SICK insight MAGAZINE

: FOCUS **ROBOTICS**

WORKING TOGETHER AS EQUALS

SENSOR SOLUTIONS FOR ROBOTICS

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WORKING TOGETHER AS EQUALS

Humans and robots are working more closely together. Sensors help robots make more intelligent decisions and give them the ability to sense objects, the environment, or their own position. Thanks to sensors from SICK, robots perceive more precisely – the prerequisite for close collaboration. For all challenges in the field of robotics: Robot Vision, Safe Robotics, End-of-Arm Tooling, and Position Feedback.

Robot Vision refers to optical and image-based systems that turn the robot into a seeing participant and allow it to identify where something is located. These systems enable flexible automation in the era of Industry 4.0.

Safe Robotics solutions ensure the safety of people and include all measures that turn the sensitive area close to the robot into a safe workspace.

In the area of End-of-Arm Tooling, SICK offers sensors that are designed specifically for grippers and robot tools, enabling them to work with fingertip precision.

With Position Feedback solutions from SICK, the motor feedback systems integrated in the drives deliver data on speed and position as well as on the condition of the drive. They thereby create the sensory foundation for all robot movements.

Flexible automation solutions thanks to Robot Vision technology and freely accessible robotics applications – this is the future that has already begun. Sensor solutions from SICK make this future possible. Humans and machines work hand in hand – just like SICK together with its customers.

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SAFETY SOLUTIONS FOR INTELLIGENT HUMAN-ROBOT COLLABORATIONS

Human-robot collaboration (HRC) describes a work scenario in which humans and automated machines share the same workspace and work within it simultaneously. Driven by Industry 4.0, this model of interaction promises highly flexible work processes; maximum plant availability and productivity; as well as economic efficiency. But HRC will only be able to live up to this promise when appropriate application-specific safety technology is assured.

>> In the context of industrial automation, interaction between humans and machines has become the focus long before the initiation of Industry 4.0. Until now, two interaction scenarios – coexistence and cooperation – have dominated, representing about 90 percent of such situations. Space and time are the important interaction parameters here. Coexistence describes a work situation in which the human and the machine are in neighboring areas at the same time during the interaction. Cooperation, on the other hand, is an interaction during which the human and the machine share the same work area but work within it at different times.

A third form of interaction is increasingly being focused on within the framework of Industry 4.0: collaboration between the human and the robot during which they share the same workspace and carry out their work at the same time. In such collaborative scenarios, the standard industrial robot with safe kinematics is no longer sufficiently safe, so collaborative robots must be used. In this case the forces, speeds, and travel paths of the robot must be monitored and limited, depending on the actual degree of risk. If necessary, the robot is stopped or switched off. The distance between the human and the robot thus becomes a decisive safety-relevant parameter.

The risk assessment is always the starting point – even with cobots

No two human-robot collaborations are the same. This means that an individual risk assessment of the HRC application is necessary, even if the robot used has been developed specifically to interact with humans and, therefore, such a cobot was designed from the beginning with many inherently safe features. At the same time, the collaboration space also has to meet fundamental requirements, e.g., regarding minimum distances to neighboring accessible areas that present potential crushing or trapping risks. The standards basis for the functional safety of HRC applications consists of general standards, such as IEC 61508, IEC 62061, and ISO 13849-1/-2. In addition, ISO 10218-1/-2 on the safety of industrial robots and, especially, ISO/TS 15066 on robots for collaborative operation, must be taken into account.

Collaboration – Human and robot share the same workspace and carry out their work at the same time

Developers and integrators of robot systems must not only carefully examine the functionalities and compliance with standards of the design-related protective measures undertaken by the robot's producer, but also take into account any residual hazards and risks. It is therefore necessary to carry out a risk assessment on the robot system according to ISO 12100 in order to derive appropriate safety measures for risk reduction, e.g., safety light curtains or safety laser scanners.

Safety-oriented operating modes of collaborating robot systems

According to the technical specification ISO/TS 15066, there are four different types of collaborative operation. The "safety-rated monitored stop" halts the robot for interaction with the human; "hand guiding" ensures safe HRC because the robot is deliberately guided manually at an appropriately reduced speed. In the third type of collaboration, "power and force limiting", the necessary safety is achieved by reducing the power, force, and speed of the robot, e.g., by using limiting functions of the safety-relevant control systems, or an inherently safe design of the robot with a biomechanical load limit at which no hazard or injuries are to be expected. This takes place regardless of whether there is any intentional or unintentional physical contact between the robot and a human.

