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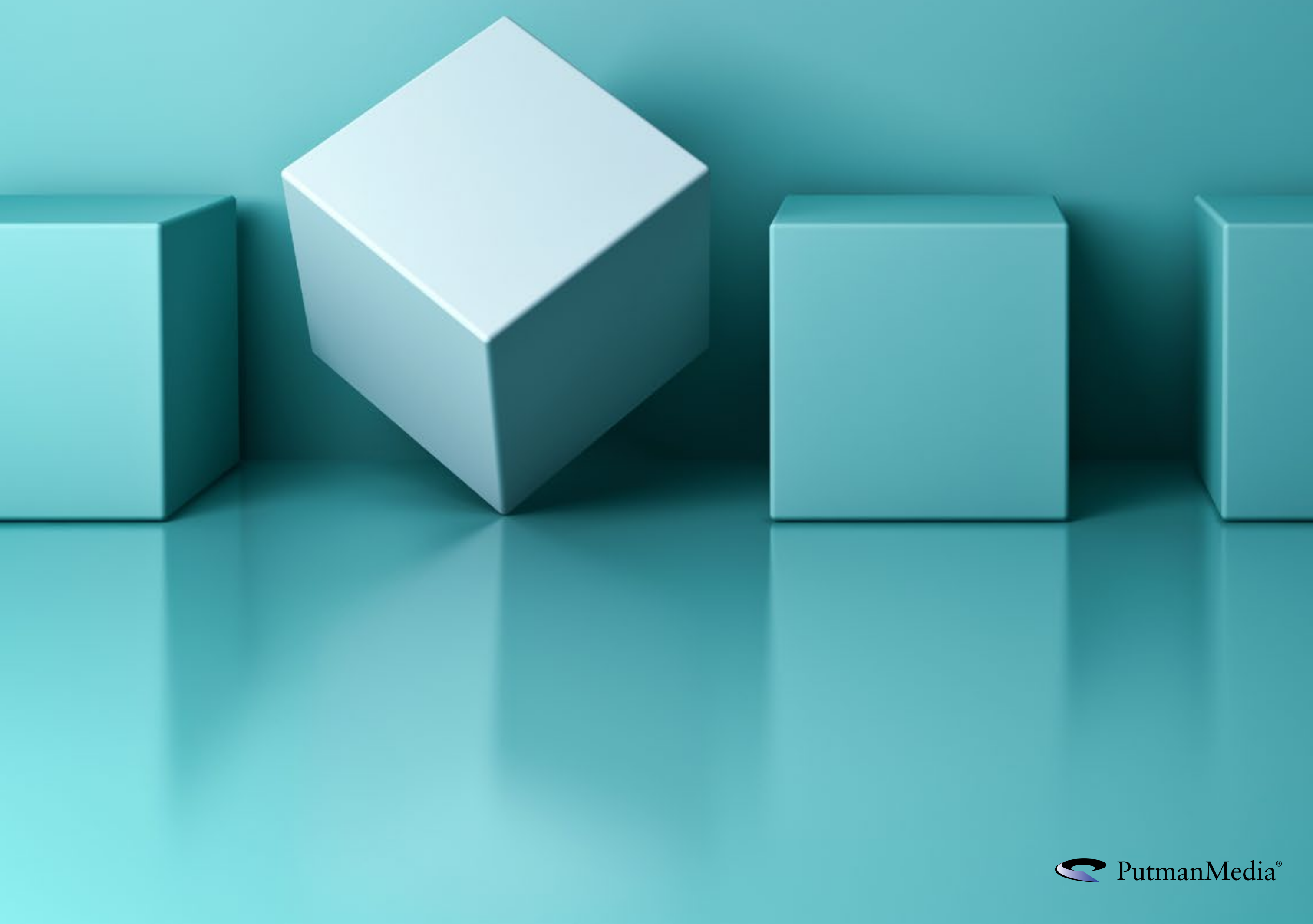

