TwinCAT Vision – Machine vision integrated into automation technology

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EtherCAT P: Maximized flexibility through mini-box modules with IP 67 protection rating

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Wassermann Technologie and Becker Engineering: PC Control automates tool magazines
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In automation applications, image processing has traditionally been handled separately and was often outsourced to external system integrators. Meanwhile, PLC programmers have branched out into numerous disciplines, including motion control, safety technology, measurement technology and robotics. It is possible today to combine all of those functions in a single control system on one computer. However, image processing has typically remained in a black box on a separate high-performance computer, with specific configuration tools and programming languages, or it is implemented directly in specially configured smart cameras. The downside to using a separate computer is that even the smallest changes require input from a specialist instead of the PLC programmer, resulting in avoidable costs. In cases where a third-party system integrator is involved, it also means that the expertise remains external. In addition, the communication between image processing and the control system has to be regulated, which is a error-prone process. As a result, an exact timing in image processing could not be ensured. External processes, such as the operating system, can affect the processing time and the transmission time, so the results may not reach the controller in the required time span.

The new TwinCAT Vision software combines both worlds into one integrated system. The configuration, especially of the cameras, is carried out in the same tool as the configuration of fieldbuses and motion axes. For programming, the familiar PLC programming languages can be used. In this way, substantial engineering cost savings can be achieved, since there is no need to learn special
programming languages, and no special configuration tool is required. The challenges of communication between image processing and control are not only eliminated, but image processing and control components can directly communicate with each other, opening up entirely new application possibilities. Everything is integrated into one tool and one runtime environment – this is the core innovation offered by TwinCAT Vision.

Architecture
PC-based automation combines all control functions on a PC platform and it therefore inherently benefits from a Gigabit Ethernet interface. Based on Gigabit Ethernet, GigE Vision is a communication standard that enables reliable and fast transmission of image data from cameras. TwinCAT Vision provides a real-time capable driver for the Ethernet interface, which makes image data available directly in the controller memory. With support for GigE Vision, TwinCAT Vision is also an open system that makes it possible to use cameras from a large number of manufacturers.

The first step after a connection is established usually involves configuration of the camera. Manufacturers of cameras with the GigE Vision interface provide a configuration description in GenApi format. The TwinCAT Vision configuration tool reads the parameters and makes them available to the user in a clearly arranged manner. Configuration changes, such as adjusting the exposure time and setting a region of interest, can be made quickly and easily, and the results can be observed in the live image of the camera.

In addition to the camera configuration tool, TwinCAT Vision provides another tool for geometric camera calibration. This determines the parameters for describing the mapping from image coordinates to real-world coordinates and vice versa. It also makes it possible to relate positions in the images to real-world coordinates and to convert measurement results from pixels into the metric system. In addition to perspective distortions, non-linear distortions of the lens are taken into account, which can be observed in the form of visible deformations in the image.
As part of the camera calibration, one or more images of a suitable calibration pattern are required initially. These images can be acquired directly in the engineering tool, or existing images can be imported. After specifying the calibration pattern, the parameters are calculated automatically. In addition to the standard 2D patterns, such as the chessboard pattern or the symmetrical or asymmetrical circle patterns (see figures on page 8/9), users can also read in their own patterns. These may also be 3D patterns. As an alternative to using the calibration tool, camera calibration can be performed in the PLC.

Image processing in the PLC
The raw images are transferred directly from the camera to the router memory of the PLC via GigE Vision. For this purpose, the camera has to be set into image acquisition state and, depending on the camera configuration, individual images must be triggered. The software function block `FB_VN_GevCameraControl` is available for this procedure.

For very precise trigger timing, the timestamp-based EL2262 output terminal is available in the Beckhoff I/O system, which can be used to send a hardware trigger signal with microsecond accuracy to the camera. Since everything takes place in real-time in a highly accurate temporal context, image acquisition and the positions of an axis, for example, can be synchronized with high precision—a frequently occurring task for PLC programmers.

Many cameras can also send output signals at previously defined events, such as the start of image capture. These signals can be acquired with a digital input terminal from Beckhoff and then used in the PLC for precise synchronization of further processes.

TwinCAT Vision offers a new image processing library in the PLC that contains numerous image processing algorithms. For example, images can be scaled or converted during preprocessing to the desired color space, and certain characteristics can be highlighted or suppressed by means of filter functions.
The image can then be binarized by means of thresholding, followed by contour tracing on the resulting image. The contours found in this way can be filtered based on their characteristics, resulting in a selection of interesting image contours or image regions, which in turn are suitable for object identification and measurement. With a previously calibrated camera, the feature points can also be transformed back into the world coordinate system, so that position and measurement data can be specified accurately in real-world coordinates.

By integrating TwinCAT Vision into the TwinCAT real-time environment, the timing of image processing functions can be monitored via watchdogs, which interrupt the functions after a defined period of time or at a certain point in time from the start of a processing cycle. At the same time, the user is provided with any partial results that may be available at the time. In addition, suitable image processing functions can be automatically allocated to multiple CPU cores for parallel processing by means of so-called job tasks, so that TwinCAT Vision makes optimum use of the multi-core capabilities in TwinCAT 3.

During analysis and visualization of the results, all images can be represented in the form of images and not only in the form of binary data. Before this, it is possible to write and draw results, such as position information, into the images. Exemplary use cases include color-coded marking of the filtered image contours or the good/bad marking of parts. The user is only limited by the image boundaries. The images can be displayed directly in TwinCAT Engineering in the so-called ADS Image Watch or for the end user in TwinCAT HMI.

**PLC and image processing in one universal tool**

TwinCAT Vision combines classic automation technology with image processing, making it especially user-friendly. On the engineering side, camera configuration and geometric camera calibration are carried out directly in TwinCAT Engineering. No other tools are required. Image processing is programmed based on the languages used by PLC programmers, i.e. in IEC 61131-3, which means that no special programming language has to be learned. In addition, it is possible to respond directly to the results of image processing in the PLC, right
away in the next line of code. By triggering the camera from within the real-time environment, image capture and PLC or motion control can be fully synchronized. The image processing algorithms are computed in real-time in TwinCAT, ensuring task-synchronous execution and monitoring in real-time via watchdogs. TwinCAT Vision leverages the multi-core capabilities of TwinCAT 3 to automatically execute algorithms on multiple cores whenever they are available. No special programming by the user is required for this parallelization capability.

TwinCAT Vision is aimed at users who are faced with the challenges and opportunities of having to handle vision tasks within the control system or wanting to do so. Through seamless integration, TwinCAT Vision is easy to operate and program. Naturally, it is also suitable for users who need a high degree of synchronization among image processing, PLC and motion control. Since delays in processing are eliminated and the processing of algorithms is time-monitored, the system is able to respond directly and deterministically.

Classic image processing tasks such as finding and recognizing or measuring parts can be performed easily with TwinCAT Vision. In addition to PLC, motion, robotics and measurement technology, TwinCAT users can now add image processing to the list of integrated functions in the TwinCAT system.

Further information:
www.beckhoff.com/twincat-vision
Reduced cabling time and effort, minimum space requirements, maximum diagnostic possibilities

One Cable Automation (OCA) technology from Beckhoff – achieved as a one cable solution EtherCAT P or a hybrid variant with the ECP and ENP plug connector families in the Beckhoff I/O system – opens up numerous efficiency potentials in machine and plant automation. In this interview Dirk Bechtel, Product Manager Fieldbus Systems, presents the new IP 67 rated I/O modules for OCA and explains the advantages of ultra-compact device designs and extensive diagnostic functions.
What advantages does OCA offer users as an overall concept?

Dirk Bechtel: As the name One Cable Automation indicates, only one cable is needed to supply a complete machine or line with both data and power. This reduces material costs, time and effort for cabling, while minimizing space requirements and error rates during installation. Furthermore, OCA offers ideal conditions for a modularized machine design. Because a plant can only be consistently divided into individual segments if a machine segment, such as a feeding or labeling unit, can be connected simply via one cable with communication, 24 V, 400 V and so on. This in turn has obvious benefits: the flexibility of machines is increased and both installation and commissioning are simplified for the end customer.

For which areas of use are the different one cable variants EtherCAT P, ECP and ENP designed?