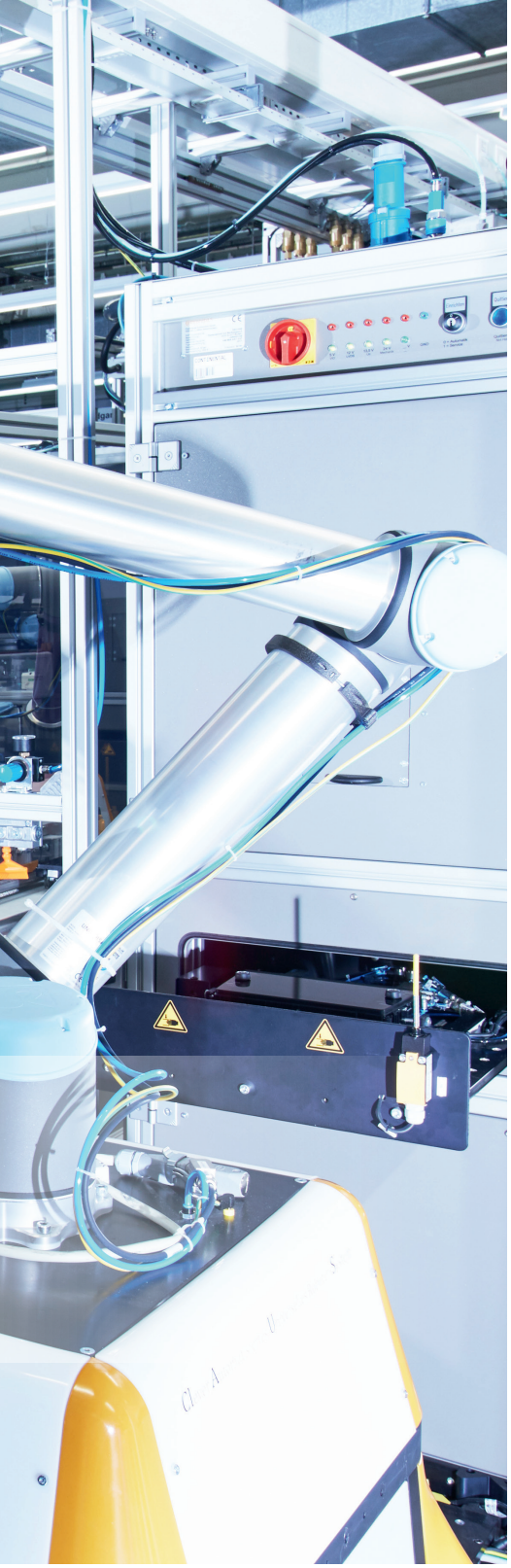
The fourth type of collaboration, "speed and distance monitoring", is very much in the spirit of highly flexible work scenarios. It is based on monitoring of the speed and travel paths of the robot and adapting them according to the work speed of the operator in the protected collaboration space. Safety distances are permanently monitored and, when necessary, the robot is slowed down or stopped, or its travel path is changed. The robot system can automatically resume its movements, with the usual speeds and travel paths, when the distance between the operator and the machine increases again to greater than the permitted minimum distance. This restores the robot's productivity without delay.

Functional safety for HRC: expertise, product range, and implementation from a single source

Of the four different types of collaboration quoted in ISO/TS 15066, it is "speed and distance monitoring" that offers the greatest future potential in HRC applications. Therefore – whilst comparing these types and not neglecting the still-dominant interaction scenarios of coexistence and cooperation – it is clear that safety-oriented sensor and control technology faces new challenges in enabling unhindered human-robot collaboration. *(fp)*

FLEXIBILITY, COLLABORATION, AND EMPLOYEE SAFETY –
A LEAN HRC SOLUTION AT CONTINENTAL

COBOTS CLAUS AND CLARA: COLLABORATIVE ROBOTICS WITH A SICK SAFETY SOLUTION



Continental is one of the world's leading automotive suppliers. The increasing variety of vehicle models, variants, and derivatives being produced and the shorter product life cycles in the automotive industry require suppliers to take a more dynamic approach. On conventional inflexible production lines, changes or faults at individual stations can have a major impact on the output of the entire line. The more serious the fault, the more difficult it is to compensate for it.

>> At Continental's plant in Babenhausen, high-tech components for car cockpits come off the production line at 15-second intervals around the clock. This leaves very little leeway to make up for downtime. For this reason, Continental is currently replacing its inflexible testing and assembly lines with flexible, redundant, collaborative testing systems. The cobots Claus and Clara load the testing machines and can be used wherever they are needed. If necessary, the employees can help them out. A safety solution from SICK consisting of S300 safety laser scanners, TR4 safety switches, and software-programmable Flexi Soft safety controllers ensures that the employees remain safe in this collaborative environment.

There are three test benches on the newly built testing line, which are loaded by collaborative robots (cobots). The cobot takes a component from a conveyor, puts it in the testing machine, then removes the tested part, and places it on the next conveyor.

Safety makes human-robot collaboration (HRC) efficient

"Claus (clever automated universal robot system) and Clara (clever automated robot application) are semi-mobile, lightweight robots that work in stationary mode, but can be moved around," explains Heiko Liebisch from the robotics department of the industrial engineering division at Continental Automotive GmbH, highlighting the benefits of the cobots. "This concept allows us to lift the robots up and move them to another location for a different shift, which means that we can use the same robot on two different machines: on one during the early shift and on another one during the late or night shift."