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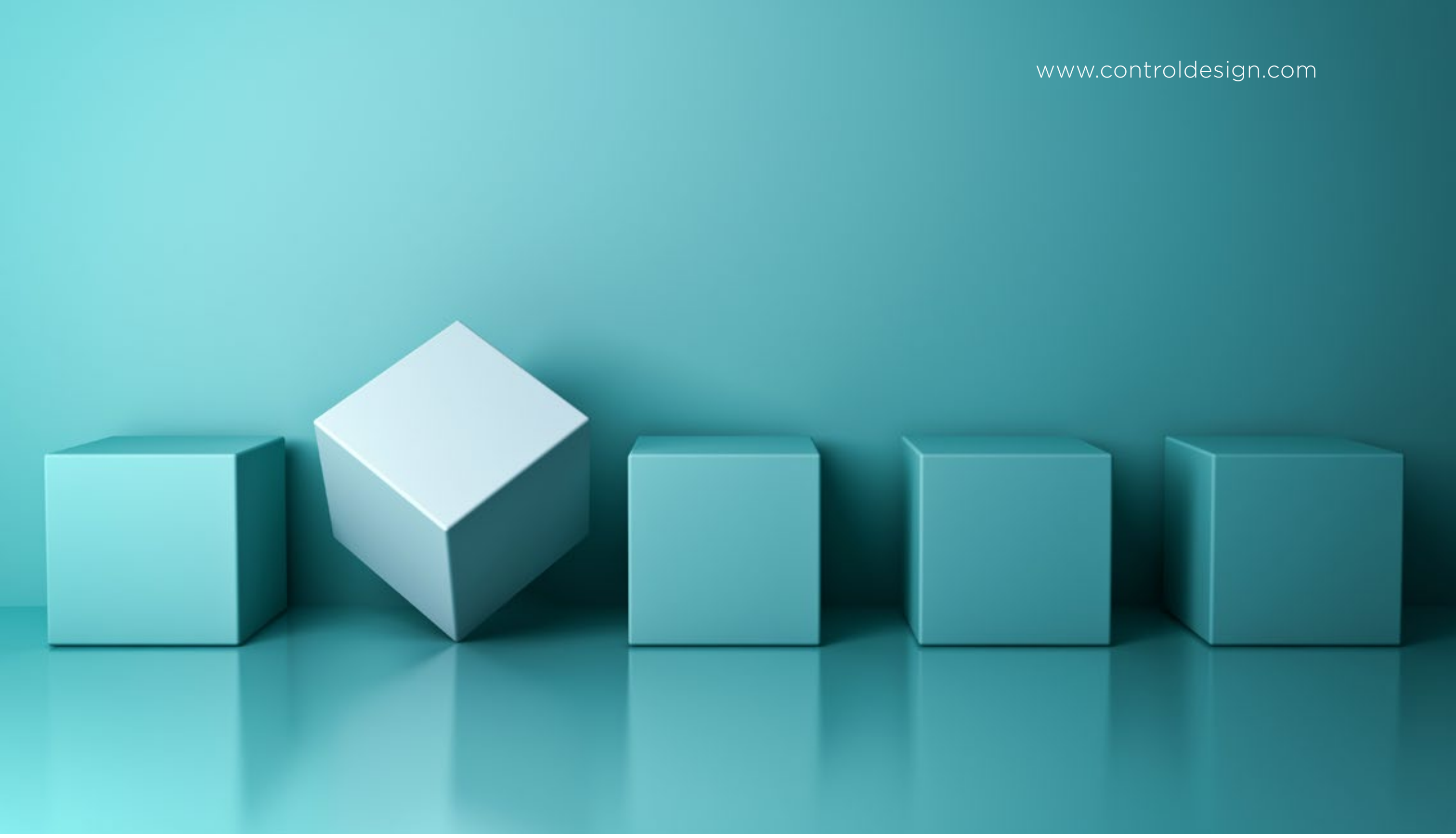

TABLE OF CONTENTS

AD INDEX

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Lubricator Options	» Oil fog	» Oil fog » Micro fog
Filter Options	» General purpose » Coalescing filter	» General purpose » Coalescing filter » Oil vapor removal filter
Filter Drain Options	» Automatic » Semi-Auto » Manual	» Automatic » Manual
Regulator Adjuster Type	» Knob	» Knob » T-handle
Distribution Block	» Standard	» Standard » Pressure sensing block
Pressure Drop Indicator	» Not available	» Available on Filters
Combination Units	» Filter/Regulator - Lubricator	» Shutoff - Filter/Regulator - Lubricator » Filter/Regulator - Lubricator
Customization	» Limited Customization	» Highly Customizable

Breakthrough Engineering

Hey robot, want to go for a stroll?

AMRs will be moving throughout the plant without the need for large engineering and infrastructure investments

By Dave Perkon, technical editor

Robots and automation may grow wheels, legs and arms. It's all part of improving manufacturing. It will be required to remain competitive in many industries. A closer look at autonomous mobile robots (AMRs) and the related standards and design decisions needed to get robots moving throughout the facility shows it may not be as hard as you'd think.

Robots will become more mobile, where needed. There will be new ways they help plant-floor workers, technicians and engineers. And there are some trends in robotics that are simplifying mobile and fixed robots applications alike.

There are a variety of ways to build and control an AMR using a SCARA or articulated-arm robot mounted on an automated guided vehicle (AGV) to improve assembly, tending, logistics, inspecting and packaging applications in manufacturing. "A robotic arm mounted on a mobile platform can have many advantages over a fixed-platform robotic solution," says Matt Wicks, chief robotics solution architect at Honeywell Intelligrated (intelligrated.com) in Mason, Ohio. "These mobile manipulation systems can enable the robot "arm" to roam over a wider area. This can effectively extend the reach of a robotic arm when used in conjunction with the AGV base. Think of the AGV as an extension of the robot arm, just like a person can reach farther when they lunge forward. Coupling these together can be an enabler for some applications such as automated truck unloading. A fixed robotic solution is not an option for

A FUTURE CONVEYOR
Figure 1: Picture this mobile bot delivering materials and tending multiple machines in the factory of the future.
(Source: Kollmorgen)

unloading a 53-foot trailer, but it is possible with a mobile manipulation platform."

Control of a mobile manipulation system will depend on the actions and applications required. "In very simple applications, the AGV and manipulation system can be considered separately," says Wicks. "Just dispatch the AGV to take the articulated-arm robot to the location that it needs to perform a certain action, and, once it has arrived, turn over the control to the articulated arm. The positioning accuracy of the AGV systems vary, so it's likely that computer vision and/or other tooling and docking methods will be required to enable the robot to understand its position and environment."

ROBOTS IN MOTION, A FUTURE CONVEYING METHOD

"Industrial robots with wheels will likely show up in a few years," says Samuel Alexandersson, product marketing manager at Kollmorgen AGV (www.kollmorgen.com). "We are seeing concepts and prototypes shown at tradeshows today. Companies are working through issues around safety such as when, where and how to reach for something. For example, reaching for goods presents moment loads and concerns around center of gravity and tipping. In a lights-out warehouse, only navigation and path/picking optimization were of primary concern. In a smart factory, with people roaming around, safety is the primary concern. We think the warehouse will nevertheless lead the way in this endeavor, as it has in recent mobile robot advancements (Figure 1). Can we envision a factory of the future where a robot can tend multiple machines, even if a few meters apart? Yes. Can we envision a factory of the future with no fixed conveyors? Yes."