Dirk Bechtel: Basically, the idea of EtherCAT P with the M8 connector means that the transmission of communication and power is not only in the same cable, but is also delivered via the same copper cores of a standard Ethernet cable. Due to the small wire cross-section of an AWG22 cable, the transmissible current in this case is limited to 3 A. EtherCAT P is therefore ideally suited to the power supply of compact digital I/O modules or smaller drives. In contrast, the ECP and ENP connector families are available if more power is required, for example if you want to connect complete machine modules. ECP combines the EtherCAT P configuration – in other words, EtherCAT communication and power...
supplied over an internal M8 cable – with additional, larger power conductors in a hybrid cable. The ENP version has a similar structure, but uses EtherCAT communication only. Since all variants can be mixed in a single system, the user can select the most suitable connection method for the task at hand. With EtherCAT P integrated in ECP, for example, the logic of a machine segment can be realized independently of the installation for energy distribution. ENP, on the other hand, is ideal if you want to use EtherCAT as the universal backbone for machine communication. Apart from that, ENP is also better suited to longer transmission distances than EtherCAT P.

What advantages does the ultra-compact design offer the user?

Dirk Bechtel: The small size can be of great importance where installation space is limited. At the same time, it follows the trend towards hardware miniaturization – this is a driving force in all areas of machine automation. Also of importance is the advantage of finer granularity, which means that in addition to the previous design with eight channels, there is now also a smaller 4-channel variant. Moreover, the new housing offers the possibility to refine the scalability still further if the series is extended in the future by modules with even fewer channels or, for example 1- or 2-channel analog box modules. In this way, the decentralized IP 67 I/O system can be adapted even better to on-site requirements of a machine or an individual machine segment.

How important are the topics of diagnostics and condition monitoring, especially from the point of view of One Cable Automation?

Dirk Bechtel: In view of the growing trend toward modularized machines and plants, the topics of diagnostics and condition monitoring are ever more important. In general, it is important in all system installations that the necessary voltage level of, for example, 24 V is present at each device, or in other words, that sufficient power is available. Previously such a verification had barely been possible using simple methods, but using the ultra-compact EPP9022 EtherCAT P Box, it can now be done in a system-integrated and simplified manner.

What diagnostic functions does the EPP9022 EtherCAT P Box offer?

Dirk Bechtel: The EPP9022 is suitable for diagnosing and measuring the voltages $U_s$ and $U_P$ as well as the currents $I_s$ and $I_P$, both temporarily during commissioning and permanently during operation. The voltage range is displayed on the box itself via variously colored LEDs and without the need for an EtherCAT master during the commissioning process. Values recorded during ongoing operation can also be read out as process data in the master. In this way, all requirements for extensive machine diagnostics, fast error detection and precise predictive maintenance of a plant can be met.

And how important is that for practical use?

Dirk Bechtel: First and foremost it’s about reliable system operation. The EPP9022 is an important and valuable tool to ensure this, even starting with the design of a machine. For this purpose, the EPP9022 can be used in the most diverse places in the EtherCAT P system. If it is placed within an EtherCAT P segment, the current flow and resulting current consumption can be measured on the fly at the desired position. When placed at the end of an EtherCAT P segment, the EPP9022 is suitable for ensuring via voltage measurement that there is still sufficient voltage supply at the last device for switching the connected actuators or for operating a sensor. The LED on the EtherCAT P Box visually displays the voltage levels, which is particularly helpful during commissioning. The three levels are displayed in green, yellow and red – with level values such as 20.4 V preset for green according to IEC 61131 and individually adjustable if necessary – clearly visualize the state of the network at a glance.

Also new is the EPP3632 with 2-channel interface for condition monitoring (CM) realized in the conventional full-size housing design. What special features does this EtherCAT P Box offer?

Dirk Bechtel: With only 50% of the volume – that means dimensions of $30 \times 86 \times 20$ mm – the new series is considerably more compact than previous EtherCAT P I/O box modules. The EPP1004 four-channel input box and the flexible EPP2334, with four channels that can be used as inputs or outputs, are designed for the connection of digital sensors. In addition to these, there are two system components. Standard EtherCAT devices can be supplied with power and communication on-site at the machine and integrated into the EtherCAT P system via the EPP9001 EtherCAT P/EtherCAT connector with voltage forwarding. The EPP9022 I/O Box enables detailed current and voltage diagnostics.
Dirk Bechtel: With regard to the functionality, the new EtherCAT P Box corresponds to the proven EL3632 EtherCAT Terminal, so that users can continue to use their existing CM knowledge, while the box module in IP 67 protection rating offers the advantage of installation directly on the machine. As a result, cabling time and efforts are reduced and machine modularization is simplified, and moreover, interference immunity is increased due to shorter sensor cables. The EPP3632 EtherCAT P Box provides a decentralized interface for up to two IEPE sensors with two-wire connection. The input signal is acquired according to the oversampling principle with up to 50 ksamples per channel and second. The EPP3632 can additionally be adapted to application-specific requirements by means of adjustable filters and supply currents.

What distinguishes the new EP9221-0057 and EP9224-0037 infrastructure box modules?

Dirk Bechtel: Both EtherCAT Box modules enable the distribution of a B17-ENP input to one or four EtherCAT P ports as well as the B17-ENP forwarding for cascading of the system. The only difference in the functionality is the number of channels. The overall design is different though, with its flat design and laterally placed B17 and EtherCAT P M8 connections, the single-channel EP9221-0057 version simplifies installation in the field. Both box modules are suitable for implementing diagnostics, because in each EtherCAT P junction the current consumption for the control voltage US and the peripheral voltage UP are monitored so they can be limited and switched off if required. Moreover, the input voltage and current values of the EtherCAT P output can be evaluated via the process data. Using these ENP infrastructure box modules, it is simple to branch from an EtherCAT backbone directly into the EtherCAT P world.

What requirements placed on an OCA system can be solved by this?

Dirk Bechtel: The EtherCAT P Box modules can be supplied with up to 14 A (per US/UP) via the five-pin B17-ENP connector on account of the larger wire cross-section of the ENP cable. This allows the bridging of considerably longer distances than is currently possible with EtherCAT P. Therefore, these new infrastructure components are ideal for control centers that are detached from the actual machine or for main control cabinets, and for the modularization of larger installations. An extensive EtherCAT network can be realized as a backbone so that individual machine segments can simply be supplied via the infrastructure box modules as a junction or star hub by EtherCAT P. The same principle can be applied in the future to suit even higher power requirements or distances to be covered. For instance, further infrastructure box modules could be supplied via a B23- or even a B36-ENP connector and then equipped with B17 or B23 outputs instead of the current EtherCAT M8 output.

This interview was conducted by Stefan Ziegler, Marketing Communications, Beckhoff
EL3783 power monitoring oversampling terminal for high-resolution diagnostics of alternating voltages up to 690 V AC

High-precision grid analysis within the EtherCAT Terminal system

Conventional automation and power measurement technology are increasingly converging. With the integration of the new EL3783 oversampling terminal for power monitoring into standard control systems, high-precision grid analysis becomes available for power-generating systems. Most importantly, 3-phase AC voltage systems up to 690 V can be analyzed simultaneously on six channels and with 20 ksamples/s directly in the PLC.
The EL3783 power monitoring oversampling terminal provides detailed current and voltage values for 3-phase power grids up to 690 V AC, while meeting demanding requirements in wind turbine applications.
Beckhoff, Microsoft and Osram join forces to provide cloud-based Smart Lighting Solutions

Integrated building automation for intelligent lighting solutions

Maximizing productivity with intelligent lighting solutions is the shared goal pursued by Beckhoff, Microsoft and Osram with their jointly developed Smart Lighting Solutions concept. The intelligent lighting solution not only makes a significant contribution to energy savings, it also enhances comfort for occupants. Ronald Heinze, editor-in-chief of Building & Automation, discussed these subjects and others with Georg Schemmann from Beckhoff, Thomas Schneider from Osram and Oliver Niedung from Microsoft.
People who feel comfortable in their workplace are more productive, more motivated and can concentrate better for longer periods of time. Optimized lighting conditions in the workplace have a significant influence on employee well-being and on the quality of work. According to Thomas Schneider, the ideal solution is to maximize employee comfort with Human Centric Lighting (HCL): “Lighting is provided exactly when and where it is needed. One positive side effect constitutes, in part, significant energy savings.” HCL consistently combines the possibilities of modern LED technology, advanced automation technology and the IoT. “An important enabler here is LED technology, which has become more than competitive in terms of both technology and price,” Schneider emphasizes. “On top of that, LED is much more environmentally friendly,” he adds. HCL is a key strategy for Osram, in public building areas in particular. “The planning concept incorporates the advantages of natural light in the room,” Schneider

Georg Schemmann, Business Manager Building Automation at Beckhoff
Thomas Schneider, Lighting Solutions at Osram subsidiary Siteco

Integrated building automation maximizes savings potential

“Automation specialist Beckhoff contributes the control expertise,” Schneider emphasizes. “After being embedded into the smart IoT environment, HCL becomes a holistically integrated part of the building automation platform.” With Smart Lighting Solutions, Osram subsidiary Siteco and Beckhoff, supplier of integrated building automation systems, together offer a solution that provides connectivity via the Microsoft Azure™ cloud platform, making data available for location-independent analysis and ongoing system optimization.