Using mechanical indexing, the cobot can be positioned in the ideal location for the testing machine at any time. A uniquely coded TR4 Direct transponder safety switch verifies the uniquely coded actuator of the TR4 Direct on Claus or Clara.

"Everything in the system that relates to safety is controlled using the software-programmable Flexi Soft safety controller. This means that the Flexi Soft checks whether the coded safety switch is in position. If it isn't, then nothing happens and the safety controller issues an error message. Once the switch has been verified, the safety laser scanners (S300 Advanced) load the field sets that have been stored for the workplace and give the cobot the command to load its program and start work," says Heiko Liebisch, describing the initialization process. "We have the option of fitting several coded switches to the front of the cobots so that we can set them up for several different workplaces."

The new production line makes it possible to return rejected test parts to the process while the line is still in operation. An

operator goes up to the test machine or the cobot, puts the part down wherever there is space available, and leaves the area. The cobot then identifies independently that a part is waiting which needs testing and continues working normally.

The safety laser scanners, which are installed in a diagonal arrangement to allow for all-round monitoring, have LEDs in traffic signal colors on the front. These indicate the protective fields and any breaches of the fields. To ensure that the operators can see the lights even out of the corner of their eyes, the entire body of the cobot underneath the arm lights up in the traffic signal colors. In collaborative mode Claus is amber-colored and reduces his speed. In red mode it comes to a complete standstill. When the operator leaves the red protective field, the system and Claus automatically start up again. The operator does not have to notify the system that he has left the area.

The risk assessment is always the starting point – even with cobots

Although Claus and Clara move relatively slowly, robot arms can come close enough to operators to put their lives at risk. “You always have to assess the overall concept. This is why the grippers on the front of the robots have been laser-sintered so that there are no sharp edges and everything is rounded off.”

No two examples of human-robot collaboration are the same. This means that an individual risk assessment of the HRC application is necessary, even if the robot used has been developed specifically to interact with humans and, therefore, such a cobot was designed from the beginning with many inherently safe features. At the same time, the collaboration space also has to meet fundamental requirements, e.g., regarding minimum distances to neighboring accessible areas that present potential crushing or trapping risks. The standards basis for the functional safety of HRC applications consists of general standards, such as IEC 61508, IEC 62061, and ISO 13849-1/-2. In addition, ISO 10218-1/-2 on the safety of industrial robots, and, especially, ISO/TS 15066 on robots for collaborative operation, must be taken into account.

SICK was responsible for advising and training Heiko Liebisch and his team on the design, guidelines, legislation, and standards for collaborative robotics. “We are very pleased with the system and how it is running,” says Liebisch. “In practice, there are a few areas where improvements could be made and we will continue working on these with SICK, our partner for the complete solution.”

Functional safety in human-robot collaboration

A high level of automation versus flexible production workflows: Where people and machines now have to work more closely and also more safely together, functional safety will take today’s production systems one step closer to greater flexibility. This requires not only an in-depth understanding of robotics applications, but also expertise in assessing risks and access to an appropriate portfolio of safety solutions.

In certain applications, people have to interact closely with moving robots. In these collaborative scenarios, the force, speed, and paths of the robot and the workpiece, including the workpiece holder, represent a risk to employees. These risks must be minimized either by using inherent safety measures and/or by introducing additional risk reduction features. The process of choosing and designing technical safety systems can be very complex.

One example of how a network of several safety laser scanners helps provide an application solution is the seamless 360° all-round protection of robots, AGVs, and AGCs with the S300 Mini, S300, S3000, or the new microScan3 Core, combined with the Flexi Soft safety controller from SICK. This solution guarantees the safety of the system in all directions of movement. It is a complete solution from one supplier, which avoids the risks involved in application interfaces and is easy to integrate, highly available, and cost-effective. SICK’s own EFI interface (Enhanced Function Interface) allows for direct safety-related communication between the different devices. The use of this interface minimizes the otherwise complex cabling requirements for users and, at the same time, reduces the risk of cabling faults, especially in the commissioning phase. The advantages of the central integration of Flexi Soft into the vehicle or the body of the robot include easy configuration and a simpler diagnostics process for the entire laser scanner system from one location. This not only saves time during commissioning, but also makes maintenance and servicing easier.

