How Smart Automation and Motion Control Are Driving Greater Industrial Productivity

By Jeff DeAngelis, Managing Director, Industrial & Healthcare Business Unit, Maxim Integrated

As intelligence continues to move to the edge in industrial environments, a new way of thinking is needed to translate the underlying semiconductor solutions into products that can provide better real-time information. Why is this important? Real-time information feeds artificial intelligence (AI) algorithms that are integral to optimizing the performance of factories as a whole as well as individual machines on the production line.

To accomplish the level of automation and flexibility that industrial convergence demands, every aspect of the equipment needs to evolve. For example, in motion control, we will need smart actuators that provide the necessary control of the flow and speed in which a product is moved through its operations. Since all applications require their own unique set of motion control and motor drive equipment, these smart actuators will need to provide higher efficiency to limit power dissipation and enable smaller sizes, better control of positioning and torque, as well as the ability to self-tune and optimize their performance while in operation. This combination of smart integration will enable a new class of products to meet the demands of Industry 4.0 and beyond. In this article, we’ll take a closer look at the technology that’s needed to achieve these goals.

WHAT DOES INTELLIGENCE AT THE EDGE LOOK LIKE?

The promise of Industry 4.0 is the flexibility that it brings to manufacturing, allowing product lines to reconfigure themselves on-the-fly to adapt to product changes and maintain higher uptime. As decision-making gets moved to the edge of the factory floor—where the machine meets the real world—this presents a need to access better real-time information across the factory floor.

With higher quality information, AI algorithms can continue to improve their analytical capabilities to enable the machine to better interpret information and take the appropriate response.

What does intelligence at the edge look like in action? At recent electronica tradeshows, Maxim Integrated demonstrated a smart football factory (Figure 1) that checked the quality and integrity of each football against Federation Internationale de Football Association (FIFA) regulations. The factory consisted of various sensors positioned at each of the stations to collect data from the semiconductors and motors as the football moved from the weighing station to the drop test station, pressure station, and circumference measurement station. This entire factory was controlled and monitored via an iPad. As the measurements were taken, the information was pushed to the cloud, where AI algorithms analyzed the data and provided options to improve the factory’s productivity.

To fully empower an intelligent factory, the semiconductor industry needs to deliver:

▶ Intelligent sensors to enable adjustment of parameters on-the-fly
▶ Software-configurable I/Os that allow more flexibility to adapt to new factory floor configurations and expansion needs
▶ Intelligent actuators that self-adjust to optimize their performance for their specific environment
▶ Advanced diagnostics for fast identification of the root causes of failure, as well as enhanced quality of real-time decision-making

Figure 1: Maxim Integrated’s smart football factory demo featured multiple sensors and utilized AI algorithms for real-time decision-making.
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To accomplish the level of automation and flexibility that industrial convergence demands, every aspect of the equipment needs to evolve. For example, in motion control, we will need smart actuators that provide the necessary control of the flow and speed in which a product is moved through its operations. Since all applications require their own unique set of motion control and motor drive equipment, these smart actuators will need to provide higher efficiency to limit power dissipation and enable smaller sizes, better control of positioning and torque, as well as the ability to self-tune and optimize their performance while in operation. This combination of smart integration will enable a new class of products to meet the demands of Industry 4.0 and beyond. In this article, we’ll take a closer look at the technology that’s needed to achieve these goals.

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Sensors, digital and analog IOs, and actuators are the three main functions of all industrial control systems. These three elements must work in unison and possess intelligence to support an intelligent system. On the sensor side, **IO-Link technology** turns traditional binary or analog sensors into intelligent sensors that can gather data and also allow operators to reconfigure their parameters remotely based on real-time health and status data of other sensors on the line. Smart sensors can support product customizations, accommodate for variations in a product, and adapt to different sets of products. **Software-configurable IOs** allow the factory to simplify its wire marshalling needs, providing more cost-effective and creative solutions to optimize productivity and reduce cycle times. What’s more, implementing software-configurable IOs also helps reduce factory downtime because replacing the sensors is fairly effortless, as is adapting the factory to add to or expand its capabilities. **Intelligent actuators** help control the shape, flow, and speed in which a product moves across the factory floor. Since all applications require a unique set of motion control and motor drive characteristics, these smart actuators will need to be highly efficient to limit power dissipation and enable smaller sizes, deliver better control of positioning and torque, and also provide the ability to self-tune and optimize their performance while in operation in their specific environments.

Given this combination of smart integration, two things need to happen to empower intelligent motion. First, we need motion control algorithms that enable a smooth range of motion, along with the ability to detect loads placed on the motor during operation to avoid line failures and minimize power consumption. Second, we need power-efficient analog device technology to allow high-voltage operation while providing health and status of the local environment to enable optimization of the motors for high efficiency and faster throughput.

By bringing together intelligent sensors, software-configurable IOs, intelligent actuators, and advanced diagnostics, the next generation of AI algorithms will become supercharged and ready to support the next phase in our industrial evolution: Industry 5.0. When we achieve Industry 5.0, we’ll see the emergence of self-aware machines that will further enhance performance efficiency and productivity (Figure 2). Picture this factory of the future, where tasks can be automatically redistributed to different machines should one on the line become bogged down with a failure. Indeed, thanks to smarter technologies, the future is looking even more productive.

**Wide bandgap semiconductors: to EV and beyond**

*By Filippo Di Giovanni, WBG Strategic Marketing Manager – STMicroelectronics*

In power electronics, Silicon has been adopted as the mainstream technology over the last four decades; today, silicon power transistors and diodes are so widespread and pervasive that equipment based on this material are everywhere in our lives. This adoption has allowed silicon to undergo continuous improvements, supported by innovative packaging and interconnect technologies, that enhance thermal management and reduce parasitic effects. By virtue of this relentless quest for improvement we are reaching a plateau where further technology iterations become only incremental.