Automation NOTEBOOK®

Your guide to practical products, technologies and applications

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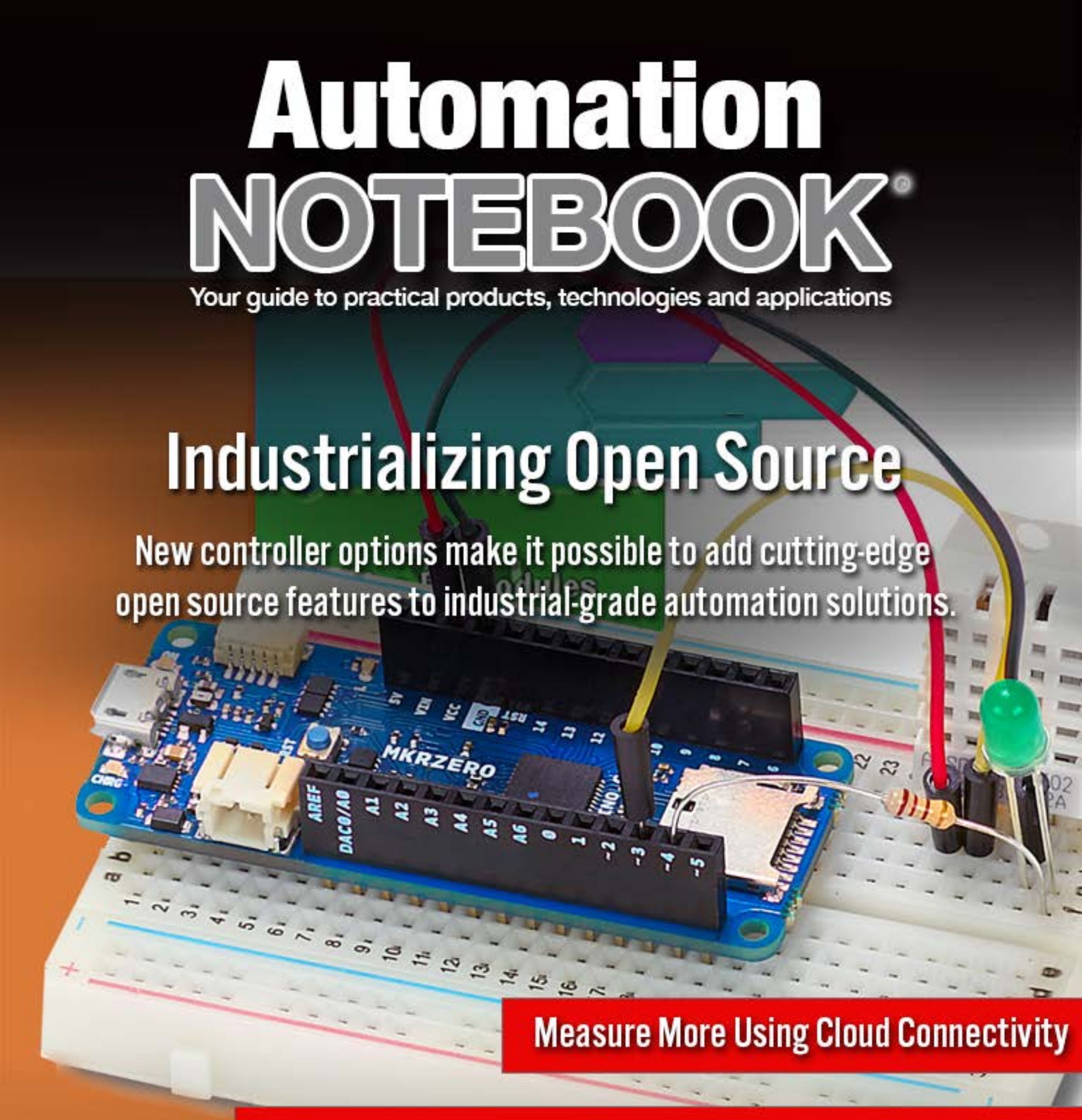

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Building Better Customer Service with PLC-Based Solutions

Industrial Automation with a Mission

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Publisher
Tina Gable

Managing Editor
Joan Welty

Editor
Bill Dehner

Design Manager
Erika Kinney

Contributing Authors
Bill Dehner, Greg Freeman, Robert Boudreaux

Contacts

Automationdirect.com Inc.
3505 Hutchinson Road
Cumming, GA 30040

Phone.....1-800-633-0405
or 1-770-889-2858
Fax.....1-770-889-7876

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For those who prefer to speak with us in person, please call 1-800-633-0405 x1845. Thanks for your interest, and we look forward to hearing from you.