Connecting a robot arm to an AGV allows end customers to increase flexibility in their manufacturing processes. “The AGV can move between different work cells depending on demand,” says Alexandersson. “It also allows end customers to go from isolated manufacturing process steps into an interconnected, fully automated factory of the future. Control of the robotic arm and AGV can be done by using one sophisticated controller. A more common solution is to integrate a motion controller for the robotic arm with an AGV controller, where commands and feedback are communicated via an industrial interface.”

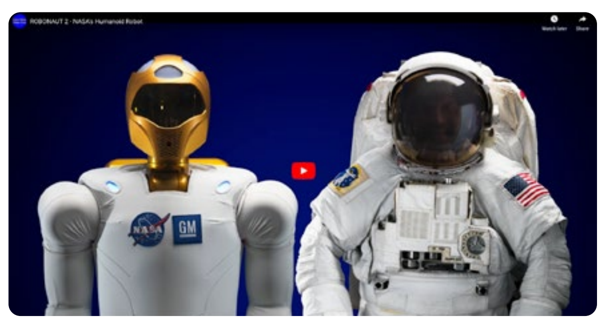
MOBILE ROBOT STANDARDS

“Autonomous mobile robots are the latest innovation that have been transforming traditional robot tasks through increased flexibility and diversified applications,” says Bob Doyle, vice president, marketing, communications & advocacy,

Association for Advancing Automation (A3, www.a3automate.org) in Ann Arbor, Michigan. “AMRs are known for their unique ability to navigate in an uncontrolled environment with a higher level of understanding via sensors, blueprints, artificial intelligence and 3D or 2D vision. Their perception allows these robots to reroute automatically when something is in the way. AMRs are highly innovative compared to a traditional AGV, which is also mobile but uses wires or magnets to navigate a narrowly defined area from Point A to Point B.”

The next step of the AMR is mounting an arm on a mobile base, so that it can start an operation at Point A to manipulate and actually move autonomously to Point B in an operation.

“The future of automation contains a fundamental shift: the reduction of barriers between the robot and its environment,” says Doyle. “Integrators should already be cognizant of the Robotic Industries Association (RIA) R15.06 American National Standard for Industrial Robot Safety Standard, addressing hazards in an industrial environment where the robot is bolted in place with fencing around the hazard zone.”



Now, the industry is full of collaborative robots working in tandem with a person while the barriers are removed, and autonomous mobile robots are adding another layer of complexity to safety considerations, continues Doyle. “The RIA is introducing a new standard to address all aspects related to the safety of people around AMRs: the R15.08 American National Standard for

Industrial Mobile Robots and Robot Systems—Safety Requirements," he says.

The new standard is designed to address these considerations for manufacturers, integrators and end users. The standard describes basic hazards associated with AMRs in an industrial environment, and provides requirements to eliminate or adequately reduce the risks associated with these dangers.

CHALLENGES OF ADDED MOTION

"While simply adding a SCARA or six-axis robot on top of an AGV or AMR can be done pretty easily, many challenges exist once you do so, and there are many important considerations to not gloss over," says Scott Marsic, product manager for Epson Robots (www.epson.com). To look at a few considerations, one must start with power. "Industrial robots are typically plugged in so they can run 24/7. AMRs and AGVs are by their nature remote devices. As such, they are kind of like forklifts and need to be charged periodically or powered remotely."

Once you've solved the power issue, you face the challenge of making the remote device do the tasks you want it to do, continues Marsic. "For example, in a warehouse environment you'll need to be able to easily find your way around to find a part bin," he says. "This requires the mapping of your environment and writing some software to do this. Once I'm there, how do I find a specific part? Vision is required, and this must be integrated into the remote system. Next, how do I grab the parts? Gripper integration is critical here, but, if I am in a warehouse environment with hundreds or thousands of parts, using one generic gripper might be inadequate."

These AMRs will need to do various things. "The bottom line is AGVs and AMRs are exciting growth areas for automation, but it's important to consider in advance the full system," says Marsic. "How do all the components integrate together such that the implementation, control and management of a remote device is both possible and adaptable to environment changes?" he asks. "There will be many considerations, and this is just looking at warehouse environments."

Warehousing end users seemed to be the leaders in AGV type robots, whether they run on the floors or even the ceilings, says Chris Elston, chief robotics manager at YRG (www.yrginc.com) in Fort Wayne, Indiana, a master distributor of Yamaha Robots. "The concept of standard industrial robots as we know them today have been looked at numerous times to make them mobile, but the power requirements continue to challenge machine builders and system integrators," he says. "Most industrial robots require ac power to operate them at faster cycle speeds, so this limits their use on an AGV. Robots that are mounted on AGVs have to be redesigned with lower power requirements or even accept dc electrical power.

TENDING AND MOBILITY
Figure 2: Add a camera and mobility to this Universal Robots' cobot with Robotiq adaptive gripper, and this robot will be tending multiple CNC machines.
(Source: Robotiq)

These are not requests that are being overlooked, just not readily available right now with standard cataloged robots."

Mechanically and electrically, it is important to make sure that the robot arm is compatible with the mobile robot on which it is mounted, says Nicolas Lauzier, vice president of engineering at Robotiq (www.robotiq.com). "There are often combinations offered on the market which can simplify the selection," he says (Figure 2).

The mobile robots are usually programmed by moving them around the factory using a remote control. The onboard sensors then map the factory, and the robot is later able to orient itself autonomously. The scanned map can be adjusted on a PC in order to add restricted zones, virtual obstacles and targets for doing its tasks.

"These mobile robots are usually precise to a few centimeters, which is not enough for most applications," says Lauzier. "One good way to cope with this missing accuracy is to use some tags mounted on the machines or stations, which can be located precisely by a camera mounted on the robot arm. With this approach, it is possible for the mobile robot to move next to the station, stop, have the camera precisely locate the tag and have the robot arm work as precisely as if it has been at this exact position when first programmed."