Successful pilot line in operation since early 2017

Heiko Liebisch and his colleague Dejan Pfaff planned the new smart production line at Continental Automotive GmbH in Babenhausen and designed the cobots. They are the fathers of Claus and Clara, who will soon have siblings in the form of

The advantages of the central integration of Flexi Soft into the body of the robot include a simpler diagnostics process for the entire laser scanner system from one location

Cora and Kurt. The successful changeover has set a precedent at Continental, which is now planning to introduce more cobots. Claus, Clara, and their fellow cobots are built by apprentices at Continental Automotive GmbH. The mechanics construct the basic frame and the mechatronics trainees are responsible for the rest. This is an exciting project for the trainees. If they find themselves working on this type of production line at a later date, they will be able to say with pride that they built the cobots. *(as)*

A safety solution consisting of S300 safety laser scanners, TR4 safety switches, and software-programmable Flexi Soft safety controllers ensures that the employees remain safe in this collaborative environment

SMART MOTOR SENSORS FROM SICK ARE ENSURING HIWIN ROBOTS ARE SAFE AND FIT FOR THE FUTURE

Robot manufacturer and expert in linear technology HIWIN is using motor feedback systems from SICK in its new 6-axis robots for pick-and-place applications. This saves space and ensures that the 5-kilogram robot is also fit for future collaborative applications. The geographical proximity between HIWIN in Offenburg and SICK colleagues in Donaueschingen was a guarantee for successful cooperation and meant that implementing the SICK solution was a real win-win situation for both parties right from the start.

„With motor feedback systems from SICK, we have chosen an extremely space-saving and reliable solution that will also be suitable for future robotics applications.“

Felix Herrling, Product Manager HIWIN

>> How do you build a robot that is both reliable and safe and which can also be adapted to meet the changing requirements of the future? This question must also have been what led robot manufacturer HIWIN to opt for Smart Motor Sensors from SICK. Product Manager Felix Herrling from Offenburg explains it as follows: “With motor feedback systems from SICK, we have chosen an extremely space-saving and reliable solution that will also be suitable for future robotics applications.”

SICK’s proven one cable technology is responsible for the space-saving and compact design of the motor feedback system used. The EKM36 has an integrated HIPERFACE DSL® interface and therefore offers all the well-known advantages associated with this: from minimal cabling requirements and the continuous production of histograms right the way up to permanent condition monitoring. And all via the two wires of the digital interface. From a mechanical point of view, the EKM36 is based on the proven 36 mm design. In this compact space, the HIPERFACE DSL® technology enables absolute position determination and a resolution of up to 20 bits per revolution as well as a maximum of 4,096 revolutions.

Accurate positions as the basis for automation

Thanks to the advantages of the EKM36, HIWIN achieves an extremely high level of accuracy with its RA605 6-axis robot. As a result, the jointed-arm robot is not only suited to handling small parts – it is also ideal for automated applications such as the mounting, deburring, and polishing of workpieces on production lines. The integrated pneumatic and electric gripper interface maximizes system reliability, reduces sources of interference, and simplifies the programmed movement sequences. What’s more, HIWIN benefits from the SIL2 certification awarded to the encoder, which makes obtaining approvals in the European and American markets much easier. Safety certifications are also becoming an increasingly important factor for the Chinese market. The success of this cooperation between robot and sensor manufacturer means that a mini all-rounder is already available for the handling and pick-and-place sector.

Cooperation leads to collaboration

Cooperation may be the watchword when it comes to the trend of the future of robotics. Yet in the smart factory of tomorrow, genuine collaboration between humans and machines will be what counts. Humans and machines that work hand in hand as equals. A future which SICK is not only thinking about with its motor feedback systems, but one which it is already making a reality with HIPERFACE DSL®. This was also a key argument for HIWIN in opting to use SICK products: “With the EKM36 and HIPERFACE DSL®, we have made a conscious decision to look to the future. Collaborative robotics is already up and running with integrated functional safety technology,” says Herrling and goes on to explain that the product will be able to meet all standard requirements relating to functional safety in the future without having to replace components.

From Donaueschingen to the rest of the world

The Donaueschingen team could not be happier to have their Asian customer here in person in the form of the German subsidiary of the robot manufacturer in Offenburg, as it meant that helpful synergies could be developed without the arduous travel. The joint development of the successful implementation of the motor feedback system was and is a good example of how close SICK is to its customers. And this is a feeling that is clearly shared by the Offenburg-based customer: “The cooperation with SICK was excellent and went extremely smoothly,” states Felix Herrling in praise of the Donaueschingen colleagues, and he declares everyone as winners with his closing words: “All our questions were answered expertly and promptly to our complete satisfaction by our dedicated contact.” *(mw)*

A SAFETY SOLUTION FOR A MOBILE
HEAVY-LOAD ROBOT

MAKING HARD THINGS EASY

In modern production facilities, humans and robots are brought into even closer proximity. Safety fences are disappearing and robots which can be moved to any location are required in order to implement flexible yet safe automation solutions in the era of Industry 4.0. Swedish robot company OpiFlex has developed a solution which means that even large industrial robots can now be made mobile – it features a patented fenceless safety solution and is made safe using safety devices from SICK.