The open PC-based control systems for building automation from Beckhoff fully maximize savings potential. “With integrated automation technology, energy costs can be drastically reduced,” says Georg Schemmann, Business Manager Building Automation at Beckhoff. He points to a user who integrated the technology in large warehouses and achieved savings in the six-digit range of artificial lighting cost savings. “Our Beckhoff control system is at the heart of Smart Lighting Solutions; in most applications, we use the compact, DIN rail-mounted CX9020 Embedded PC,” Schemmann explains. The device controls the lights via Bus Terminals for the second-generation DALI interface. The system also uses Beckhoff power measurement terminals and digital I/O terminals.

The key benefit is that PC Control from Beckhoff not only enables end-to-end automation solutions for all technical building systems, it also offers retrofit options for IoT-enabled products to implement simple and secure cloud connections. Cloud solutions can be used to further optimize systems during operation. The lighting concept benefits from IoT integration in building control systems, fast engineering, centralized and cloud-based energy data analysis, trend mapping and simplified big data handling. “The data acquired by the power measurement terminal is available in the Microsoft Azure™ cloud for system-spanning processing and data analysis, but could also be stored in any other cloud system if the customer so desires,” Schemmann continues.

“The Azure™ IoT Hub service not only makes operational data from the building control system available centrally, it also provides control functions from the cloud via a secure return channel in the other direction,” says Oliver Niedung, IoT specialist at Microsoft. The Azure™ service also offers options for device maintenance and updates. “The visualization of equipment status and data on different devices can be individualized depending on the user’s role. We were able to integrate the visualization for PCs and mobile devices in a very short time by using ‘PowerBI,’ adds Niedung. We also demonstrated the integration of a new B2B wearable running under Windows 10 IoT Core. “Although the wearable has a lower display resolution compared to larger end devices, it offers tremendous mobility benefits, and through the integration of Azure™ cognitive services it can also be voice-controlled for hands-free operation,” Niedung says.

The controller can be directly connected to the cloud via the Beckhoff EK9160 IoT Bus Coupler, which can be used with standardized cloud protocols such as MQTT, AMQP or OPC UA. HCL uses OPC UA communication technology, which is an internationally recognized interoperability standard for Industrie 4.0 implementations. The TC3 IoT Communicator App from Beckhoff provides direct mobile access to the TwinCAT control software platform. TwinCAT Analytics, a complementary IoT product within the TwinCAT software suite, enables complete, cycle-synchronous data acquisition as a basis for predictive maintenance and trend analyses. Lighting can also be controlled using process data from the cloud, which simplifies efficient energy management.

Access lighting system status from anywhere

The automation of buildings and real estate is usually not possible without access to remote diagnostics, remote maintenance and remote control. Swift support from specialists is essential for troubleshooting, software maintenance and installation of updates in order to avoid unnecessary costs caused by system failures. Information on process variables, along with warning and error messages, is also helpful in the ongoing operation and optimization of building systems. All this information can be made readily available by cloud services.

Azure™ is a cloud offering from Microsoft that is trusted to deliver the highest levels of data security and privacy. It was developed with the goal to empower such IoT scenarios as Smart Lighting Solutions. The remote connectivity functions enable users to monitor the status of systems and devices, while predictive maintenance can anticipate the need for service to avoid unplanned downtime.

Smart Lighting Solutions can monitor the status of an entire lighting system, or even an individual light, in real-time from anywhere in the world. Information on energy consumption, service life and maintenance requirements is available at any time. There are virtually no limits as to how the data on energy consumption, switch-on times, frequency of use and service life can be analyzed. “Such topics as predictive maintenance, consumption data acquisition and optimization are
processed by the cloud solution – from individual systems to installations that are widely distributed across different locations,” explains Georg Schemmann.

The user employs a dashboard tailored exactly to their requirements to retrieve the information needed. It can be operated conventionally using the screen or even via Microsoft HoloLens. “The data can be accessed in the future from a remote location with these augmented reality glasses in the simulation phase and in operation. Only when service is required does a technician have to be on-site,” Schemmann says. The advantage of the cloud solution is that operational processes are centrally monitored and controlled. “The energy efficiency of a building can be continuously monitored, visualized and optimized,” Schemmann continues. “Another positive aspect is that a report, which can be used for DIN ISO 50001 compliance, can also be easily generated using the existing data.”

Joint projects of all sizes
Partners Beckhoff and Osram/Siteco are working together on projects of many different sizes. The spectrum of applications ranges from sports facilities to mega-logistics companies, from the reception desk at Lufthansa to large industrial projects. “The combination of the efficient lighting concept and the powerful control and communication solution has proven itself many times over,” emphasizes Georg Schemmann.

Several projects have already been installed with clearly measurable success. “The amount of money that can be saved with efficient lighting control, which is small at first, can quickly add up,” says Thomas Schneider, pointing out benefits for operators. “In a warehouse with several thousand lights, however, this pays off very quickly,” he continues, quoting an example of a “follow me” solution in which “the light follows a moving forklift as required and energy is consumed only in the area of traffic or activity.”

What’s more, in this application case, the total lighting of previously 22 kW of fluorescent tubes was reduced to 11 kW of LED light output, which could be cut to below 2 kW with the “follow me” technology – resulting in energy savings of more than 90%. “Not only do we reduce the maintenance costs of lamps and lighting systems, the needs-oriented control of lighting depending on user presence also saves a huge amount of energy,” says Schneider. “Each project is customer-specific and is developed together with the customer according to their individual needs.” With the advance of Industrie 4.0, so-called DTSs (driver-less transport systems) are an essential component of automated warehouses and production facilities. “If such systems are used, the light can follow the transporter by means of ‘follow me’ technology and thus only use energy where it is needed,” he points out and goes on to describe the paradigm shift: “To bring these concepts into reality, our lighting solutions are increasingly dominated by intelligent software.”

Of course, what the customer wants and needs are the top priorities. “In a data center, however, where each individual server consumes a great deal of energy, the money that can potentially be saved with the lighting system might play a more secondary role. Nevertheless, it is also important to seek contact with these customers as well, because lighting is still an aspect of a holistically integrated point of view,” says Schneider. “To this end, we provide these customers additional services such as energy metering and the corresponding analyses.”

Another project involved the automation of lighting as well as ventilation and air conditioning. “In the past, the entire building was always completely air-conditioned – something that was not necessary because there were only a few people in certain areas of the building at any given time,” explains Georg Schemmann. “The data from the lighting control system were used to determine where the people in the building were, to control HVAC systems accordingly and save energy.” This is also a good example of how to take advantage of the benefits of integrated building automation.

“New ideas for building automation are developed together with the customer,” continues Schemmann. “There is seldom a solution for only one building system. More advantages arise from a cross-system, holistically integrated approach.” According to Schemmann, the partnership between lighting expert Osram, cloud solutions provider Microsoft and automation specialist Beckhoff significantly improves market opportunities all around: “Together, we are able to successfully capitalize on savings potentials for projects large and small,” he concludes.

In a nutshell
The three partners Osram, Beckhoff and Microsoft have joined forces to create Smart Lighting Solutions in order to provide fast, affordable systems based on standards. Osram lamps save energy, ensure user comfort for productive employees and deliver all essential data for predictive maintenance efforts. Beckhoff components are highly robust, flexible, and enable fast integration and efficient system expansion even in the context of cloud scenarios. In addition, Microsoft Azure™ dramatically simplifies the visualization of key figures and the implementation of predictive analysis.

