



# Intelligence

Jeanine Katzel for  
Control Engineering

Everything is smarter these days, it seems: smart cars, smart appliances, smart toys. It's not surprising, then, that intelligent devices are on the rise in industrial automation and control as well. Smart motors, smart sensors, smart flow-meters are only a few among many components packed with microprocessor power in a trend that has all the earmarks of ushering industry into an age of unprecedented product and system performance.

Computing power today is seemingly infinite and data storage and memory relatively inexpensive, says Jeff Woolfolk, business developer and consulting engineer for Siemens Industry Inc. "The name of the game now is how much information can I obtain efficiently and how can I best use it."

It appears manufacturers are obtaining and using information quite efficiently—and effective-

ly. Thanks to the advent of technological advancements such as systems on a chip, multi-core processing, and higher levels of integration, devices are smaller, lighter, faster, and smarter. They are finding their way into endless applications and reaping benefits in many areas. They are increasingly more capable, as vendors introduce products that are easier to use, energy efficient, self-diagnostic, and wireless; and they are filled with features that are helping to drive companies to the greater efficiencies and through-puts and higher-level processes that they need to stay competitive.

**One controller can link to many devices, adding flexibility.**

## Use those brains!

Building capability into components is not entirely new. Smart motors, drives, and motion control systems are frequent sights in modern facilities. "The components inside drives—the IGBTs, the processors," says Rich Mintz, product manager, SEW Eurodrive, "were built early on to handle

## Intelligence in action: Smart devices save energy

Putting intelligence into a device can improve performance and save energy, as a retrofit project at a tractor manufacturer showed recently. A John Deere facility wanted to modernize a 25-year-old storage-and-retrieval machine to incorporate energy-saving technologies, and turned to SEW Eurodrive for assistance.

The system in question included an X axis that travels a storage-and-retrieval crane and a Y axis that moves the pallets up and down. Typically, explains Rich Mintz, product manager, "If you configure a storage-and-retrieval system to go from point A to point B to retrieve a pallet off the rack, both axes start moving at once. The X axis starts to move and the Y axis starts to lift. Both motors start at the same time. But do they have to? If the Y axis is set to wait a second or

two before it starts lifting, it can avoid a simultaneous inrush and reduce demand on the electrical system."

The vendor also looked at what happens when the drives decelerate. Continues Mintz, "When you decelerate the X axis, you put energy back into the dc bus. When you decelerate the Y axis—when the system is lowering the pallet, it is bleeding off energy. It is being burned up over the braking resistor. Now what if we timed the operation so that when one motor is regenerating energy, instead of burning it over the resistor, we wait and use it to move the other motor? What if we time when these two motors act so that when one is regenerating power, the other is using that regenerative energy instead of giving it up over the braking resistor?"

The answers are that energy is

saved and efficiency is increased. The concepts were applied to the existing system using SEW's MOVI PLC motion controller. As a result, Deere was able to reduce energy consumption by the system some 25% without changing the cycle rates—and they did it just by adding intelligence to the components.

"We took a PLC controller and put it inside one of the drives," explains Mintz, "and were able to achieve a significant energy reduction on a large system for a major manufacturer. Doing it inside the main PLC would have required a more robust and expensive unit as well as additional programming. But if you take the load off the PLC, let a task controller tell intelligent devices which tasks to perform, and let each intelligent device control itself, big savings in time and money are possible."

# at the Device

A stylized illustration featuring a crowd of people in the foreground, holding various protest signs. The crowd is composed of silhouettes in shades of blue, purple, and green. The signs are colorful and feature bold, hand-drawn text. In the background, a large green pedestal stands, topped with a blue industrial component and a white control panel. The sky is a gradient of orange and yellow, suggesting a sunset or sunrise. The overall style is graphic and expressive.

As components get smarter and more powerful, manufacturers are finding themselves managing high-performance automation and control systems whose parts are capable of monitoring themselves, diagnosing their own problems, and maybe even making a decision or two, economically and easily.

MAKES THE  
IMPOSSIBLE  
**POSSIBLE!**

MORE  
INTEGRATION!

Ubiquitous Sensor  
Networks  
**NOW!**

MORE  
WIRELESS  
LESS  
\$\$\$

INSANELY  
POWERFUL

DOWN  
with  
DUMB!