CONTROL AND POSITIONING

"From my experience the controls have been discrete at this point for the fleet management of the mobility portion and the existing OEM robot control for the arm," says Micah Troxler, mobility product manager at ABB Robotics. "It is typically a PLC interface, and no single controller for both mobility and the arm have been widely established yet. Most of the mobile manipulators currently on the market follow a multi-controller strategy. The manipulator is triggered by a signal (IPC/PLC) from the AGV when the AGV confirms to have reached the designated destination to execute Task XYZ."

Because, typically, the positioning accuracy of the AGV is not sufficient enough, or is too expensive time-wise, for a manipulator to execute its tasks, an integrated vision system is needed, continues Troxler. "Combining all these different control systems, including AGV, safety, robot control, robot vision and optional additional axis and AGV guiding called simultaneous localization and mapping (SLAM), is difficult but likely to be achieved in the future."

Control is only one of several aspects of mobile manipulation. "From a regulatory perspective there is nothing in place, and the industry follows the rule that an AGV must stand still while the mobile manipulator is moved, and the manipulator must be still while the AGV is moving," says Troxler. "Power demand, current peaks, especially of fast and/or heavy manipulators does not fit a classical battery performance and needs to be bypassed, as well. Robot control on a mobile base is both art and science. Before you worry about control, you have to address the power requirements and ensure the combined technologies have a reasonable operational time between charging needs."

Fortunately, much has already developed for the machine builder, integrator and end users of AMRs. "One of the biggest trends in robotics has been advances that make robots easier and less expensive to implement and maintain," says Mark Handelsman, U.S. channel sales manager at ABB Robotics. "Within the past several years collaborative robot solutions have grown from a few early adaptors to a major portion of the robot market. This includes robots designed for collaborative operations such as ABB's YuMi single- and dual-arm robots, as well

A REAL FUTURE ROBOT
Figure 3: ABB's mobile and autonomous YuMi laboratory robot concept will be designed to work alongside medical staff and lab workers.
(Source: ABB)

as scanners and other safety devices that monitor the work area in conjunction with robot safety controls such as ABB's SafeMove2 (Figure 3). This trend both reduces the integration costs and eliminates feeders and indexers by allowing operators to safely work within the robot work envelope."

GETTING A ROBOT IN MOTION

Less is better when adding mobility to a robot. "Last year we introduced what we call our next-generation solution, which is a truly integrated machine controller versus the traditional machine/PLC controller with a separate, stand-alone robot controller," says Craig A. Souser, president/CEO of J.L. Souser & Associates (JLS, www.jlsautomation.com), in York, Pennsylvania. "An integrated machine controller, beyond eliminating a number of pieces of hardware by combining the machine and robot controller into a single controller, eliminates some critical communication requirements as everything is now in one machine, and the system overall is much simpler. The electrical footprint reduction is dramatic. This is a pretty common approach for companies in Europe, but JLS is one of the few to offer this in the United States. We selected B&R as our platform."

MULTIPLE AMRS IN USE

Figure 4: Bosch-Rexroth combines known technology from its articulated arm APAS robots with an AGV and uses it in its manufacturing facilities.

(Source: Bosch-Rexroth)

Others are combining the mobility and robot control, as well. "By taking a holistic approach on the assembly process, we are able to combine these technologies using known technology from the SCARA/articulated arm with the ever-improving guidance of AGV location," says Chris Lupfer, sales manager assembly technology at Bosch Rexroth (www.boschrexroth-us.com). "The result is the ability to provide a complete system that customers can easily build themselves and then use in their assembly operations. At Rexroth, we have done this with our APAS robot mounted on an AGV, and we are using it in Bosch manufacturing facilities (Figure 4)."

Mounting a collaborative robot on an autonomous guided robot (AGR) or AMR platform is straightforward, according to Joe Campbell, senior manager of applications development, Universal Robots (www.universal-robots.com). "Universal Robots' cobots are lightweight and are not power hungry, making them ideal for mobile applications," he says. "New controller configurations allow mounting within the AMR platform, and the collaborative technology ensures safe operation in multiple locations (Figure 5)."

Unlike traditional robots, collaborative are a perfect match for AGV or AMR mounting, continues Campbell. "Control is simple, as

LIGHTWEIGHT, WILL TRAVEL
Figure 5: Universal Robots' cobots are lightweight and are not power hungry, making them ideal for mobile applications.
(Source: Universal Robots)

robot motions and AMR motions would not overlap, and simple communications between the two devices can be established in multiple protocols," he says. "It is also worth noting that this is an extension of a very simple concept that is gaining favor throughout low-volume/high-mix manufacturing: cobot-as-a-tool. Collaborative robots mounted to manually powered carts allow the cobot to be moved from machine to machine, station to station, depending on the production mix for the day."

ROBOTS PLAYING TOGETHER

"Integrators should know the AMR's easy programming and implementation make them even more attractive to end users, and most AMRs are at peak production when combined with another traditional robot system," says Bob Doyle at A3. "Something to keep in mind, however, is understanding AMR companies can go straight to market without an integrator. Providing solutions for using AMRs with traditional systems will give integrators the competitive edge."

Two examples of AMRs in action include the Honeywell General Merchandise Truck Unloader and the Mobile Industrial Robots MiR1000. The Truck Unloader is a flexible piece of machinery that can unload a variety of shapes, sizes or multi-weighted products from a truck container using machine vision and sensors to decide how

Welcoming robots to the plant floor

You have to crawl before you walk. “There are still a lot of end users getting their hands on a robot for the first time, and not yet ready for AGVs or robots with legs,” says Chris Elston at YRG, a master distributor of Yamaha Robots. “Many older manufacturing companies in North America are re-learning automation with many companies who are reshoring production back to the United States after years of manual production overseas. Manufacturing engineers are struggling with choices of which robot to deploy, such as a cobot verses a tradition industrial robot, and in a lot of cases cobots have been misapplied. North American automation, robotics and AGV uses continue to lag, compared to Asian type companies, for example. Exceptions are tech companies or online retailers who are finding faster and better ways to use AGVs and robotics, but a bulk of manufacturing in North America is still that company in Small Town, USA, that has been in business for 50-plus years, combatting finding employees and maintaining the labor workforce.”