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Highly compact and flexible tool handling solution

The tool terminal developed by Wassermann Technologie in collaboration with system integrator Becker Engineering is characterized by an exceptionally compact design and high flexibility. This is largely due to the open and modular control technology from Beckhoff, with which machine tools can be seamlessly connected to the most diverse control systems available.
The increasing demands placed on cutting technology and the associated requirements for higher flexibility and productivity are leading to an increase in the need for more advanced machine tools. Eberhard Hahl, managing director of Wassermann Technologie GmbH in Eichenzell near Fulda in Germany, explains: "The innovative tool terminal was designed in accordance with these current customer needs. Only the diameters of the tools and tool drums are predefined, while all parameters such as tool lengths, length divisions, number of tools, tool cleaning, tool holders and RFID tool data acquisition are freely configurable. The salient feature is an extremely compact design. It is achieved by having the tool drums run inside one another around one axis instead of side-by-side."

This tool terminal from Wassermann integrates up to three concentric drums and is therefore extremely compact.
Christoph Neuhaus, application software developer at Becker Engineering GmbH in Leichlingen, Germany, adds, “Higher flexibility also means the option to integrate the widest variety of machine tools with the most diverse control platforms. The openness of PC-based control is crucial for this capability. For instance, third-party software can also run on the Beckhoff control hardware, which among other things facilitates access to the tool tables for the individual machine.”

Flexible in structure and use
The concentrically structured tool terminal consists of one, or the addition of up to two more drums running inside one another, depending on application requirements. The tools are handled by a linear unit with an integrated tool changer. The latter places the tools in the drums and also takes them to a tool buffer or directly to a tool changer on the machine. “The tool terminal offers tool management for up to 9,000 tools and is suitable for use as a direct magazine and tool store for tool management, and alternatively as an extension of existing tool magazines or as a central supply magazine for several machine tools,” Eberhard Hahl points out. Julian Becker, application software developer at Becker Engineering, describes the key benefits of the terminal as an intelligent auxiliary magazine. “The tool terminal can operate completely autonomously. For that purpose it has its own tool management, database and sequential control system as well as its own interface to the machine tool. In addition, there is software in the tool magazine itself for external auxiliary handling, interfaces to peripheral devices and integrated data acquisition for the tooling,” Becker says.

The high flexibility of the tool terminal means that the end customer benefits from significant cost savings, as Hahl explains. “In the tool terminal we have designed a standard magazine with a wide range of uses, and that is reflected in its excellent price-to-performance ratio. However, an individual connection to a machine tool, for example, can be realized entirely according to customer specifications if desired. The tool terminal is available as standard in two model variants: S-Curve for up to 280 tools and D-Curve for a maximum of 570 tools,” he says.

Open, scalable and efficient control technology
Becker Engineering has been gaining experience with PC-based control since 2014. According to Christoph Neuhaus, numerous benefits have been achieved: “We benefit from the fact that PLC and additional high-level language applications can be realized on one universal multitasking platform. Another
advantage is high scalability. Should performance requirements increase, the system enables the uncomplicated migration of a control project to more powerful hardware, such as a device equipped with a multi-core processor, for example.” Wilm Schadach from the Beckhoff sales office in Monheim, Germany, adds, “PC-based control offers complete continuity from the point of view of engineering and design, too. This means that the tool database can run on the same platform as the PLC, motion control and visualization applications. That has proven to be a major advantage in the overall system architecture.” Not only that, getting familiar with PC-based control technology from Beckhoff was very simple, according to Becker: “Support of common, standardized programming languages simplified the programming significantly.”

Becker Engineering has also benefitted from the wide range of data communication options via TwinCAT ADS. Neuhaus said, “ADS provides easy access to PLC data from a high-level language application. On the other hand, it is also easily possible to develop an ADS server in a high-level language that you can access conveniently from the PLC. In this way, reliable transmission of data between the tool magazine and a machine tool can be achieved with little effort, for example, to exchange job numbers or previously evaluated usage data. Also, in the case of future developments, necessary updates can be loaded quickly and conveniently. Industrie 4.0 solutions can also be realized with the client/server architecture available via the ADS communication.”

For Christoph Neuhaus, other important aspects of PC-based control are the availability of the current Windows operating systems, the user-friendly software update policy, and the simulation options available without additional license or hardware requirements. “The complete system can be simulated on your own development PC. This means, for example, that you can convert the motion axes to simulation axes or map the I/O behavior similar to that with hardware using software simulation blocks,” he concludes.

Convenient and efficient motion control
In a recently implemented tool terminal with two drums, a total of five servo axes are used for fast and precise tool handling. The associated AX5000 Servo Drives and AM8000 servomotors are controlled by a CX2030 Embedded PC with TwinCAT NC PTP. In addition, one rotational axis is provided for each of the two tool drums as well as a vertical axis for reaching the desired drum level, a horizontal axis for reaching into the level and a rotational axis for a double gripper. The pneumatic control for the double gripper is an additional automation task. Eberhard Hahl adds: ”The tools are transferred from the drum to the outside via the gripper rotation axis. This can also be implemented as a telescopic axis in order to transfer the tool directly to a magazine on the machine without intermediate handling.”

The motion control application was implemented in TwinCAT software with the aid of PLCopen motion blocks, which Christoph Neuhaus says has proven itself in practice: “The programming of the motion functions with the associated function blocks was very simple and extremely time-saving. Another advantage of the Beckhoff Drive Technology is the One Cable Technology (OCT). It dramatically reduces assembly and material costs and allows the use of smaller cable carrier chains, facilitating more compact designs. Apart from that, the electronic name plate considerably accelerates startup procedures.”
Commercial meat freezers: Easy implementation of sophisticated controls

Tekloth GmbH in Bocholt, Germany, has designed an innovative compound CO₂ refrigeration system that operates without the cumbersome intermediate defrosting stage as required by other commercial meat freezing systems currently available on the market. PC-based control technology made it easy and convenient to implement the expertise required for the special configuration and control functions of the system despite the high degree of complexity involved in the application.
Tekloth, a specialist for technical building systems, used PC-based technology to develop the complete control system for a compound CO₂ refrigeration system as supplied by Fischer Kälte-Klima in Essen, Germany. The installation is used as a cooling unit for a deep freezer for smoked and cured pork. After the meat has been smoked, it is shock-frozen at a temperature of -18 °C (0 °F) or colder. Because the meat is still warm (30 to 40 °C) when it enters the system, a large amount of moisture is introduced into the process, which collects on the evaporator and is then frozen. As a result, conventional systems must be defrosted in regular intervals.

Since defrosting requires a lot of energy, Tekloth completely redesigned the compound refrigeration system to be more efficient. Marco Möllenbeck, who works in planning, development and sales at Tekloth, explains: “Due to a special system design and corresponding control functions, our solution does not require regular defrosting like conventional installations. What makes it special is a switching valve that allows changeover from regular cooling (RC) to deep-freeze (DF) operation. Since traditional installations would require two separate systems for this, our design delivers clear benefits in terms of lower investment costs as well as reduced power consumption.”

Two operating modes combined in a single system

With the switching valve, the system can be operated for regular cooling in the so-called transcritical range or as a booster with DF and RC compressors in the transcritical range. This kind of switchover function requires many control processes that standard systems cannot support. Christoph Holtschlag, who works in planning and software development at Tekloth, explains: “By switching operating modes, the system initially cools and dehumidifies at an evaporation temperature of approximately -6 °C (21 °F). The elevated RC evaporation temperature keeps frost on the evaporator to a minimum. When the room temperature reaches 4 °C (39 °F), the system switches to the RC-DF booster mode.”

During this process, the RC mode initially stops, and a circulation defrosting mode starts. The RC mode provides energy-optimized cooling in the regular cooling temperature range while dehumidifying most of the product surface – all with minimal freezing of the heat exchanger in the evaporator. After the circulation defrosting stage and switching to RC-DF booster mode, the chamber and the product are cooled to -18 °C (0 °F). Depending on the product quantity and the time it stays in the chamber after the target temperature has been reached, the need for intermediate defrosting may be completely eliminated, according to Holtschlag.