BeanBoozled

So…2021…I'd like to say I'm glad you're here, but as I write this it's the end of March and with everything that has happened in the last year and beginning of this one, I'm not sure what to expect. I feel like I'm playing a game of BeanBoozled®. If you've never played this before, I would warn against it. It's a risky game of chance where you choose and eat different jelly beans. Although the jelly beans all look the same and look delicious, the risk is in the flavor. Is it birthday cake or is it dirty dishwater? Is it chocolate pudding or canned dog food? You won't know until you're a few chews in and the flavor really takes hold. Then it's a race to get it out of your mouth as fast as possible while your kids laugh hysterically. So, with everything that we've experienced in the last year and a few months of this one, I can't really say what 2021 will be. But whether it's coconut or it turns out to be spoiled milk, you can count on us to keep you in the game with great products at great prices.

This issue of NOTEBOOK is loaded with informative articles such as our Tech Thread, which takes a closer look at using cloud portal devices to add IIoT connectivity to existing systems with minimal effort. The Cover Story discusses new controller options that allow open-source control to survive in the industrial world. The User Solutions show how Gulf State Instruments, an industrial calibration provider, used automation to optimize their customers' processes and how the Nehemiah Manufacturing Co. took automation into their own hands with an in-house wastewater treatment system. You'll also find information on our newest products, such as the new line of WEG motor controls, WAGO multi-channel circuit breakers, IronHorse farm duty and open drip-proof motors, and lots more. As always, the Break Room is stocked with fun and challenging brainteasers, so give them a try and see how many puzzles you can solve.

Attabox Enclosures and Accessories

AutomationDirect has added to its offering of Attabox enclosures and accessories from RobRoy. The Heartland series of polycarbonate enclosures from AttaBox is ideal for applications requiring protection from moisture, corrosive environments, UV exposure or extreme temperatures...To read entire article,

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Productivity2000 PLC Analog and Specialty I/O Modules

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WAGO Multi-Channel Electronic Circuit Breakers

New WAGO multi-channel circuit breakers (from $201.00) are available in two, four and eight channels. These electronic circuit breakers monitor load current and reliably recognize overloads and short circuits on an output. Circuit breaker electronics permit brief current peaks and switch longer overloads off...To read entire article,

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WEG Electric Motor Controls

The WEG Electric CWB series of IEC contactors meets the requirements of a wide range of industrial applications. The magnetic contactors are available with AC or DC coils, in ratings up to 60hp at 575V. RW27/67 series thermal overload relays include (1) N.O. and (1) N.C. isolated auxiliary contact, and mount directly to the compatible contactor for compact and reliable installation. RW-E series electronic overload relays protect motors in a wide range of applications by offering selectable trip classes...To read entire article,

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Industrializing Open Source

New controller options make it possible to add cutting-edge open source features to industrial-grade automation solutions.

By Bill Dehner, AutomationDirect

Have you ever noticed that a lot of industrial automation technologies seem to be a frumpy distant relative of the glitzy consumer-grade hardware and software so common in our everyday lives? There are many good reasons for this, but some good news is that industrial tech is closing the gap with consumer tech, and this is creating some significant and even unexpected benefits for end users.

Industrial automation technologies are often portrayed as developing at a slower pace when compared with consumer technologies, and rightfully so. The lag is explained by the fact that only once consumer technologies become proven and accepted in the mass market will they eventually trickle down to be adopted into more conservative and more rugged industrial applications.

Furthermore, because industrial applications need to reliably operate potentially dangerous equipment for years, it is more important for automation products to be carefully crafted and packaged for this purpose. This means other aspects such as ease of use and good connectivity are often secondary considerations.

Over the past 15 years or so, a "maker" culture has gained momentum in the consumer world. This community brings a passion and creativity to using PCs and microcontrollers to operate all sorts of do-it-yourself projects. Most of these developers make these homebrew projects "open source" for anyone to use, but the technologies usually aren't ready for the factory floor.