HOLD THE MOBILITY

Figure: Often, robot mobility is not needed as this simple Yamaha SCARA can do a lot of work simply and quickly.

(Source: YRG)

Recently, General Plug & Manufacturing from Oberlin, Ohio, looked at automating a plug process. A collaborative robot was looked at first, but the desired cycle rate of 2.5 seconds per piece was too demanding for a cobot, so a traditional SCARA was considered. Three weeks after installing its first Yamaha SCARA robot, a sustained 2.25-second cycle time with a much higher uptime and runtime has been averaging more than 1,600 pieces per hour with automation, versus 1,400 pieces per hour before automation.

“I had instructions to look into automation and was invited to a demo for a collaborative robot from a local distributor and shared findings with the owner about a guided robot vision application,” says Ernie Campbell, sealant manager at General Plug & Manufacturing. “I was quite impressed with the collaborative robots but didn’t see an application for it, so I got into a discussion with the same distributor, which led to Glen Morr, Yamaha application engineer, bringing a sales gurney out and showing us a Yamaha SCARA robot, and the proverbial light bulb went off. After additional research we bought two for our assembly process.”

to best complete the task. The MiR1000 replaces the forklift, designed to withstand a payload of 1,000 kg and equipped with six laser scanners, 3D cameras and an artificial intelligence camera.

"Incorporating cutting-edge technology, AMRs like these can allow companies to reduce the work in manufacturing and make more on-time deliveries," says Doyle. "Hybrid solutions incorporating traditional systems and AMRs working together are optimal. The truck-unloading AMR interfaces with a traditional fixed automated palletizer or conveyance system, leading the product further on its journey with complete automation. The robots enhance each other and increase efficiency and can even maximize floor space, allowing for system integrators to work more machines into solutions; all of this can move product through processing at a faster pace."

It's no longer enough to transport material from Point A to Point B; the most valuable AMRs incorporate a data-driven strategy," continues Doyle. "Traditional fulfillment centers use a person to pull inventory and bring it to a pick-and-pack station, which is done off-line with no understanding of flow-path optimization. Today's AMRs are creating a digital understanding of end-to-end movement. AMRs are building aggregate data across the entire organization to create a common data architecture that understands the movement pattern of materials, how to improve and how to reconfigure and simulate optimizations."

So far, system integrators can look for AMR incorporation in unloading trailers, fleet management in warehouses, conveyor systems, manufacturing work cells, hospitals, aerospace, semiconductors, automotive and logistics.

Next level of operator interface

By Rick Rice

It's 1979. Your machine has suddenly stopped. You walk up to it with a million questions, but the most important one is: "What is wrong?"

Maybe you are lucky, and someone heard a clunk. Perhaps there is physical evidence; one of the widgets is jammed in a clamp station. You might even be fortunate enough to have a machine that has status lights that tell you when there is a motor overload or one of those high-tech machines where the designer has a graphic representation of the machine on a big board with little lights at key locations around the picture to show you where to look for the source of the trouble.

Or imagine that you have none of those features available, and you are faced with a machine that stopped running and no idea where to start looking for problems.

Many might be surprised to learn that, here in 2019, there are still machines and processes out there that still don't have a human-machine interface to aide with the operation. Many vintage machines are still around because they were built to last. In the absence of a means to graphically display the operating conditions of the machine, the owners of these workhorses would resort to hiring and training people with advanced skill sets to compensate for the lack of a window into the function of the machine. The investment in human resources was key to the success of a company.

As machines and processes became more sophisticated, a means to provide better information for the operator or technician became a very important addition to the design of a control system. Cathode Ray Tubes (CRT) had been around for years but the use of the technology didn't reach the mainstream of control systems until the late 80's when several manufacturers brought out devices that combined the display capabilities of a CRT with the input capabilities of a membrane keypad. These early HMI (human-machine interface) or OI (operator interface) used the CRT to display the status of bits and integers in a PLC and the membrane keypad provided a means by which to provide input to the PLC as well as a means to navigate to different screens that were displayed on the CRT.

Much has changed over the ensuing 30 years. The advent of the touch screen eliminated the need for the membrane keypad. CRT's have given way to LCD (liquid crystal display), plasma (small cells containing plasma that are then excited by electrical fields), then LED (light emitting diode) arrays and, most recently OLED (organic light emitting diode) technology. It is the progression of the display technology that has had the largest impact on the use of an operator interface in a control system. Screen resolutions are greatly improved as is the viewing angle and the screen contrast. These improvements have prompted a change in the type of information that is exchanged between the PLC and the operator.

Early HMI's were really nothing more than a mimic board in an electronic format. Pushbuttons and selector switches, status indicators, numerical display and inputs were common elements of these early devices. As the graphic ability of the technology improved, the ability to display elements that looked more like the physical devices greatly enhanced the appearance of the HMI. The representation of objects on an HMI was originally limited to the use of a combination of squares (rectangles), ellipses (circles), creatively placed such that some of the constructs of the object could be hidden by placing objects on top of objects. Later versions could accept imported graphics from programs like Paint and, if properly formatted, these devices could be made to have dynamic properties that allowed for the image (or a portion of it) to change colors to represent the status of the actual devices. An example of this would be an image of a vessel that shows the level of the contents of that vessel.