PC-based control as an open and flexible control platform

Stefan Bollmann, who works in project planning and sales at Tekloth, believes there are many good reasons for implementing the complex sequence control with PC-based control technology: “We benefit from the ability of Beckhoff control technology to meet industrial requirements in all our projects. In addition, the systems’ modular structure and open programming environment make them very flexible and enable an exceptional degree of innovation. As a result, we were able to program the sophisticated controls for this compound refrigeration system ourselves, which allowed us to maintain total control of the...
The advantages of PC-based control are also apparent in the custom-configurable modular I/O system.

Another benefit is the consistent use of PC-based control technology across platforms as Christoph Holtschlag explains: "Whether we build heating, cooling, ventilation or building automation systems with individual or centralized controls, we can implement all open-loop and closed-loop control requirements with Beckhoff hardware and software. This kind of universal applicability allows us to employ our software modules in all areas. The system’s openness and its support for a wide range of bus systems used in buildings is another contributing factor." There are also financial benefits, he adds: "Common control systems for HVAC systems are fairly complex and demanding. The Beckhoff platform offers everything we need to keep our processes in-house, implement them efficiently, and deliver added value to the customer compared to standard offerings on the market. This absolutely applies to the compound refrigeration system, because no standard refrigeration controller provides this switching capability from regular cooling to deep-freeze mode."

**Optimized closed-loop process control**

A Beckhoff CP2716 multi-touch Panel PC with a 15.6-inch screen serves as the operator interface hardware for automation, data recording and visualization tasks. The modular I/O system is custom-configured with digital and analog Bus Terminals that collect data from all sensors and actuators as well as control-relevant values. The control system integrates components such as PT1000 sensors, high-, medium- and low-pressure sensors, temperature sensors and CO2 sensors. It also handles operation feedback from the various units as well as target and actual values and closed-loop control values.

The system acquires over 150 data points, with value changes in one-minute intervals, to provide a complete image of the process status. If a malfunction occurs, data changes are registered in one-second intervals and can be buffered at this high resolution for up to one hour. As a result, says Holtschlag, the process is under total control. "The flexible and easy-to-use implementation with PC-based control was critical to ensure our ability to accumulate the necessary knowledge in-house and advance our refrigeration technology. We conducted a lot of electrical and software engineering to reflect the refrigeration process in our control technology and map it with many new features compared to standard refrigeration systems. Making this possible were the many additional features available with PC-based control technology, such as graphical user interfaces, data trend mapping, fault signal logs, and email notifications. Features like these enable us to implement individual customer requirements in the best possible manner," Holtschlag sums up.

The system layout represented on the Beckhoff CP2716 15.6-inch multi-touch Panel PC illustrates the high complexity of the application.
TwinCAT IoT helps optimize smart vehicle repairs

Beckhoff has developed the perfect addition to its proven TwinCAT 3 engineering and control software with TwinCAT IoT. As a basic technology for the fast and efficient implementation of applications in the context of Industrie 4.0 and the Internet of Things (IoT), TwinCAT IoT helps users implement a wide range of solutions in different industry segments. As one of the most recent examples, the Danish company Carheal uses TwinCAT IoT in its vehicle spray booths for paint work.

With its Smart Repair spray booths, Carheal has delivered a turnkey solution with which car repair workshops can swiftly repair minor damage to the paintwork of cars. The complete body panel is not repainted in the conventional manner, only the immediate damaged area. The advantage for the customer is that they can collect their car from the workshop on the same day they drop it off. Henrik Bro Christensen, Carheal’s founder and managing director, wants not only to set a new standard in repair quality and duration with his spray booths, but also to meet the highest environmental protection requirements. Christensen consistently pursues Industrie 4.0 concepts by connecting the spray booths to a cloud system. Apart from state-of-the-art automation, Christensen aims above all with the booth concept to create scalable solutions that can be used all over the world in order to offer intelligent B2B services. To do this, Christensen makes use of IoT technology from Beckhoff. The special feature of the Smart Repair spray booths is their innovative filter system, which creates no impact on the environment. The air from the interior of the booth is not transported to the outside; instead, it is cleansed completely of solvent residues and reconditioned by an integrated filter system. This substantially improves the supply of fresh air and prevents the emission of particle-laden air. An ARM-based CP6606 Panel PC with TwinCAT 3 automation software is used to control this advanced exhaust system.
The Smart Repair spray booth is suitable for outdoor use, for example in auto shop yards or in the vicinity of shopping malls or airports.

About Carheal

Carheal was founded by Henrik Bro Christensen as an online platform and network for car repair workshops that fix minor damage using special Smart Repair systems. The idea was to create a contemporary alternative to traditional workshops that can quickly and inexpensively repair minor damage on the vehicle body, the paintwork, in the car interior, on the windshield or on the headlights. With the development of the Smart Repair booth, which is a self-contained, turnkey system for both indoor and outdoor use, the company offers trend-setting solutions with regard to both environmental impact and the consumption of energy and raw materials. Between September 2016 and August 2017, the company installed seven turnkey systems worldwide – in Australia, England, Norway, the Netherlands, Germany, Denmark and the USA.

Carheal founder Hendrik Bro Christensen expects cloud connectivity to bring many benefits for scaling his business model.

The interior of the booth offers perfect conditions for quick and straightforward repair of minor paint damage. The right light and smart repair tools are crucial for the quality of the paint results.
TwinCAT IoT for simple communication with the cloud

The Smart Repair spray booths are connected to the cloud via TwinCAT IoT, which features various functions to exchange process data via standardised communication protocols and to access special data and communication services from cloud service providers. Corresponding services can be hosted in public cloud systems, such as Microsoft Azure™ or Amazon Web Services™. Alternatively, they can also be hosted in local networks.

Together with the CP6606 as the IoT controller, TwinCAT 3 PLC and TwinCAT IoT establish a seamless connection between the Internet of Things and the Internet of Services in the solution realized by Carheal. In the company’s Smart Repair booths, the analog and digital sensor signals recorded in real-time are sent by means of TwinCAT IoT to the Microsoft Azure IoT Hub at intervals of five seconds, five minutes or ten minutes, depending on the relevance and properties of the information. Among other things, the data provides information about the location and general condition of the booth, the filter operating hours, the air quality, the duration of the individual work steps, and the consumption of energy and paint. The system raises the alarm if volatile organic compound (VOC) limit values are met or exceeded.

The primary reason for using the Beckhoff control platform is the fact that TwinCAT IoT offers the option to communicate with the Microsoft Azure IoT Hub directly from the PLC logic, even on small ARM-based CPUs such as the one found in the CP6606.

The acquisition and evaluation of data in the cloud is currently still new territory for Carheal, but Henrik Bro Christensen expects it to provide him with many advantages when upscaling his business model. The cloud connection makes
sense, especially in view of the growing number of Carheal booths and service providers internationally. It guarantees the secure storage of data on various servers all over the world. The data are already being used to measure Key Performance Indicators (KPIs), which provides information on performance and utilisation, and helps improve the service of the Carheal booths. If a workshop operates several booths, data can be compared and potential areas for optimisation can be determined. Another advantage is the addition of predictive maintenance functionality. By tracking the measured values from the booth, the operator can tell at an early stage when, for example, filters need to be replaced, sensors exchanged or paints refilled. As a result, maintenance costs can be reduced significantly.

Further information:
www.carheal.net
www.beckhoff.dk

The Carheal Smart Repair booth for installation inside auto repair shops: thanks to the integrated and innovative air extraction system, the air in the repair shop is not contaminated with solvent particles.

An ARM-based CP6606 Panel PC is used for controlling the air extraction system in the spray booth.
High-precision laser marking of aluminum tubes

**XTS doubles throughput and enhances quality**

Specialist for industrial automation Egaratelek S.L. develops and manufactures special machines according to customer specifications. For a customer from the pharmaceutical industry, the Spanish company recently developed a laser marking system for the labeling of filled tubes, which is based on the eXtended Transport System (XTS) from Beckhoff. With the new system implementation, Egaratelek managed to increase the speed of the comprehensive labeling process from 120 to 240 tubes per minute, while at the same time enhancing the quality.