This article shows how there is now a practical way to combine open source ingenuity, in the form of industrialized microcontrollers, with proven industrial platforms to give end users more automation options.

FROM PLC, TO PAC, AND BEYOND

Just a few decades ago, it was pretty clear what an industrial programmable logic controller (PLC) was, and also what it wasn't. Compact, built for installation on machinery, and connected to monitor sensors and command devices like valves, these devices helped power the third industrial evolution of automation. They often used specialized cables, communication protocols, and languages for these tasks. Even though they were relatively closed platforms, they were very mission specific and effectively tailored for industrial applications.

As technologies like Ethernet, fast/efficient/inexpensive processors, and more reliable PC operating systems became available, both the consumer and industrial markets benefited.

For industry, PLCs became more convenient and economical to use. Some vendors began marketing their most capable PLCs as programmable automation controllers (PACs) as added features made them suitable for a greater number of applications, and greater connectivity made it possible to network more devices.

Today, computing and wireless hardware are so compact and cost-effective that even the smallest field-located sensors and devices have become intelligent, able to communicate with each other and with supervisory systems. These smart devices make up the industrial internet of things (IIoT), and there is a growing amount of processing power located out at the industrial edge.

Controllers, gateways, input/output modules, and smart sensors continue to be built specifically for industrial markets. But defining the capabilities and roles for PLC, PAC, edge, or IIoT devices becomes a little more difficult as they each overlap to some extent.

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Now, as some users look for ways to combine their open source experiences into their industrial projects, new industrialized products incorporating open source are leading to even more options.

Open Source Processing

Open source projects are relevant for industrial applications in many ways. For example, the common Linux open source operating system has played an increasing role in the past few years as it is embedded within IIoT implementations and as a platform for running control and visualization software.

Open source programmers make code snippets and entire programs available to all users, generally at no cost. Many would consider this open nature to introduce an increased risk to those implementing open source code, but greater openness makes code available for anyone to inspect, and the large community of developers can provide a quick response when issues are identified.

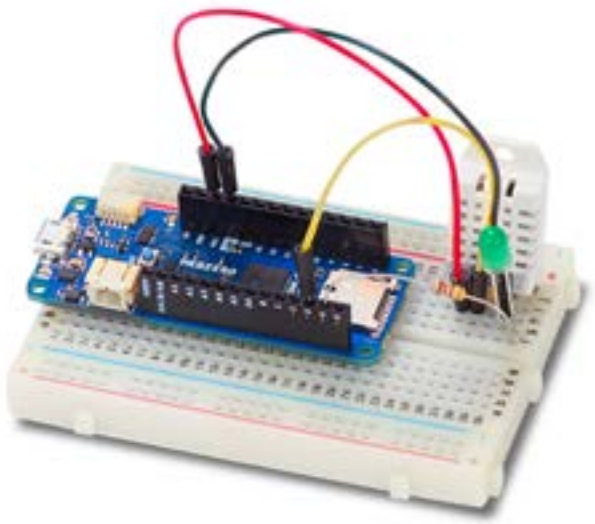

Figure 1: Arduinos and similar microcontrollers are a staple of the maker community, enabling many types of hobby-focused computing and automation projects.

From an open hardware standpoint, the two leading microcontrollers are Raspberry Pi and Arduino. The former is more like a miniaturized single-board PC, while the latter is more bare-bones. A basic consumer-grade Arduino controller can be purchased for around $20. Inexpensive stackable accessory boards called shields add Ethernet, Wi-Fi, GPS, and other extended functionality, making Arduino systems especially suited for prototyping and hobbies (Figure 1).

Microcontrollers like the Arduino were created for students learning to program in C++, and as such are designed to be usable by those with any level of programming experience. An effectively free and extensive software library, many low-cost hardware options, and an end user design focus have made this open source concept a favorite of the maker community.

Microcontrollers are so popular that the industrial automation industry has taken notice, because many of the features desired by hobbyists are also needed for industrial projects. Some end users have even incorporated consumer-grade microcontrollers into industrial applications, but there is some risk involved.