One of the key features of those early HMI's was the realization that a savings on wiring could be realized by using the HMI instead of physical buttons on an operator panel. This added the ability to not only control the process via the HMI but the HMI could be used to enable/disable functions at a level not reasonably possible with a panel of physical buttons and selector switches. The downside of doing this in a control system is the risk that your system being inoperable if the HMI fails.

Fast forward 30 years to 2019 and we see a significantly different human-machine interface. Screen resolutions in the area of 1280x1024 pixels bring crisp graphics and fast connections to the PLC result in animations of functions that are practically seamless. Package sizes are dramatically smaller, resulting in the ability to put a significantly larger screen in the same cutout as a much smaller version. The bezel on an operator screen used to be as much a 2" outside the size of the screen, mostly in order to support the weight of the screen itself.

Another major advance has been in the area of communications. Early operator interfaces were limited to RS-232 protocol communications with speeds as low as 300 baud (bits per second). Todays' HMI communicate at speeds of 100 million bits per second or greater. Faster speeds means far better responses to the pressing of a button on the screen and the PLC receiving the input from the screen.
Two recent additions to the tool set of an HMI is the ability to run Active-X and PDF content from the user application. The former means that other applications can called from within the operator interface application. The latter has opened up the possibility of including hardware and software manuals on the operator interface and custom documents relative to the machine or process being controlled. The advantage here is that the operator or technician doesn't need to retrieve the manual from an electrical enclosure or maintenance shop library. They can access the manual right on the operator interface itself. This significantly decreases the time needed to access appropriate information in the path to restoring a machine to operation.

Technology is only one of the advances in the human-machine interface. One trend that has, happily, gained traction is the unification of the PLC and HMI programming environment. Most major hardware suppliers have long had the ability to import the tag database from the PLC into the HMI software development application but it formerly involved an intentional action to export the database from the PLC for use in the HMI or an action to point the HMI application at the PLC application in order to upload the tags into the HMI application. The focus on fully integrating the PLC and HMI development applications into a "suite" has resulted in a practically seamless unification of the two applications during development. In this type of cooperation between applications, a tag can now be created in the PLC database from within the HMI development software. Another new feature allows a tag to be identified as an alarm tag in the PLC and it is automatically included in the alarm list on the HMI.

Two other features of new HMI's are high-speed tags and add-on graphics. High speed tags are assigned in the same manner as other HMI tags but are designated as high-speed tags. Think of this in the same was as an immediate input or output in the PLC. Buttons, so defined, are deterministic and auto-diagnosing, allowing for an HMI button to be used for jog functions that would normally involve lag that might make them less than desirable for that purpose. Custom, re-usable add-on graphics are a new feature that has great advantages for development of operator interface applications. The developer can create custom graphic elements and then save them in a library for future use. This pre-built content can significantly reduce the time required to develop a new application.

The next two features are definitely the children of smart phone age. Newer HMI's have built in VNC servers that allow access to the operator station via network with a smart phone or tablet. This tool is a boon to operator and maintenance mechanic alike as a smart phone can be used as a remote control device as one walks around the machine or process. In a further nod to the smart phone, some human-machine interface units now have a navigation button, similar to the "home" button on a smart phone or tablet. Pressing this button brings up a navigation bar on the HMI that can be customized to suit the application. The great advantage of this feature is more of the normal operator screen is available for content with the navigation button used to pop up a graphic with the customized navigation bar.

While today's human-machine interface seems to be nothing like the HMI of yesterday, there are still some things to keep in mind when using this technology. The HMI is a tool, both for the user and the programmer. A tool is only useful if people are going to use it. Aside from the obvious control elements, a good HMI application also serves duty as the primary window into the inner workings of the machine or process. Build on the development of applications and employ continuous improvement on your design. Once the controls are in place, add troubleshooting by including a graphical display of the input and output modules of the PLC. Add screens to display the status and command structures of your VFD and servos. Think about adding popup help to your machine status page. Compare it to how easy it is to use your office copier now that a step by step prompt with pictures follows you through clearing a paper jam.

Finally, if your process or machine doesn't require many changes once set up, consider keeping the main controls as physical buttons to allow for operation in the event of an HMI failure. The same goes for a machine where starts and stops are common. No sense wearing out the touch screen with constant use of the same spot on the screen.

The operator interface of today isn't just a replacement for an operators console any more. Value-added features are coming out with each new product release and it is very important to stay up on the vendor literature as many features make the design process quicker and the result is an elaborate application that enhances the user experience.

The future direction of control

Add vision guidance to delta robots on packaging equipment and combine it with state-of-the-art controller technology for an image of innovation and the future

By Craig Souser, JLS Automation

Over the years, we have reinvented and repurposed JLS Automation as necessary and moved into new markets as we identified trends and opportunities. More than a decade ago, we decided to focus on hygienic packaging solutions for the food industry, including primary and secondary packaging systems. Although we had some food customers, it was an uphill battle because we simply had no brand identity.

As we moved into meat, poultry, dairy, and frozen foods, we discovered these spaces were very skeptical of technology and had almost impossible-to-meet ROI targets. It made selling equipment in these harsh sanitary environments difficult. We tried to focus on applications where we could design it once and build it many times, but it was still a challenge to meet the financial constraints in these markets.

Despite the challenges, we decided to focus on the technology of vision-guided robotics and apply it to high-sanitary machinery. Even today, it is not a highly served space in terms of suppliers. It's a rapidly growing niche, and we worked hard to establish ourselves in this space as a recognized leader.

Most food companies had not heard of us, and it made for some tough sledding. We also had to compete with some large European equipment suppliers that were in the same space and had a strong following. It was difficult getting a foothold.

Located in York, Pennsylvania, JLS Automation (www.jlsautomation.com) was founded by Joseph L. Souser (JLS) in 1955 as a manufacturer's-rep firm, and there have been many big changes since then. There is a lot to that story. Some changes were very deliberate, and some were forced by marketplace conditions, markets we served and customers coming and going. Today, and in the future, technology is making us successful.