Once the tubes have been filled and sealed in the filling unit, the laser marker labels the tubes with batch number, production date and expiry date. The applied labeling is then checked by a vision system, and then correctly labeled and defective tubes are sorted to be discharged separately. The main objectives in the development process were to double the labeling speed, improve the quality and reduce the number of rejects. In addition, the processing of different tube sizes (3 g and 5 g) should be enabled. The customer also required the machine to be compact, reliable, maintenance-friendly and economical.

In order to meet this wide range of requirements, Egaratelek opted for the XTS linear transport system from Beckhoff. The system takes the tubes at high speed from the filling unit to the discharge chutes, passing through the position detection and laser labeling units, and the visual inspection unit that checks the labeling.

The conveying capacity of the laser marking machine is designed for groups of four tubes. The tubes to be labeled are arranged in pairs in adjacent compartments and fed to the machine via a conveyor belt with a central splitter unit.
The machine itself consists of three cylindrical carousels: The first carousel uses vacuum grippers to pick up the tubes from the conveyor belt in pairs, takes them to a starting position in the XTS, and places them in a tube holder attached to the XTS mover. Each of these trays holds four tubes, while a vision system checks the correct positioning of the tubes. The tubes then pass through the laser section, followed by a second vision system, which checks whether the labeling was applied properly. The second carousel picks up the upside-down tubes, the third carousel discharges incorrectly labeled tubes and also picks up random tubes for quality control purposes.

A total of four Industrial PCs are used in the machine: A C69xx Industrial PC is used as a central platform for machine control, including safety I/Os. A second PC controls the XTS system. A CP6202 Panel PC with 15-inch display and touchscreen runs Scada software. The fourth IPC controls the laser marking system.

A total of 21 axes have to be controlled, including the XTS linear transport system with 10 movers. The Beckhoff drive components used in the system — AM80xx and AM81xx servomotors, AX5203 EtherCAT Servo Drives and the compact EL7211-0010 servomotor terminal with integrated One Cable Technology — ensure proper synchronization between conveyor belt, XTS and carousels. The safety solution, based on the EL6900 TwinSAFE logic terminal and safety I/Os, is seamlessly integrated into the EtherCAT network.

**XTS doubles production speed**

Based on the linear transport system, it was possible to increase the tube labeling throughput to 240 per minute. The tube receptacle mounted on the XTS movers also allows the flexible processing of two different tube sizes, which is a significant benefit benefit. The Beckhoff solution also offers significant advantages from the perspective of the machine builder: Integrated software for the XTS system, the other motion components and the safety technology simplify the engineering process. In addition, XTS offers a high degree of flexibility when it comes to controlling individual movers or whole mover groups as required. Plus, XTS optimally meets the requirements of the end customer for a compact machine with small footprint and high maintainability.

Further information:
www.egaratelek.com
www.beckhoff.es

A CP6202 Panel PC is used as HMI for the laser marking machine.

This image shows the three carousels of the laser marking machine. On the right is the vision system for verifying the correct tube position on the XTS.

Once the tubes have been filled and sealed in the filling unit, the laser marker labels the tubes with batch number, production date and expiry date.
Industrie 4.0 meets Building Automation

Service technicians in the field of electrical engineering receive advanced training based on the latest standards at the Limtec+ Training Center in Diepenbeek, Belgium. More than 2,000 participants attend these training courses each year. The advanced building automation platform in the company's new building, which was completed in 2017, reflects the principles of Industrie 4.0 and integrates the complete range of building services, media control and industrial communication in a central control system.

“In order for the industrial companies in our region to grow, they need well-trained personnel,” says Limtec Managing Director, Benny Siemons. “Our training courses focus specifically on the maintenance of machines and systems. In order to help participants learn how to efficiently eliminate machine malfunctions, frequently occurring incidents are simulated and corrected using state-of-the-art technology.”

EtherCAT network connects all rooms

Limtec’s goal was to implement the principles of Industrie 4.0 in the context of building automation, so all systems had to be intelligently connected. “First, we wanted to implement a powerful system, and now we can expand our training activities to also include building automation,” explains Benny Simons. His colleague, Bert Vanderhallen, a technical coordinator at Limtec, adds: “We have implemented extensive digitization and a holistically integrated system, so that all technical functions can be managed from one software platform.”

A CS210 Industrial PC was chosen as the central control platform, while the building management system was developed completely in software using TwinCAT 3. Monitoring and operator interface are carried out on 28 multi-touch CP2611 Panel PCs using TwinCAT HMI software. “The PC platform offers us the necessary openness required for seamless communication between the various systems in the building,” explains Bert Vanderhallen. He continues: “In the world of buildings, each system speaks its own language: in our training building, there are a total of 14 different bus systems. Of these, 13 were already available in the extensive Beckhoff interface portfolio, while Beckhoff developed one new RFID interface especially for us.” In addition to DALI, M-bus and MP-bus, the window blind control system as well as Modbus and RFID for access control and security equipment were also integrated into the automation platform.

Limtec uses the industrial communication standards of EtherCAT and Safety over EtherCAT to guarantee safety in the training workshops, with the possibil-
Each room is equipped with a centrally configured touchscreen on which, for example, the projector in the classroom can be switched on, the lighting can be dimmed and the blinds can be lowered by the press of a button.

Seamless integration of media control and building automation

“The special thing about our new building is that all building functions, including media technology, are handled on one platform. In addition, we can communicate using almost any of the common protocols. This gives us the freedom to implement all the functions we want and need at any time. In the control system, for example, we used AES 70 (OCA) to integrate the loudspeakers and PJLink to operate the projectors,” explains Benny Siemons.

The intelligent networking of all systems in the building improves not only the energy efficiency of the building, but also makes life easier for the users. The air conditioning and lighting of the rooms are dependent on whether or not people and daylight are present, and this is linked to the blind control system as well. “It’s all incredibly easy to use,” Bert Vanderhallen explains: “As soon as someone wants to start a presentation, he or she can switch on the projector, dim the lights and close the blinds by pressing a single button. Each room is equipped with a centrally configured touchscreen that offers these functions. As an alternative, each device in the room can also be operated separately using the touchscreen.” In addition, the Beckhoff platform is linked to the room occupancy plan, so that the control system can also take this into account.

The control platform functions like a large, modular system,” reports Bert Vanderhallen. A large part of the programming is carried out using pre-configured software function blocks, which are provided by Beckhoff as a standard offering. This also includes functions that only run in the background — for example, a specially developed automatic process for testing emergency lighting. To do so, the controller activates a test function in the lighting module via the DALI bus to which the emergency lighting is connected; the result is then read out via the bus. The building manager receives an automatically generated e-mail with the test results on a regular basis.
Short delivery times have become a decisive competitive requirement for consumer goods manufacturing. The consequence of that is that manufacturers have to fully optimize their production chains. One of the prerequisites for this are fully automated warehousing systems. For example, where automatic conveying systems handle the storage and retrieval of fabrics in a furniture factory, not only manpower but also valuable warehouse space can be saved. Canadian solution provider DIVEL specializes in this market segment and develops fully automatic warehousing systems for the furniture industry.

The particular challenge facing furniture manufacturers today is the need to meet end customers’ individual wishes while at the same time maintaining profitability in production. DIVEL has developed a fully automatic fabric storage system for Canadel, a company founded in 1982 that manufactures home furniture from Canadian birch wood. The conveying system for material handling quickly and quietly zips between the extensive racks in which the furniture fabrics are stored. “High storage density, automated operation and minimal plant floor footprint were all key goals of Canadel,” says Louis Lupien, President at DIVEL. “Through the integration of leading-edge control technologies, and by leveraging our years of manufacturing experience, we struck a perfect balance in terms of performance and form factor.”

The warehousing system removes the fabric rolls, which can weigh up to 50kg (100 pounds) each, from the racks and takes them to the cutting machine, where the fabric is automatically cut to length for the respective order. It is subsequently trimmed exactly to size by a precision cutting machine and the fabric
The conveying system for the storage of fabrics seamlessly integrates with existing warehouse shelving and enables high storage density, automated operation and minimal footprint.

