities to ensure support for a variety of cameras, lighting and controllers catering to various inspection requirements. The eBOX671-521-FL embedded system, for

example, features ECC memory supported by an optional Intel® C246 chipset to harness the latest graphics technologies.

More importantly, this robust embedded computer plays a critical role in facilitating high-speed image acquisition and processing. The platform is also crucial in machine vision embedded systems managing robots due to safety concerns and the risk of collision with humans.

Axiomtek's eBOX671-521-FL is scalable. It offers choices of 8th Generation Intel® Core™ i7/i5/i3 and Celeron® processors that provide ample capacity for transmitting multiple and simultaneous data collection streams. The processors offer a rich visual experience with the latest 4K Ultra HD graphics improvements.

PoE and connectivity

The machine learning designs also mandate reliable high-speed connectivity with sensors and on-premise servers or cloud computers. Here, PoE connectivity offers a highly suitable solution to connecting sensors and cameras and communicate acquired data without finding additional sources of power and complicating the implementation of sensors/actuators to the edge server and machine-to-machine or machine-to-server connectivity and communications. PoE connectivity significantly lowers the networking cost by consolidating the back-up power and reduces the integration complexity by transporting both data and power on a single Ethernet cable.

The eBOX671-521-FL offers four- or eight-channel gigabit PoE onboard. The PoE ports are critical in supplying power to facilitate continuous camera connections in machine vision applications such as automated optical inspection (AOI). PoE switches can add additional power source for applications that require more cameras.

The eBOX671-521-FL, a robust edge microserver for digital twin technology

The eBOX671-521-FL with scalable 8th Gen Intel® Core™ i7/i5/i3/Celeron® CPU choices

A high performance embedded system is required to make the digital twin concept a reality. High processing power, ample system memory and hard drive space, flexible I/O interfaces and great connectivity options are some of the examples of why a reliable and feature-rich edge microserver is the key to successful deployment of the digital twin technology. To simulate manufacturing assets, processes, people and physical objects in real time; choices of CPUs; its capabilities; connectivity and communications interfaces between sensor-to-sensor and sensor-to-edge processors as well as protocol compatibility are critical factors driven by the hardware choice.

Gateway device for IoT applications

Robust DIN-rail, Intel® Atom™ embedded system, The ICO300-MI

Axiomtek also offers embedded IoT gateway platforms like **ICO300-MI** targeted at industrial applications such as smart factory automation, smart energy, facility monitoring systems and more.

The ICO300-MI is based on Intel® Gateway Technology and has been upgraded with Wind River Intelligent Device Platform XT v3.1. It provides enterprise-grade security and intelligent manageability features for industrial automation designs. But more importantly, it simplifies the development process with an application-ready IoT gateway platform.

The IoT gateway platform features low power Intel® Atom™ processor, wireless connectivity, rich expansions and ultra-light-weight and compact design. The abundant processing and memory capacity at lower power consumption allows ICO300-MI to efficiently transfer the captured data from the physical world to the virtual world in digital twin, AI and machine vision applications.

The hardware choice: the critical IoT building blocks

Many new trends in manufacturing and factory automation may rely upon software to make them happen. However, they cannot become reality without the right hardware selection. The embedded systems like eBOX671-521-FL and ICO300-MI have been developed from the ground up to cater to design requirements for applications such as those mentioned for smart manufacturing, IoT edge-processing and industrial IoT analytics. They facilitate ample computing power for AI offshoots such as machine learning and newcomers like digital twins as well as ensure dependable and secured connectivity and communications from edge to cloud/on-site server.

For more information on embedded systems and gateway devices for IoT applications, go to **us.axiomtek.com**.

As an associate member of the Intel® Internet of Things Solutions Alliance, Axiomtek continuously develops and delivers cutting edge solutions based on the latest Intel® platforms. For more information, please visit: **https://solutionsdirectory.intel.com/member-roster/axiomtek**