HIGH-SANITARY TECHNOLOGY

Virtually 100% of our machines use vision-guided robotics, which is becoming a big thing in high-sanitary machinery (Figure 1). The two elements that put us in somewhat of a unique position is vision guidance plus high-sanitary capabilities. There are folks that make sanitary equipment, but not vision-guided, and there is vision-guided equipment, but not sanitary.

We developed a machine called the Osprey case packer specifically aimed to be adjacent to washdown areas. It's a case packer, but designed to meet environmental requirements and motion requirements based on the somewhat random presentation of a package. It was designed and optimized to be downstream of thermoforming machines but is suited to handle a variety of other products/packages.

With the vision guidance, the machine can handle products and packages that are

TECHNOLOGY IN PACKAGING
Figure 1: The Osprey Robotic Case Packer is space-efficient and designed to integrate with existing packaging systems packing multiple products and packaging styles with quick changeover.
(source: JLS Automation)

not soldered neatly. Products are often slammed onto a conveyor at the output of the thermoformer machine and shoved onto a conveyor where we have to meter them and spread them out on a belt and then pick them, regardless of their orientation, and place them in a case. It's a good application for vision-guided robotics technology.

The use of vision-guided robotics also makes it easy to change the end effector and then pick and case-pack a completely different product, such as a ground beef, sausage or cookie dough chub. Different configurations enable it to function as a tray loader.

SIMPLY STANDARDIZE

Approximately 80-90% of the machine elements are the same, whether the machine is downstream of a thermoformer, chub maker or tray line. It uses standard solutions that can be built quickly and built to stock instead of starting from a clean sheet of paper.

Control cabinets are examples where standardization helps. Even in our large, highly engineered systems, we are still trying to standardize. Even so, our off-the-shelf machines have cost and lead-time constraints that our more custom machines may not. By standardizing on Hoffman enclosures and cabinets, we have a partner that can meet our quality and delivery needs, regardless of the project.

Hoffman is able to meet the demand for high-quality stainless steel solutions in the form of Watershed and Concept enclosures. The ability to customize enclosures to meet unique size and cutout requirements was also a great advantage. They help us from a supply-chain standpoint, manage inventory and lower cost to keep the equipment available and respond to the market without us having to stock cabinets or make design changes.

IN A PINCH AND ON THE FLY
Figure 2: There's no need to stop the box to load it as vision guidance, encoder tracking and a photo eye provide the needed control signals to pack on the fly.
(source: JLS Automation)

We work hard to standardize our designs. For example, although we don't always need them, we use a common build, standard design that integrates motors in the conveyor rollers. The pinch belts that position the cases as they are loaded, regardless of the packages we are going to pick and place, are another common design (Figure 2).

The integrated motor conveyor rollers and round machine frames help with sanitary requirements. The cabinets we buy from Hoffman are sloped top. With sanitation, the devil is in the details. When you open the cabinet, there is a slope on the lip, not a flat surface. Flat, horizontal surfaces are the enemy, and anywhere we can eliminate them we do.

VISION GUIDANCE AND BETTER HANDLING

Many case-packing machines will stop a case or cases in a static location and place packages into one or several cases at one time. With the addition of vision guidance and tracking, the cases don't need to stop. They move slowly through the system on a pinch belt conveyor and are tracked with an encoder and a sensor to detect the leading edge of the box.

The robot uses vision guidance to find the product and adaptively pick it up before packing the case. Changeover is easy as there is no flight conveyor spacing to worry about. There are simply fewer parts and very few changeover parts, typically just the robot end effector, which saves time and money.

The robotics can also be gentler when handling a product. For example, a bakery often makes product that is fragile. With a traditional gantry-style, "bang-bang" case packer, it pattern-forms the packages to build a layer and then loads that into the case using pneumatics and moving products to hard stops. That can and does damage the contents. Using the robot, it is easy to control how aggressively the product is picked, moved and placed.

Fewer control cabinets but better control

We have a lot less equipment and fewer control cabinets, due to our new control system design. Historically, we used ABB robots with Rockwell Automation PLCs, HMIs and variable frequency drives. That has been successful over the years. With our new machines, ABB didn't have everything we needed nor the payload required.

MORE CONTROL CAPABILITY
Figure 3: The new controls platform combines the robot, motion, logic and HMI into one controller, eliminating many parts yet providing more powerful control.
(source: JLS Automation)

With our new generation of machine offerings, we are using Codian Robots and a B&R Automation controls platform that integrates the motion, logic and HMI into one controller (Figure 3). It uses one hardware space and one software space. This configuration has eliminated a huge number of parts including electrical and software interfaces. The result is a more powerful but less complicated control system.

Codian Robotics focuses on providing delta pick-and-place robots. They don't do controls, and they don't build SCARA or six-axis robot arms. They make deltas. They also have a hygienic line. Customers don't like the idea of painted robots or carbon fiber above food products. Codian robots are all stainless with the lower arms titanium-jacketed. It's a much more food-safe, food-friendly robot. A B&R control platform runs it.

Rockwell Automation and B&R have similar capabilities. They both offer logic controllers, HMIs, servo controllers and VFDs, but B&R works well for use from a price, value and performance perspective. With our new generation of controls, we expected customers to accept the change from ABB to Codian with B&R Automation controlling it, but they would still want Rockwell as the PLC and HMI solution. That hasn't been the case as our customers understand the value of this solution. The B&R hardware is controlling everything.

LESS IS MORE CONTROL

For new designs at JLS Automation, we use both Power Panel or Automation PCs from B&R Industrial Automation. It's PLC, motion and visualization all in one device. The B&R solution is a controller you can hold in your hand. It's about 3-by-5 inches and an inch-and-a-half deep that plugs on the back of a touchscreen display and contains the code for the robot motion, PLC control and HMI graphics. It's all together in the same software platform. We also integrate B&R safety technology.