Reducing Open Source Risk

As interesting as microcontrollers are, there are many issues preventing them from being suitable for industrial applications. A few challenges are:

- Unprotected bare circuit board consumer-grade design to remain economical
- Not designed to meet temperature, vibration, and electrical noise conditions present in industrial applications
- Not extensively field tested in typical industrial environments
- Lack of I/O using typical industrial signals
- No agency approvals or industrial certifications

Figure 2: New products, such as AutomationDirect's ProductivityOpen, offer end users a way to combine open source microcontroller functionality within an industrial-grade form factor using proven I/O designs.

Despite these risks, some end users are looking for ways to take advantage of open source benefits, but in a manner robust enough for any kind of commercial or industrial application. A few industrial vendors have worked to combine open source elements with industrial form factors so end

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users can realize the best of both worlds and eliminate or significantly minimize these risks (Figure 2).

Many conventional PLC form factors are already modular with I/O and other modules connecting to a processor. One supplier realized they could industrialize an Arduino controller and configure it to take the place of, or supplement, a traditional PLC controller. To do this, they redesigned a MKRZero microcontroller from the ground up with industrialized parts and assembly methods, and packaged it in a protected form factor compatible with their industrial I/O modules (Figure 3).

The result is an industrialized open source controller that connects with a full suite of field-proven industrial power supplies and I/O modules, so a configuration can be created for use in almost any conceivable general automation application. The manufacturer also makes available both industrially-hardened shields and 3rd party commercial Arduino MKR shields for increased functionality.

Figure 3: Unlike consumer-grade controllers, industrialized controllers like the AutomationDirect ProductivityOpen shown here, are tested in extreme conditions to ensure reliability in the field.

Developers use a software interface maintaining Arduino sketch to program in C++. For enhanced usability, the supplier also created ProductivityBlocks, a drag and drop graphical programming interface (Figure 4) which simplifies the most common programming tasks. From ProductivityBlocks users can use block programming as-is or add blocks of C++ code to access more advanced programming features.

Unexpected Benefits

Figure 3: The addition of AutomationDirect ProductivityBlocks graphical programming software gives end users another accessible way to incorporate open source Arduino microcontroller functionality into their industrial projects.

End users choosing open source for their automation project will certainly benefit from the mashup of contemporary programming options with proven industrial practicalities. There are many ways users can mix-and-match to get just what they need.

Sometimes it will make sense to continue using a PLC-based system, while adding an industrialized open controller networked nearby to perform specialized tasks or calculations. In some cases, users comfortable with the Arduino environment can develop all of the control logic and general-purpose calculations in the open controller, and then automate associated equipment with proven I/O to create a reliable solution.

Another consideration involves design and maintenance personnel skill sets. While existing industrial users have effectively been trained on PLCs through their careers, the next generation of users are more likely to be comfortable with contemporary technologies and programming languages associated with Arduinos and other maker hardware. Because this platform is a way to bridge open controllers with traditional PLCs and I/O, industrial manufactur-

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ers can apply their current skillsets while growing their technical staff with new employees who would prefer to work on modern open source platforms.

Endless Applications

As industrial open source gains momentum, users will continue to find new applications. A basic way to use an open controller, even for those who are new to C++, is to configure it as an inexpensive data logger. OEM equipment manufacturers can use open controllers as an all-in-one solution for operating their machinery, while incorporating more advanced algorithms and data handling than they would with a PLC.

Open source can be a great fit for various semi-industrial applications like environmental controls or laboratory equipment monitoring. More consumer-oriented applications such as automated smoker grills, home automation, and agricultural projects suddenly become viable with industrialized open source platforms.

For instance, a gardening hobbyist might configure a microcontroller to operate the vegetable hothouse and irrigation in their backyard. At work they could use these same concepts to automate much larger scale agricultural systems and equipment. Similarly, someone using a microcontroller in their home to remotely control light and other devices could extend the same concepts to automate lighting and environmental controls at commercial or industrial facility.

Conclusion

The proliferation of consumer-grade microcontrollers might be a tempting automation choice, especially for machine manufacturers, due to the low hardware cost. However, any solution that is unable to withstand an industrial environment will quickly become a drain on support budgets because up to 20% of their operating expenses are typically maintenance related.

Now that PLC and PAC technology has evolved to include industrialized open source hardware options, end users can incorporate the modern automation systems they want using the robust platforms they need.