A mobile heavy-load robot – without fence

>> "Together with SICK, we have mastered the challenge of automating small series manufacturing as well as flexible high volume manufacturing," says OpiFlex CEO Johan Frisk. "It was very important for us to have a solution without fences, as this provides our customers with a lot more flexibility". Small and medium-sized enterprises (SMEs) in particular are keen to automate the production of small series, which has been difficult before based on the use of traditional, less flexible fixed and fenced robots cells. Now this kind of automation is possible thanks to the OpiFlex flexible mobile robot cells with fenceless safety and easy robot programming.

With the help of a manual pallet forklift truck, lifting truck, or automated guided vehicle, the mobile OpiFlex robot is moved to the relevant workstation in a production facility. It is docked and plugged into a previously installed platform and is then ready for immediate use. "This allows us to move large robots and let them run at full speed," says Frisk.

Safe Robotics from SICK makes the robots safe

Two S300 Mini Remote safety laser scanners from SICK are permanently mounted on the mobile robot cell and detect people near the station at the respective application sites. If a person approaches the robot, the safety laser scanner sends a signal to the Flexi Soft safety controller and the robot reduces its speed in the first instance. The robot only stops operating completely if the person enters the safety zone. This increases productivity as the robot does not always have to be stopped completely. The Flexi Soft safety controller also monitors the robot gripper and stops the robot as soon as a situation occurs in which the robot could lose parts and thus endanger the surroundings.

If the robot is easily moved to another location, the safety solution also checks whether the mobile robot cell is firmly anchored in the respective docking station. The robot and docking station are perfectly matched for high precision and stability. "Our solution is innovative because it is very easy to integrate. Everything is included. You take the robot, set it in the right place, and everything is made safe straight away," says Ake Tornros, Product Manager Safety Systems from SICK in Varby, Sweden.

Safety Services – advice from the word "go"

In the beginning, Johan Frisk and his OpiFlex team were mostly met with skepticism. "We had this innovative idea to develop a mobile solution with fenceless safety for a big robot, and at first people said, 'That's impossible. You won't comply with the safety regulations," says Frisk, describing the initial challenges. But the inventors at OpiFlex did not want to give up so quickly and contacted the SICK safety experts – and together, they were eventually able to develop the right concept.

"Over the course of a few workshops, SICK helped us to identify potential risks," explains Frisk. The support provided by SICK included the risk assessment, comprehensive advice, and support in creating

a safety concept for the mobile robot cell, so that in the end they were able to implement the right solution for OpiFlex. “It was a very exciting project for us. From the initial risk assessment to the hardware and software concept, we supported the customer throughout the entire process,” says SICK expert Tornros.

The era of Industry 4.0: Solving the challenge of high mix and low volume

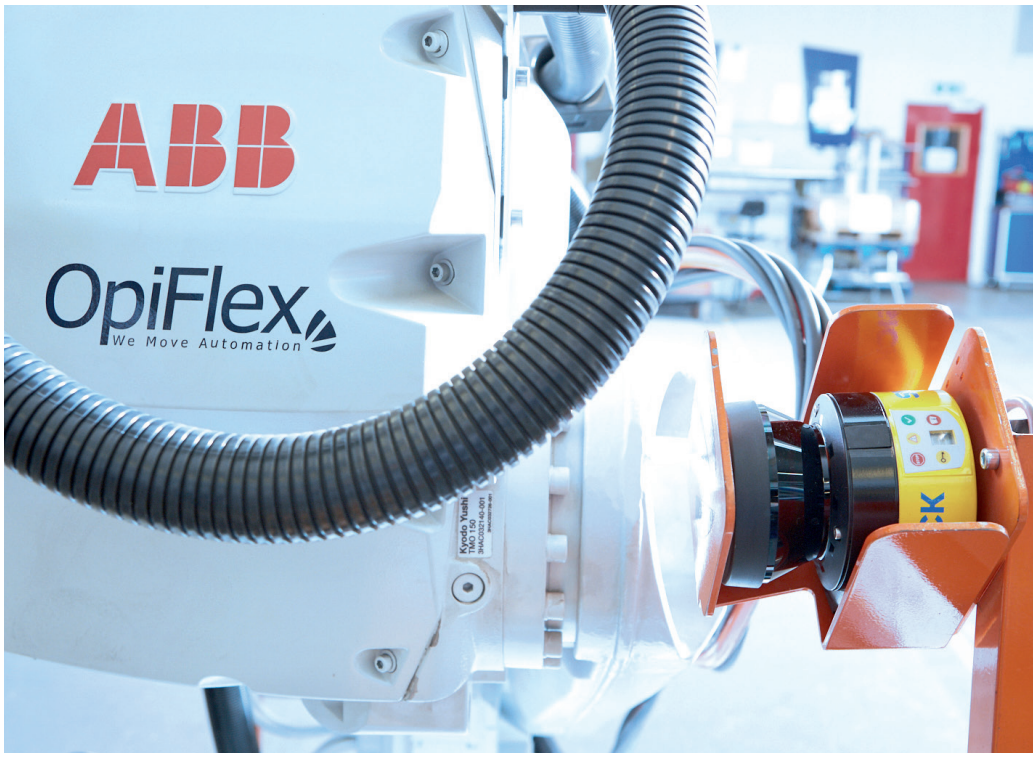
The new mega trend with high mix and low volumes drives the new third robot revolution, also known as "flexible robots". Flexible robots support SMEs, Tier1 companies, as well as OEMs with increased flexibility and productivity for both small series manufacturing and high volume production. The OpiFlex flexible robot cells were initially created for SMEs with small series and low machine utilization. Now, a high number of large corporations, OEMs, and Tier1 companies, have expressed their increased need for flexibility as they go towards higher mix and lower volumes. Some of these companies also want to use an OpiFlex solution for high volume manufacturing as it is much faster to integrate and set up when required at a new machine. Or they need flexibility in robot cells in cases where you have, e.g., five robots for one product and two robots for another product.