B&R's motion is outstanding, and the safety and HMI capabilities are other reasons they have been so successful, in non-motion-intensive applications.

The controllers we use talk to distributed I/O using Powerlink. It's B&R's go-to Industrial Ethernet solution, and it is very fast and deterministic. I think it competes well with EtherCAT, EtherNet/IP and Profinet.

We use maybe 16 inputs and 16 outputs, and the rest is Industrial Ethernet or fieldbus or it's tightly integrated. There just isn't as much I/O needed. Most of our I/O is safety-related or a few sensors and interfaces to an upstream or downstream machine. The fewer the number of terminations, the better.

The robot is controlled by the B&R controller and includes B&R servo amps and servo motors. The entire control platform is B&R. However, some electrical devices, such as pilot lights, push buttons, circuit breakers and disconnects, are all Rockwell Automation. It keeps Rockwell products on our machines which is important to many of our customers as they keep some of these common elements in their stores.

In the past, we used ABB's PickMaster 3 software product as part of our robot integration for picking and packing integration along with its advanced vision and conveyor tracking capability. Some years ago, we switched over to Cognex In-Sight vision systems and continue to use it today with each camera providing guidance information on up to two robots.

The In-Sight has all the tools that we need, but it is one more thing to integrate. However, at the end of last year, B&R announced it will offer an integrated vision solution. We'll watch and see how well control, motion, HMI and vision integrate into a single controller. It's another level of tighter integration; do it all with just one controller.

WINDOWS NOT REQUIRED

Once we show the customer what we accomplished with our B&R control system, physically and in the software, it's usually an "aha moment" for the customer.

One of the things that swayed our opinion was that B&R does not run Windows. Physically, it runs an Intel chipset and is technically a PC that can run Windows, but you don't have to. They have their own operating system, and we felt that is a big advantage. Many of our historical problems with some of the previous platforms that required a PC to do the motion and vision were the headaches that were PC- and Windows-related, not robot-related. We have worked hard-to-keep Windows out of our equipment, and B&R allowed us to do that.

The technology in the PC-based design provides servo update times that are incredibly fast; scan rates are off the charts; and they have good value. Their price points are lower and they are physically smaller, as well.

MORE CONTROL IN SOFTWARE

We have very strong knowledge of tracking conveyors and encoder information and passing high-speed, important data around efficiently and quickly and adapting that information with vision inspection results. It is our expertise and what we do.

We use B&R Automation Studio 4 for program development, and its built-in libraries help speed programming. We use function-block programming, but we create many of our own control algorithms and function blocks.

Probably the most significant algorithm we created started with some of B&R robotic kinematics motion-path planning. After working with it, the software platform allowed us to create our own custom functions. The canned approach worked, but the system openness allowed us to create an improved machine specific solution. We had a better way to do it that was better for us in the long run.

Although painful to develop, we now own it, and it makes our equipment special. It does what we need it to do without any overhead. There was some pretty intense math by our developers. When he first told me what he was going to do, I told him he was crazy. That's for robot companies, not for us, but he did it and it works great. Our new solution involves almost no actual motion programming; everything is done on the HMI via a series of configuration tools saving significant engineering effort. We are planning on our service department handling some of the simpler applications on the floor, in many cases eliminating the need for engineering to have to set up the recipes.

We had also taken a very big step over the last few years, starting with ABB and PickMaster, but we had all these Windows issues and found it to be a very constrained environment. It was made to do some things very easily, but if you needed do significant customization; you were stuck.

We ended up developing EyeQ Tracker, which is our own conveyor tracking algorithm and approach. With that, we took PickMaster and all associated overhead costs and physical costs, the PC in particular, and got rid of it. It simplified our machines, even before we switched to B&R controls hardware. That has evolved over the years, and we took those algorithms, written in ABB's language, and rewrote them in B&R's programming environment. We have EyeQ Tracker solutions for both ABB and B&R.

BETTER AND MUCH LESS INTEGRATION

On our dual head Osprey machine, we used to install our control panels on top of the machine because they were so large. With the B&R platform, those cabinets are gone. Everything is in the cabinet that is on the machine. We have seen significant interest in the economy of scale in our smaller control enclosure (Figure 4).

LESS IS MORE
Figure 4: The capabilities of the control system eliminated control enclosures, and the remaining one reduced cost, size, number of components and wiring complexity.
(source: JLS Automation)

We also like to show off our wiring, because there is not a lot of it. It's a very simple control system, physically. The previous wiring went to racks of I/O, encoder termination boards, drives, a PLC, robot controllers and an HMI. The integration of the B&R hardware has greatly reduced that. We reduced the cost, size, number of components and wiring complexity while increasing the control capability.

It is also more reliable. There used to be many connections between the PLC and robot controller, and, if a connection comes loose, a technician needs to troubleshoot the problem. We don't have that connection anymore; it's all one controller and the same program. We just have fewer things to fail, which by definition is more success.

The feedback with this next-generation control system has been great. A customer called early this year and said, "Look, I had to call you because I had no idea where my maintenance information is. I never used it and wanted to do some preventive maintenance on the machine, but we never touched it other than to start and stop it. It just runs." We enjoy hearing those comments, and the mechanical design, control system and programming is how we got there.

Leveraging standard designs, reducing control hardware cost and complexity and a tightly integrated control system has led to our success. We are moving into a new facility, with twice the square footage, by doing the right things. The market is ready for technology to help keep the equipment running.

Craig Souser is president of JLS Automation, a provider of robotic based automation solutions for primary and secondary packaging operations in the food industry. Contact him at csouser@jlsautomation.com.