About the Author

Bill Dehner has spent the majority of his fourteen-year engineering career designing and installing industrial control systems for the Oil and Gas, Power, and Package Handling industries. He holds a bachelor's degree in Electrical Engineering with an associate's in Avionics from the USAF and is currently working for AutomationDirect as a technical marketing engineer.

Go here to learn more about the open-source Productivity®Open

Tech Thread

Measure More Using Cloud Connectivity

Industrial sites commonly operate a significant number of systems and equipment as isolated 'islands of automation'. Remote locations, legacy hardware, and incompatible automation platforms have often made it expensive or unfeasible to tap into the valuable data available from these systems. To read entire article,

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Business Notes

ProductivityOpen Arduino-Compatible Controller Receives Industry Recognition

AutomationDirect's ProductivityOpen controller combines the open-source capabilities of an Arduino-compatible controller with the robust reliability needed for industrial applications. The ProductivityOpen was announced as a Control Engineering 2021 Engineers' Choice Awards Honorable Mention winner in the Machine and Embedded Control – PLCs category. To read entire article,

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User Solutions

Building Better Customer Service with PLC-Based Solutions

The core business at Gulf States Instruments (GSI) began over 20 years ago with technicians applying their experience and proficiency with high-end calibration equipment to help processing customers optimize operations. Over subsequent years, GSI carefully built their maintenance and testing contract business and grew their clientele. A unique part of GSI's success has developed as the team actively looked for additional ways to help their clients. To read entire article,

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User Solutions

Industrial Automation with a Mission

Some companies seek to excel at more than just their core business operations. Nehemiah Manufacturing Co., located in Cincinnati, Ohio, was founded in 2009 with the mission to build brands, create jobs, and change lives. Nehemiah designs, manufactures, markets, and sells brands in a variety of product categories such as detergents, cleaners, and personal care products. Nehemiah works with Procter & Gamble and other companies to license or acquire brands and launch new product concepts. To read entire article,

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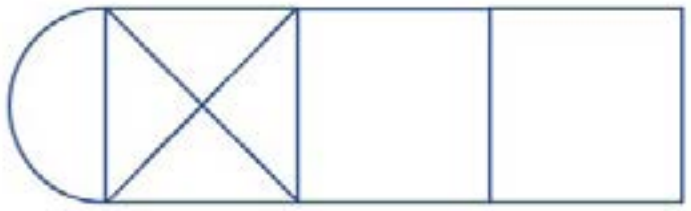
Brain Teasers

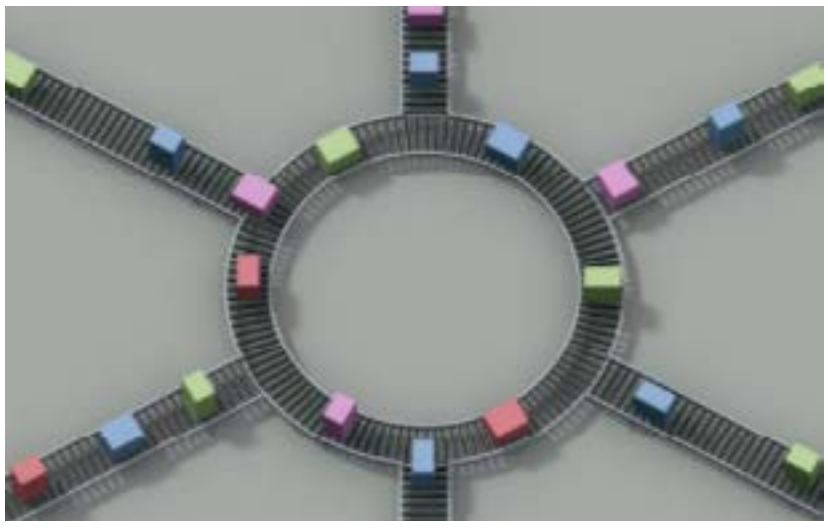
By Chip McDaniel, AutomationDirect

1.) Spastic Gasket



A robotic applicator needs to extrude a gasket in the above shape without stopping the flow of the gasket material – or retracing any of the lines. The robotic arm can start and end the extrusion at any position along the path. Can you find the path that will allow a continuous extrusion for the gasket?