TwinCAT software not only automates the order in which rolls are put into storage: “With TwinCAT, we can also design dynamic graphical elements, such as on-screen push buttons, pilot lights, monitoring of actual values, recipe acquisition, data table displays, bar graphs and trends, among others. TwinCAT Modbus TCP Server is used to configure a communication path with the cutter for roll number orders and alarm advising. TwinCAT offers many advantages,” explains the DIVEL Operations Director. “The ability to use different programming languages represents a powerful advantage over other software options, since all programming challenges can be easily solved using the most suitable language for the task at hand. Built-in instructions and data conversion facilitate significant flexibility for data handling and management.”

DIVEL uses synchronous servomotors from the Beckhoff AM series and AX52xx EtherCAT Servo Drives in the motion system. “In the Canadel project, two axes of motion had to be used in master-slave mode, in order to create a linear movement with a rotary axis and another linear axis, due to tightness of space. The compact form factor of the Beckhoff components was a welcome addition to combat the space-constrained nature of the project,” comments Jean-Sebastien Descôteaux.

**Time and cost savings create competitive advantages**

DIVEL has implemented the Beckhoff PC platform as a standard offering in its various product lines over the past seven years. “The use of EtherCAT as a universal bus system from the I/Os to the safety components to the motion system is a great advantage for us,” Louis Lupien emphasizes, and continues: “The speed of the communication system and its reliability are one aspect, but we also reduce costs through the use of EtherCAT. For instance, we were able to significantly reduce the cabling costs and the commissioning time through the use of standard Ethernet cables. The compact size of the PC-based control architecture also helped us reduce the electrical cabinet height by an impressive 15 cm (6 inches), generating instant savings on each machine.”

Jean-Sebastien Descôteaux also highlights the significant value found within EtherCAT connectivity and the feature-rich TwinCAT development environment: “The openness of the EtherCAT platform enables streamlined connectivity with the vast majority of popular fieldbuses as well as simple data collection for analysis of power quality and energy consumption. Data exchange with external databases is easy with the appropriate TwinCAT libraries, reducing programming time and effort.”

Further information:

www.divel.ca

www.beckhoff.ca
Microsoft and OPC Foundation deploy 40 Industrial IoT demo walls worldwide

With 40 Industrial IoT demo walls shipped all over the world, Microsoft is demonstrating how integration between Azure™ Cloud and OPC UA enables bidirectional data communication and visual representation on dashboards — all in line with Industrie 4.0 concepts. The system sends data from the controller to the cloud and back in a transparent manner via the OPC UA publisher/subscriber (pub/sub) model and the MQTT or AMQP protocol, or via client/server tunneling. This not only ensures secure and efficient transmission of telemetry data to the cloud, it also makes it possible to exchange command-and-control data between Azure™ and individual field devices without having to make any changes on these devices. With the company’s Azure™ IoT Suite Connected Factory demo walls, Microsoft exhibits its commitment to support OPC UA as a reliable and established interoperability standard for the seamless integration of the production and IT worlds to enable plug-and-produce. The IIoT demo walls are deployed in Microsoft Technology Centers (MTCs) worldwide, including Microsoft’s Executive Briefing Center in Redmond, Washington, and the Microsoft IoT Lab in Redmond, as well as other IoT lab locations in Munich, Germany and Shenzhen, China. The new IoT Innovation Center in Taipei, Taiwan, will also receive a demo where Microsoft opened an OPC UA test lab.

These demo walls showcase OPC UA as an established and open standard for communication across a heterogeneous sample factory with components from nine renowned automation technology providers. As one of these partners, Beckhoff has contributed an interactive area on the wall with an Embedded PC from its highly scalable CX series, which in this case functions as an IoT controller with direct OPC UA connectivity to the Azure™ cloud. In addition to the Embedded PC, the application includes EtherCAT Terminals as the I/O system, two push-buttons, a halogen light, a temperature sensor and a fan. The system demonstrates three different communication scenarios:

- Data is transmitted to the cloud as an example of vertical communication. In this case, the data is generated from temperature changes when a light is turned on and a fan is switched on. The operating mode of a blinking light signaled via the EtherCAT Terminals is transmitted as well.
- In reverse, the lamp and fan can be turned on and off, and the blinking mode can be selected within the Azure™ cloud.
- The third scenario involves horizontal data communication. An IoT-capable barcode reader from Leuze Electronics uses PLCopen-based OPC UA client modules to read two different barcodes in order to activate or deactivate the blinking lights in the Beckhoff section of the demo.

For this third scenario, the IoT controller is the only device supporting horizontal OPC UA communication, on the basis of PLCopen OPC UA Client software function blocks that Beckhoff initiated in 2006. As a result, the system features Industrie 4.0 connectivity with a level of security that has been approved by Germany’s Federal Office for Information Security (BSI, Bundesamt für Sicherheit in der Informationstechnik). Features like these are evidence of the many years of successful cooperation between Beckhoff and the OPC Foundation, which has resulted in the world’s first PLC with integrated OPC UA Server functionality in 2007, in addition to many other solutions.

Further information:
www.opcfoundation.org

Erich Barnstedt, Principal Software Engineering Lead, Microsoft Azure™ IoT, Jason Zander, Corporate Vice President Microsoft Azure™, and Stefan Hoppe, Global Vice President, OPC Foundation, during the unveiling of the Industrial IoT display (from left to right).
Connectivity and comprehensive data collection are critical components of Industrie 4.0 and Industrial IoT (IIoT) strategies. While more processes are being handled in the cloud, capable industrial hardware is still required to establish IoT connectivity on the plant floor. With dimensions of only 82 x 82 x 40 millimeters (3.2 x 3.2 x 1.6 inches), the ultra-compact C6015 Industrial PC (IPC) from Beckhoff is the ideal solution to collect machine and process data for transmission to the cloud. This hardware format is especially useful for example, when an existing installation needs to be retrofitted with additional sensors, or when the available installation space is extremely limited. In such cases, the exceptionally compact IPC can be used as an intelligent IoT gateway for applications such as data buffering, remote diagnostics, preventive maintenance and more.

The C6015 is already listed as an Azure™ Certified device in the Microsoft Azure™ IoT Device Catalog. It has also been approved for the Microsoft Azure™ OPC UA Gateway Program, provided the two Azure™ IoT Edge Modules, OPC Proxy and OPC Publisher are successfully integrated. These two modules enable simple and secure data transmission from the field level to the cloud, where all information can be displayed and analyzed in dashboards. The system uses the OPC UA standard as approved by the German Federal Office for Information Security (BSI) to transparently send data to and from the cloud, according to Microsoft currently a USP (Unique Selling Proposition) of Microsoft Azure™.

Further information:
www.beckhoff.com/c6015
ETG celebrates record year of events

The EtherCAT Technology Group (ETG) has seen a record year in 2017 – not only regarding the number of seminars held, but also the number of countries in which they took place. While in 2012 ten countries were covered in a year, the EtherCAT roadshow 2017 took place in 21 nations. With around two seminars per country, the total number of events has reached 38. Nine of this year’s host countries saw their first ever EtherCAT industrial Ethernet seminar, namely Mexico, Ecuador, Peru, Colombia, Russia, Czech Republic, Slovakia, Slovenia and Croatia.

The seminar series hosted by ETG, which addresses the challenges of industrial Ethernet as well as the characteristics and benefits of EtherCAT, is primarily directed towards users. The educational presentations deal with the basics of EtherCAT technology and the resulting benefits for machine builders and system integrators. Further seminar topics include instructions for the correct installation of EtherCAT networks and diagnostic options, migration of traditional fieldbus systems to EtherCAT as well as the implementation of the technology for Industrie 4.0-based concepts for digital transformation.

The seminar program is rounded off by table top exhibitions where EtherCAT solutions and products are presented by many different industrial device manufacturers.

The industrial Ethernet seminars from the ETG will continue around the world in 2018. A list of these upcoming events, including links for registration, can be found on the event section of the ETG website.

For the first time, ETG hosted a seminar in Lima, Peru, which was met with great interest by the participants.

¡EtherCAT para todos!
Industrial Ethernet seminar series in Latin America

After the ETG conducted multiple educational seminars in Brazil and Mexico, the organization’s list of South American venues now includes Peru, Ecuador and Colombia. In mid-October, four seminars were held in the cities of Lima, Quito, Medellin and Bogotá. The seminar series was met with great interest and was covered by the local trade media.