INCREDIBLY  
USEFUL!

harsh plant floor environments, and that capability, perhaps more than others, has enabled intelligence to move to the device more readily. For intelligence to move to the device level, it must be designed specifically for that environment. Intelligent devices are not the same components found in standard control cabinet electronic products. Manufacturers have asked for these devices, and suppliers have responded, allowing the progression from centralized to device intelligence to occur."

In addition, those initial devices did not have the benefit of the tremendous computing power, memory capacity, or data transmission capability emerging today. Current microprocessor horsepower coupled with low power requirements are what's allowing us to embed more and more decision-level firmware and software into devices, says Ray Rogowski, manager global product marketing, field instrumentation, Honeywell Process Solutions. "Not too many years ago, you had to go back to the DCS to find out what was going on in the field. Now you can package it right up in the sensor."

Initially, microprocessors "went down to the device to improve performance," says Mark Schumacher, president of the Rosemount Pressure Business for Emerson Process Management, "to do things like temperature linearization and compensation. It is that performance improvement and reliability that continue to be the foundation for the growing application of intelligence devices."

Since his company has historically followed a philosophy of centralized control, Graham Harris, president, Beckhoff Automation, argues that multi-core processing puts unprecedented amounts of power on a chip to create an "all-in-one" automation, control, and measurement platform that can do everything from performing machine conditioning and real-time measurement to modifying control algorithms in real time. According to Harris, "Using one powerful CPU, it is more efficient to manage numerous devices in software versus control via distributed CPUs in every measurement and monitoring device. PC- and Ethernet-based tools are



*Intelligent wireless devices analyze and transmit information from remote installations accurately and economically. Source: Emerson Process Management*

similar in approach to the human brain, managing 'control' of our organs and body parts via the nervous system. This kind of approach in automation is what we call 'scientific automation,' an exciting growth area of technology. Within five years, engineers will see it in areas like adaptive control and condition monitoring, and in the development of more intelligent machines overall."

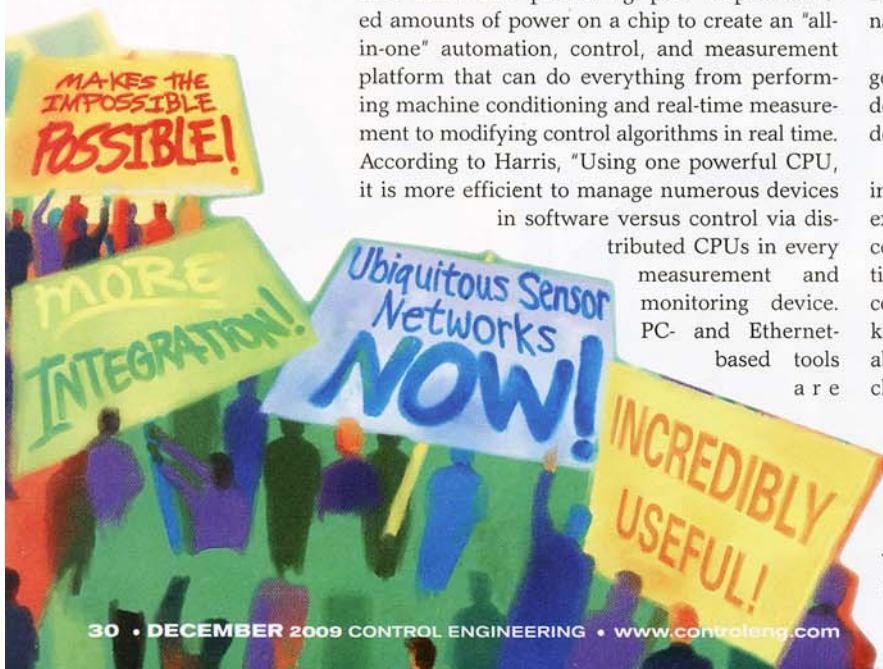
#### Benefits in balance

Intelligent devices reap three primary benefits for automation and control, says Rami Al-Ashqar, motion control product manager, Bosch Rexroth:

1. The controller doesn't have to do everything. Component intelligence frees the controller to do other tasks.
2. Electronic equipment on a machine can be more easily modularized, allowing better maintenance and easier troubleshooting.
3. Flexibility is increased. Distributed intelligence facilitates the easier incorporation of more devices. One controller interfaces with many devices which do the work.