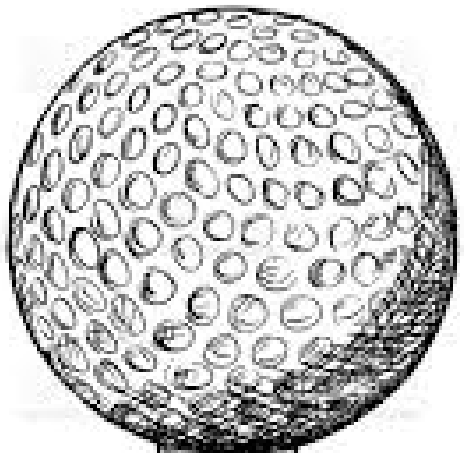
2.) Circular Reasoning



An eccentric factory owner has a large circular conveyor measuring 27 feet in circumference in the center of his factory. She wishes to place 6 sensors in positions around the conveyor such that one sensor or another is at a distance of one, two, three… up to twenty six feet from some other sensor. In other words, she wishes that all the integer value distances from one to twenty-six feet will be measurable between some pair of the sensors. Where should she place the sensors?

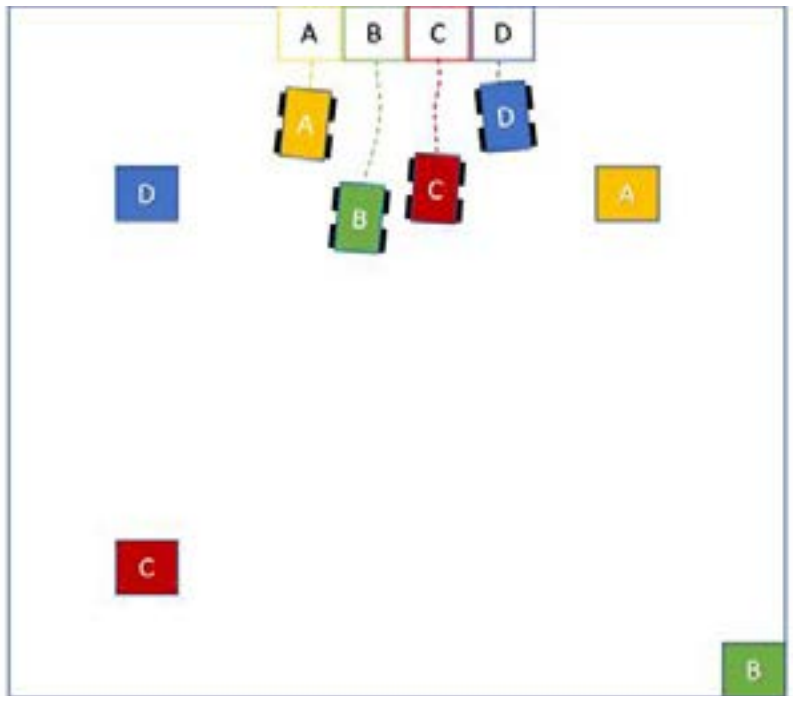
Extra Credit: How much longer could the circular conveyor be, and still allow placement of the 6 sensors with all the integer distances represented (up to the new-circumference-distance less one foot)?

3.) Goofy Golf



A certain nine-hole golf course has the following yardages for each hole: 300, 250, 200, 325, 275, 350, 225, 375, & 400. If a golfer could hit one of exactly two distances on every stroke, so that the ball would go directly toward the hole, pass directly over the hole, or go in the hole – what two distances would be optimal for playing the course with the fewest number if strokes? For example, the two distances of 125 yards and 75 yards would get a golfer around the course with 28 strokes – but this is not the lowest score possible.?

4.) ABCs for AGV



The puzzle factory's four Automated Guided Vehicles (AGVs) all leave their charging stations one morning for their first pickups. A is to pick-up at location A, B at B, and so on. But the owner of the factory has stipulated that none of the AGVs should cross the path of any other, on this first trip. Can you find a path for each AGV that will get it to its destination, without crossing the paths of the other AGVs (or leaving the confines of the factory: the outer border)?