More than 100 participants visited the EtherCAT seminar in Quito, Ecuador.
Drinktec

On 15 September 2017, Drinktec closed its doors in Munich, Germany, with a record attendance. With the presentation of its all-stainless steel control system ranging from Control Panels, I/O modules and servomotors through to the XTS linear transport system in hygienic design, Beckhoff demonstrated its ability to meet the high demands in the beverage industry. In conjunction with technologies for cloud-based automation, users can realize technological advances in production including lot size 1 manufacturing, product personalisation and maximised system availability.

More info and Trade Show TV coverage: www.beckhoff.com/drinktec

EMO

EMO, the world’s leading trade fair for metalworking and production technology in Hanover, Germany, came to a successful close on September 23, 2017. About 130,000 visitors were able to obtain information about the benefits and possibilities of digitization and connectivity in manufacturing. This guiding theme was also in focus at the Beckhoff booth: Products and solutions for cloud-based automation were shown as they can be used on a machine tool. Another key topic concerned the new opportunities made available by PC-based control to increase machine productivity, from the all-in-one TwinCAT CNC software to highly scalable drive technology.

More info and Trade Show TV coverage: www.beckhoff.com/emo

Husum Wind

As a pioneer in the field of wind energy, Husum Wind is still regarded it the No. 1 meeting place for technology experts from the wind industry. “The many interested inquiries that we received concerning the integration of measurement technology and condition monitoring in the control systems of wind turbines, confirm that we have hit the nail on the head regarding future developments,” says a satisfied Dirk Kordtomeikel, Business Manager Wind Energy at Beckhoff. “The market for regenerative energies can only grow on the basis of reliable data analysis and diagnostics to ensure the availability of the systems.”

More info and Trade Show TV coverage: www.beckhoff.com/husumwind

Motek

More than 30,000 trade professionals visiting Motek in Stuttgart, used the opportunity to gain insight on current trends towards an increased production efficiency. “For efficiency optimization, the automation solutions from Beckhoff offer crucial benefits,” states Frank Saueressig, head of the Beckhoff office in Balingen. „The powerful PC platform offers in combination with the fast fieldbus system EtherCAT, TwinCAT Automation software and innovative drive technology solutions such as the XTS system a wealth of possibilities to increase cycle times and throughput rates, and to implement flexible and space-saving machine designs.”

More info and Trade Show TV coverage: www.beckhoff.com/motek
Trade shows 2018

Europe

Germany
Tire Technology Expo
20 – 22 February 2018
Hanover
www.tiretechnology-expo.com

Meorga
17 March 2018
Frankfurt am Main
www.meorga.de

Light + Building
18 – 23 March 2018
Frankfurt am Main
www.lightbuilding.de

Anuga FoodTec
20 – 23 March 2018
Cologne
www.anugafoodtec.de

Fensterbau Frontale
21 – 24 March 2018
Nuremberg
www.frontale.de

Prolight + Sound
10 – 13 April 2018
Frankfurt am Main
www.prolight-sound.de

Hannover Messe
23 – 27 April 2018
Hanover
www.hannovermesse.de

Automotive Testing Expo
05 – 07 June 2018
Stuttgart
www.testing-expo.com/europe

Achema
11 – 15 June 2018
Frankfurt am Main
www.achema.de

Automatica
19 – 22 June 2018
Munich
www.automatica-munich.com

Sensor + Test
26 – 28 June 2018
Nuremberg
www.sensor-test.de

SMM
04 – 07 September 2018
Hamburg
www.hamburg-messe.de/smm

Meorga
12 September 2018
Ludwigshafen
www.meorga.de

AMB
18 – 22 September 2018
Stuttgart
www.messe-stuttgart.de/amb

FachPack
25 – 27 September 2018
Nuremberg
www.fachpack.de

WindEnergy Hamburg
25 – 28 September 2018
Hamburg
www.windenergyhamburg.com

Motek
08 – 11 October 2018
Stuttgart
www.motek-messe.de

Meorga
10 October 2018
Bochum
www.meorga.de

EuroBLECH
23 – 26 October 2018
Hanover
www.euroblech.de

FMB
07 – 09 November 2018
Bad Salzuflen
www.forum-maschinenbau.com

SPS IPC Drives
27 – 29 November 2018
Nuremberg
www.mesago.de/sp

Austria
Smart Automation
15 – 17 May 2018
Vienna
www.smart-wien.at

Switzerland
EPHI - EPMT-SMT
12 – 15 June 2018
Geneva
www.ephj.ch

Sindex
28 – 30 August 2018
Bern
www.sindex.ch

Finland
Forum Smart Manufacturing & Services
24 – 25 January 2018
Hännelina

Sähkö Tele Valo AV
07 – 09 February 2018
Jyväskylä
www.sahkomessut.fi

Finland
Pohjoinen Teollisuus
23 – 24 May 2018
Oulu
www.pohjoinenteollisuus.fi

Energia
23 – 25 October 2018
Tampere
www.energiamessut.fi

France
Smart Industries
27 – 30 March 2018
Paris
www.smart-industries.fr

Sepem Industries
05 – 07 June 2018
Colmar
www.sepem-industries.com

Great Britain
Drives & Controls
10 – 12 April 2018
Birmingham
www.drives-expo.com

Manufacturing & Engineering North East
04 – 05 July 2018
Newcastle
www.menortheast.co.uk

Italy
SPS IPC Drives Italia
22 – 24 May 2018
Parma
www.spitalia.it

IPACK-IMA
29 May – 01 June 2018
Mailand
www.ipackima.com

Netherlands
ISE
06 – 09 February 2018
Amsterdam
www.iseurope.org

Norway
EuroExpo Trondheim
22 – 23 March 2018
Trondheim
www.euroexpo.no

Eliaden
29 – 31 May 2018
Oslo
www.eliaden.no

ONS
27 – 30 August 2018
Stavanger
www.ons.no

Poland
Automaticon
20 – 23 March 2018
Warschau
www.automaticon.pl
Sweden
Nordbygg
10 – 13 April 2018
Stockholm
www.nordbygg.se
Elmia Automation
15 – 18 May 2018
Jönköping
www.elmia.se/sv/automation
Scanautomatic
09 – 11 October 2018
Göteborg
www.scantautomatic.se

Slovenia
IFAM
13 – 15 February 2018
Ljubljana
www.icm.si/ifam-slovenia-2018

Spain
Hispack
08 – 11 May 2018
Barcelona
www.hispack.com

Czech Republic
Amper
20 – 23 March 2018
Brünn
www.amper.cz

Turkey
WIN Automation
15 – 18 March 2018
Istanbul
www.win-eurasia.com

Africa
South Africa
Electra Mining Africa
10 – 14 September 2018
Johannesburg
www.electramining.co.za

Asia
China
SIAF
04 – 06 March 2018
Guangzhou
www.spsinchina.com
Auto Tech
22 – 24 March 2018
Wuhan
www.chauototechexpo.com
CCMT
09 – 13 April 2018
Shanghai
www.ccmtshow.com
InfoComm China
11 – 13 April 2018
Beijing
www.infocomm-china.com
ChinaPlas
24 – 27 April 2018
Shanghai
www.chinaplasceline.com
IAMD Beijing
09 – 11 May 2018
Beijing
www.industrial-automation-beijing.com
AHTE
03 – 06 September 2018
Shanghai
www.ephchinashow.com
China Wind Power
17 – 19 October 2018
Beijing
www.chinawind.org.cn
China Brew & Beverage
23 – 26 October 2018
Shanghai
www.chinabrew-beverage.com
Industrial Automation Show
06 – 10 November 2018
Shanghai
www.industrial-automation-show.com

India
Intex Forming
25 – 30 January 2018
Bangalore
www.intex.in
ACMEE
21 – 25 June 2018
Chennai
www.acmee.in
Automation Expo
29 August – 01 September 2018
Mumbai
wwwautomationindiaexpo.com

Israel
Motion Control & Power Solutions
09 January 2018
Lod
http://www.new-techevents.com

North America
Canada
FABTECH Canada
12 – 14 June 2018
Toronto, ON
www.fabtechcanada.com
ATX Montreal
14 – 15 November 2018
Montreal, QC
www.atxmontreal.com

USA
ATX West
06 – 08 February 2018
Anaheim, CA
www.atxwest.com
Modex
09 – 12 April 2018
Atlanta, GA
www.modexshow.com

Further information:
www.beckhoff.com/trade_shows