They also can save energy, adds Mintz. "Having intelligence inside motors and drives, for example, gives you closer communications and connections that allow the components to function better together. The more a controller can communicate with a drive, and the more the drive knows what is going on in the motor, the better able an operation is to make those small process changes that make a difference."

Among the more important aspects of incorporating intelligent devices into a system is ease of use. Says Emerson's Schumacher, "Putting more intelligence into field devices unquestionably makes them more complicated. That's why it is critical to keep devices easy to use, a delicate balance and a tough engineering chal-



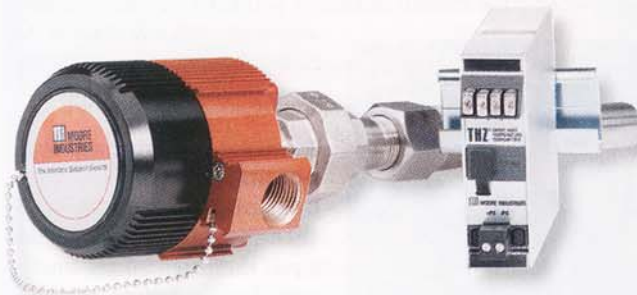


*Components such as Siemens Simocode Pro V current/voltage monitoring modules add intelligence to motor control center applications. Source: Siemens Energy & Automation*

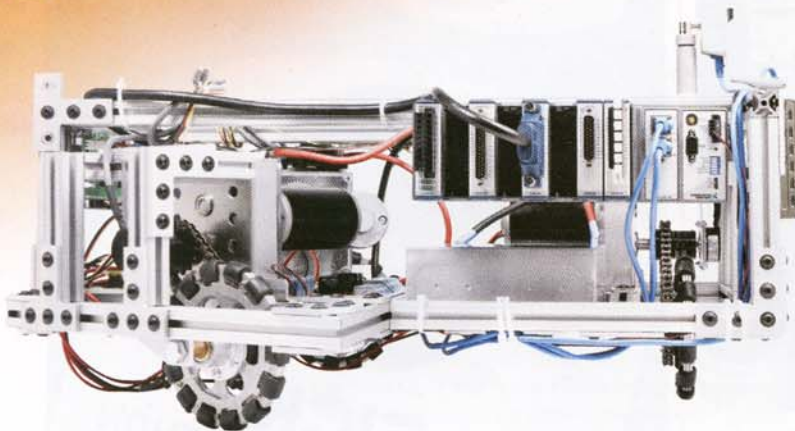
lenge. No information from a device is important if it is not easily accessible. Many plants, today, are staffed by fewer, less experienced workers. On the one hand, vendors must concentrate on building ease of use into their intelligent products. On the other, end-users must be disciplined about what information they really need to know."

Part of the burden, adds Arves Stolpe, CompactRio Product Manager, for National Instruments, falls to software developers to create applications for modern multi-processing systems that are easy to use. "Today's complex systems are extremely powerful, but without the right tools, they are also difficult to program, design, and manage. We need products that don't require a multiprocessor embedded system developer to apply them," he insists. "If we don't do that, industrial and automation engineers will need to be more than control experts, they will need to be embedded experts. And that is really asking a lot."

Building intelligence into devices also has driven diagnostics to the component level. "It reduces maintenance because the machine can be modularized," says Al-Ashqar. "If the electronics and the machine are modularized, it is easier to identify a problem. Error messages can be displayed and problems pinpointed."



*Intelligent components, such as this microprocessor-based temperature transmitter, enhance measurement accuracy and reduce maintenance. Such devices are capable of continually monitoring a sensor, tracking operation, diagnosing failures, and generating error messages. Source: Moore Industries-International Inc.*



*The need for easy-to-use smart devices is critical. To show how easily even non-engineers can learn to develop intelligent systems, National Instruments has launched a robotics competition using Nitro (above). The Nitro control system platform is designed to help students learn to use tools such as NI's LabView and CompactRio to build intelligent robotic devices and solve challenging engineering problems. Source: National Instruments*

First generation smart instruments could fail in unpredictable ways due to undetected software faults, adds Charles Larson, director of technology for Moore Industries-International Inc. "But increased processing power available at low power has allowed devices to perform more extensive diagnostics. Some temperature transmitters can detect and identify broken lead wires and high lead resistance conditions when multi-wire sensor configurations are used. Temperature transmitters that accept dual-sensor inputs allow fallback to single sensor operation when a sensor failure is detected. When coupled with external watchdog hardware, a device that is not operating properly can be guaranteed to generate a fault signal. That kind of reliability allows smart instruments, such as intelligent safety alarm trips, to be used even in safety applications."