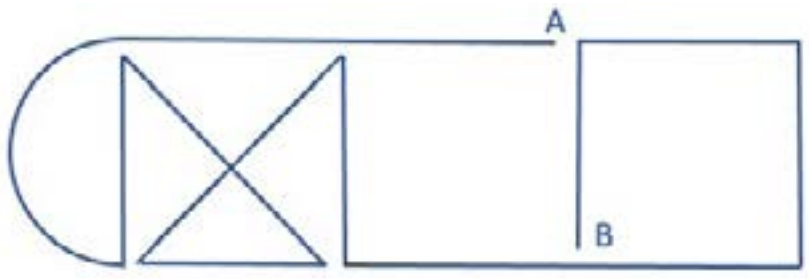
Solutions on next page

Brain Teaser Answers

By Chip McDaniel, AutomationDirect

1.) Spastic Gasket

The applicator can start at point A or B to trace the following (approximated) path in either direction.



2.) The Circular Conveyor

Place one sensor at any point on the conveyor (call that position zero), then place additional sensors at 1, 5, 9, & 12 feet respectively from position zero. The remaining gap from the last sensor back to the first sensor (completing the circle) should be 14 feet.

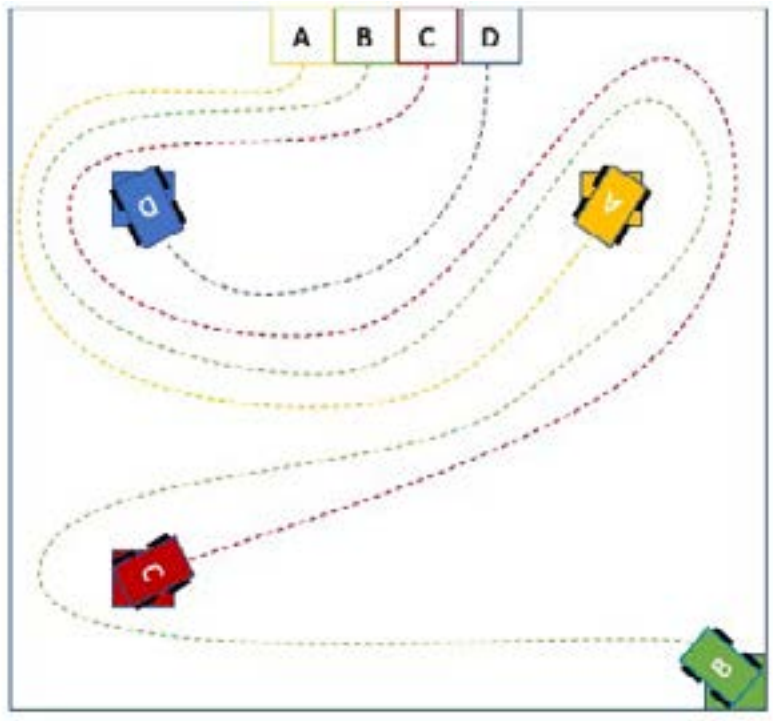
Extra credit: the conveyor can be increased in length to 31 feet, and sensors placed at the 0, 1, 3, 8, 12, & 18 foot marks.

The general solution: for a sensor count of n sensors, the formula n(n-1) will define the number of integer distances possible (with n = 1, 2, 3, 4, 5, 6). So, for 6 sensors, all the integer distances from 1 to 30 are possible on a 31 foot conveyor. [Extra credit reference Michael Goldberg's solution to Problem E1716 in American Mathematical Monthly, September 1965, p. 786.]

3.) Goofy Golf

The two distances of 100 yds and 125 yds will yield a low score of 26 strokes. Let's call the 125 yard stroke the 'drive', and the 100 yard stroke the 'approach'. The first hole is 300 yards, so the golfer uses three approach shots. The second hole simply needs two 'drives'. The third hole; two 'approaches'. The fourth at 325 requires one drive and two approach shots. The fifth is perhaps the trickiest of all; the golfer overshoots the hole with three drives, and then uses one approach shot to get back to the hole The sixth at 350 uses two drives and one approach. Hole seven is one of each distance. The eighth is three approaches, and the ninth is four drives. Thus resulting in a score of 26 strokes.

4.) ABCs for AGVs



All puzzles credited to: Henry Ernest Dudeney (1857 – 1930)