Furthermore, OpiFlex enables the robot to be programmed extremely quickly without prior robot knowledge – in about ten minutes. Instead of programming the robot for several hours, the operator only has to answer a few questions and teach the robot a few simple movements, then it will program itself automatically.

One of the challenges for Tier1 companies and OEMs working with three to five shifts is to plan production stops for adjusting or implementing new automation solutions. Traditional robot cell implementations usually stop the manufacturing process for more than ten days, which means loosing up to 30 to 50 shifts. OpiFlex reduces the installation and commissioning time of a complete robot cell by up to 90% – so it takes about two to three shifts only. Especially within a tight production schedule, it is of great advantage that the planning of automated implementation becomes easier due to a minimized loss of production.

The Swedish company has already won several awards for its innovations, including being named as a finalist for the IERA Award, one of the most important awards in robotics. CEO Johan Frisk concludes: “As we are a small, innovative company, SICK played a big part in helping us to achieve our goals. I am very proud to have teamed up with SICK for support to design this flexible and mobile robot solution, which will help small and medium-sized companies in particular to automate smaller production series.” The aim of OpiFlex is to drive the third robot revolution "flexible robots", with its patented fenceless solution, patented easy robot programming, and patented docking solutions. This solution is very flexible and cost-efficient compared to traditional robot cells – and it is powered by SICK products. *(ma)*

The mobile safety solution from OpiFlex is working with safety laser scanners from SICK



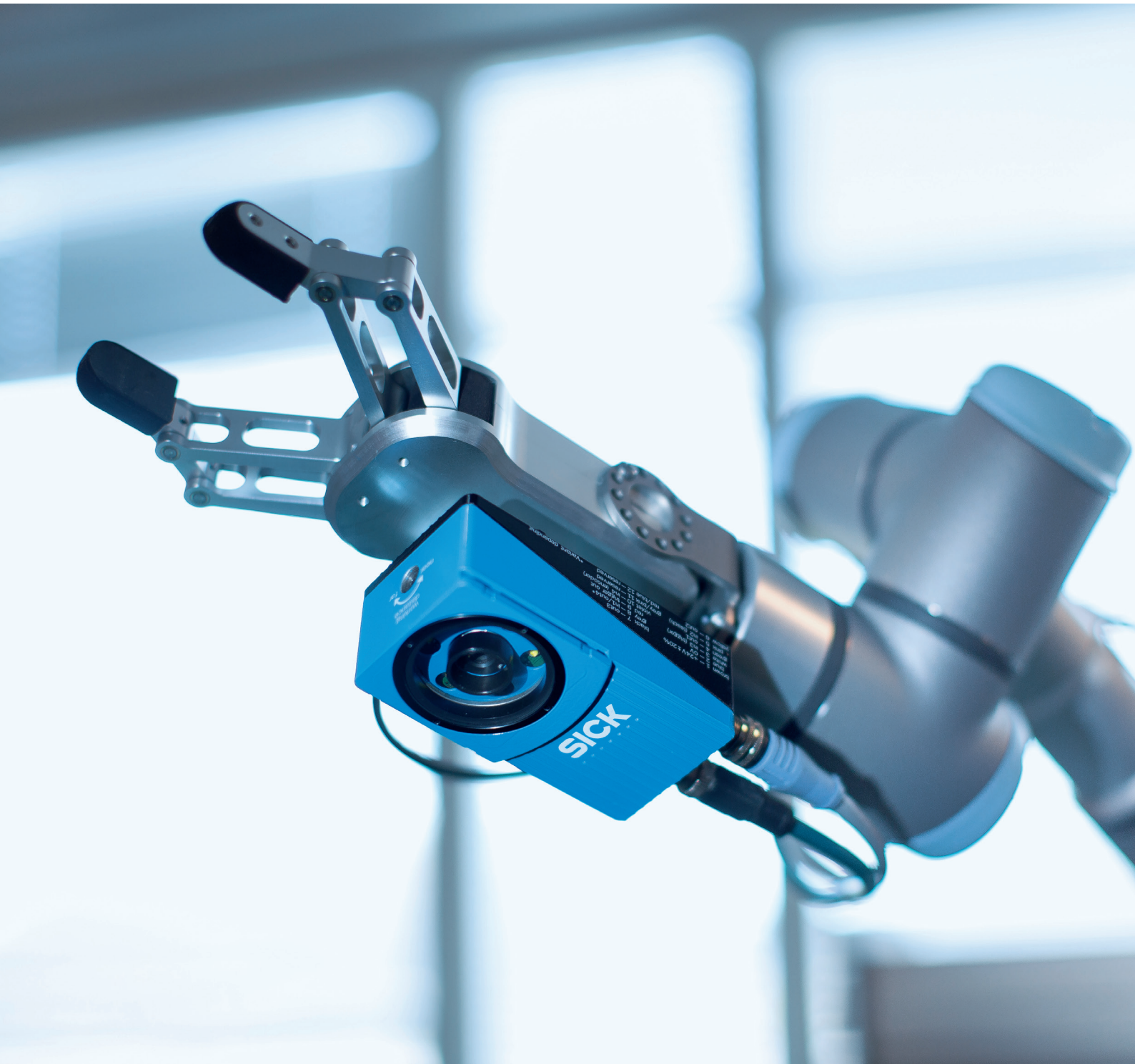
OpiFlex enables the robot to be programmed extremely quickly in about ten minutes