Many users today want to embrace device-

*Integrated motor and drive mounted directly on a machine make it easy to configure a system in different ways. Continued integration of intelligent components is expected to increase monitoring and control accuracy even further. Source: Bosch Rexroth*



### **To make the impossible, possible and the possible, easy**

To hear those closest to the topic, the potential for intelligent devices has an exciting, varied, and limitless future. "We see further integration coming," says Mintz. "We've got algorithms that use a sensor on the gearbox and intelligence in the drive to tell you when to do an oil change. We

level intelligence, says Siemens' Woolfolk, but are still thinking in terms of old school capabilities. "Products today are so capable," he says. "The more you let them do for you, the more valuable will be the return. Intelligent components do more than monitor a contact closure. They diagnose a developing problem and let users preemptively head off a fault or a failure that could shut down production."

### **Technology of choice**

What, then, is the ultimate in field device intelligence? Wireless, agree most. It may still be "a giant leap of faith" for many, but comfort with the technology is growing and more applications will emerge as wireless is proven to work. "It will be the easiest, most economical option, which will make it the technology of choice," says Emerson's Schumacher. "The cost of devices is much less than the cost of installing them," adds Honeywell's Rogowski. "If you can eliminate the wiring and still have devices that are reliable, safe, and robust, the savings are huge."

Microprocessor performance and lower power requirements have enabled wireless technologies to expand significantly, says Mark Muldowney, field instruments technology, product architect, Honeywell Process Solutions. "Advances in signal processing let devices not just give data to end users, but to analyze the data and generate information that is actionable—giving users information they need and information they can trust."

The concept of intelligent sensors everywhere—or ubiquitous sensor networks as UCLA researchers call them—could one day become part of our control processes, muses Stolpe, whose company has just released wireless sensor nodes. "The closer the sensor can be to the decision-making process, the higher quality signal possible. And really, control depends on the accuracy of the measurements. If you have an accurate measurement with low noise at the node, you can respond to any input quickly and accurately."

see the next generation integrating functions into single packages: a gearbox with everything inside that you plug into an Ethernet port. It gives many pause for thought."

"The possibilities are incredible," says Al-Ashqar, recalling that few would have predicted 20 years ago the impact of mobile phones. "A remote PLC might one day act as a master controller taking information from multiple plants, communicating it to the right personnel, and perhaps even making decisions or running machines in multiple locations."

The ability to add functions more easily will continue to expand, offers Woolfolk. "Safety functions will become more and more important," he observes, "and are starting to find their way into the intelligent device."

Of course hurdles remain, among them powering intelligent devices and ensuring wireless link reliability. "Ubiquitous sensors will have to be very low power devices that are nonetheless very powerful; and wireless still must solve issues with communicating back to a central host, especially in mission critical applications," says Stolpe, but he believes the challenges will be overcome. "If we can make intelligent products sufficiently

capable and easy to apply, we will allow operations and manufacturing personnel to be successful in what they need to do. We will drive intelligent device technology to the point of being incredibly usable and insanely powerful, making the impossible possible, and the possible easy." **ce**

*Jeanine Katzel is a contributing editor to Control Engineering. Reach her at [jkatzel@sbcglobal.net](mailto:jkatzel@sbcglobal.net)*

**For more information, visit:**

[www.beckhoffautomation.com](http://www.beckhoffautomation.com)

[www.boschrexroth-us.com](http://www.boschrexroth-us.com)

[www.emersonprocess.com](http://www.emersonprocess.com)

[www.honeywell.com](http://www.honeywell.com)

[www.miinet.com](http://www.miinet.com)

[www.ni.com](http://www.ni.com)

[www.sea.siemens.com](http://www.sea.siemens.com)

[www.seweurodrive.com](http://www.seweurodrive.com)



*John Deere saw a 25% savings in energy use on its storage retrieval system just by carefully coordinating movement of the X and Y axes.*

*The action allowed the company to re-use the potential energy stored in the rack locations. (See story on p. 28)*

*Source: SEW Eurodrive*