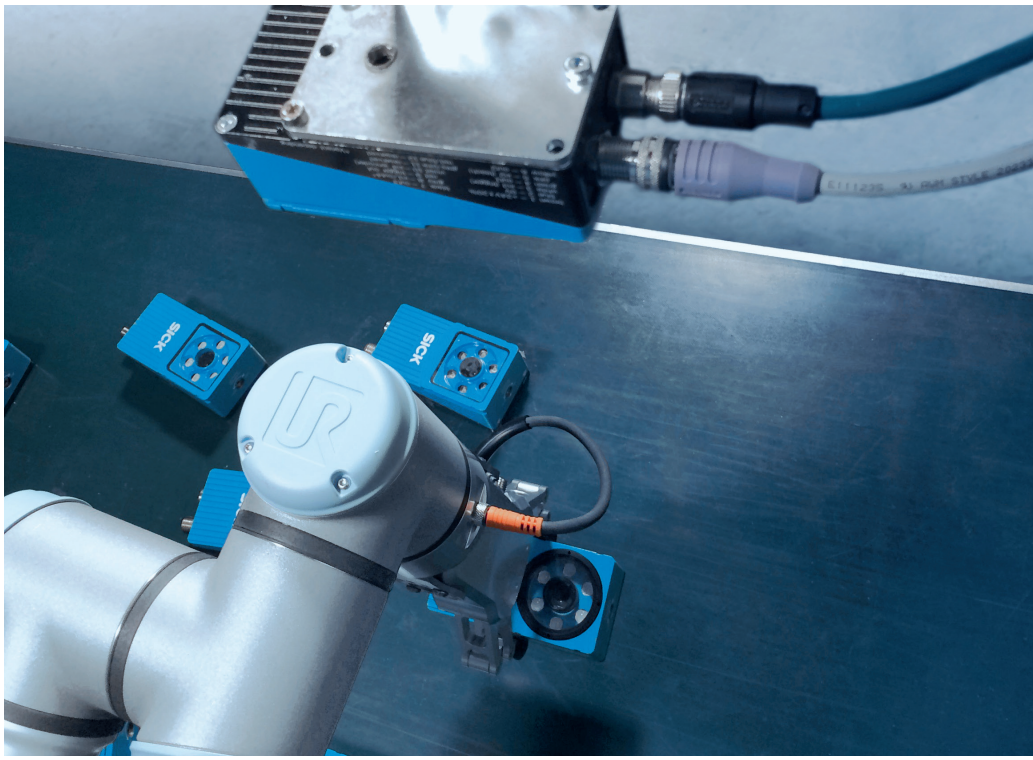
With the help of a manual pallet forklift truck, lifting truck, or automated guided vehicle, the mobile robot is moved to the relevant workstation

VISION TECHNOLOGY FOR COLLABORATIVE ROBOTS

ROBOTS WITH A VISION

With the increasing interaction between humans and robots in the factory, the collaborative robots (cobots) of Universal Robots are now working closely with the SICK Inspector PIM60 and the SICK Inspector URCap software, enabling more applications.





>> Traditional industrial robots are stationary and heavy; they require safety devices or caging around them. Deployment of industrial robots comes with big investments and requires lots of special skills. And once they are set up, they will do the same thing over and over again, for a very long time.

Cobots, on the other hand, are flexible, lightweight, and user-friendly robots. They are easy to deploy and re-deploy, without the need for programming experience. Cobots are viewed more as an additional arm to the factory floor; an arm that does not get tired. The targeted applications cover, among others: packaging and palletizing, machine tending, pick and place, assembly and quality inspection. The world's first cobot was launched in 2008 by the Danish company Universal Robots (UR).

Cobots lowering the barrier for automation

In combination with a low initial investment and a very short payback time, cobots enable companies to do their first steps towards industry automation. Just like Hestra Teknik, a Swedish company that works with cutting processes. The cobot is used for part feeding to a CNC machine and thus eliminates the need of constant availability of an operator. For exact robot guidance, Hestra Teknik uses the Inspector PIM60 2D vision camera from SICK. It handles the localization of the parts on a conveyor belt and the UR cobot picks the parts and feeds it to the machine. Configurations of up to 32 different parts can be stored directly on the Inspector PIM60.

Enabling more applications with vision

When adding "eyes" to the robot, there are a lot more things you can do. As a pilot customer, Hestra Teknik integrated the SICK Inspector URCap software, a UR+ plug-in, into the robot controller. With this software, it is easy to add the full functionality of the Inspector PIM60 to the robot application: The Inspector PIM60 is an embedded vision sensor, which means that all calculations are done on the sensor itself, and there is no need for an external computer.

The natural step to take with a vision sensor and a robot is to enable robot guidance applications: After the quick calibration routine, the URCap software can output pick-points in the robot's coordinate system; and in addition to outputting coordinates, the Inspector PIM60 enables inspection and measurement tasks for pass/fail-criteria or trending.

With the SICK Inspector URCap software, you get an easy-to-use interface for the Inspector PIM60 and robot integration. It gives you an accessible way to reduce monotonous work for the operator and it lets the user expand the use of collaborative robots.

Stefan Manfredsson, Business Manager at Hestra Teknik, explains the main advantage of the SICK Inspector URCap: "Simplicity – anyone with basic technical know-how can set this up!" Stefan continues: "Everything is integrated in the robot controller software; there is no need for setting up a PLC or another communication system. With the SICK Inspector URCap, SICK has developed an easy-to-use system that well matches the simplicity of the Universal Robots interface." *(db)*

FPT ROBOTIK AND SICK WORK IN PERFECT HARMONY IN ROBOT VISION APPLICATION

SOLVING THE PUZZLE OF SUCCESS

If all the pieces of a jigsaw puzzle fit together, what emerges is a beautiful picture. Renowned automation specialist fpt Robotik has combined its new patented gripper with SICK's Visionary-T 3D camera to solve a specific type of automation puzzle – but unlike a jigsaw, the project wasn't just started for fun. Through this professional collaboration, fpt Robotik has been able to design a completely new robot cell for pick-and-place applications, closing the gap in robot-based picking of non-rigid and dimensionally unstable products, particularly pouches. The sophisticated gripping technology has made it possible to singulate and place products that are unable to achieve a tight vacuum seal and for which no automation solutions have been available so far – and it does all this while handling the products with care. Reliably detecting the positions of the products requires the right vision system, and for this, the robotics manufacturer has turned to the Visionary-T AG. After just under a year of successful development work and comprehensive support from SICK in the process of implementing the technology in the cell, the results really are a beautiful picture.

>> Finding an automated process that is able to pick pouches of various shapes and sizes, and with varying contents, has always been a difficult challenge to overcome. Now, fpt Robotik has developed a reliable solution for detecting, gripping, and setting down pouches: its Subito Connect A cell combined with the smart Visionary-T AG 3D camera from SICK. First unveiled to the public at the Automatica 2018 trade fair in Munich, the robot cell is compact, flexible, and mobile, and can be installed easily at manual workstations as well as logistics or picking workstations alike. So it comes as little surprise that the solution has had an extremely positive reception on the market, with big-name companies – including a major German games manufacturer – registering their interest in it.

In the process of seeking out an expert partner to provide camera-based gripping technology, fpt quickly turned to SICK and its Robot Vision products. A company focused on "Sensor Intelligence.", SICK's many variants of its Visionary-T technology provide the market with highly competitive camera solutions. The 3D camera is comparable to 3D snapshot solutions delivered by other competitors – but it is more cost-effective by far. As a result, its excellent value for money was one of the key factors in fpt choosing SICK.

Superior gripping thanks to 3D technology

Particularly in pick-and-place applications involving non-rigid surfaces and surfaces that are unable to achieve a tight vacuum seal, the devil is often in the details – and the same is true in the specific case of gripping and setting down packaged puzzle pieces. Solutions for executing intricate, complicated applications like this require several small steps in order to be reliable. These steps are themselves pieces of a larger puzzle, and they need to be put together correctly in order to reveal the right picture. fpt Robotik and SICK successfully united their skills and expertise in this area, reaching a real milestone in cooperation. Both sides delivered exceptional standards of skill, assuredness, persistence, and professionalism in incorporating the Visionary-T AG camera into the Subito Connect A cell. After just under a year of working closely together, the staff members involved in the project were able to bring the gripper and camera combination up to a dependable standard for series production.

Cell-based collaboration

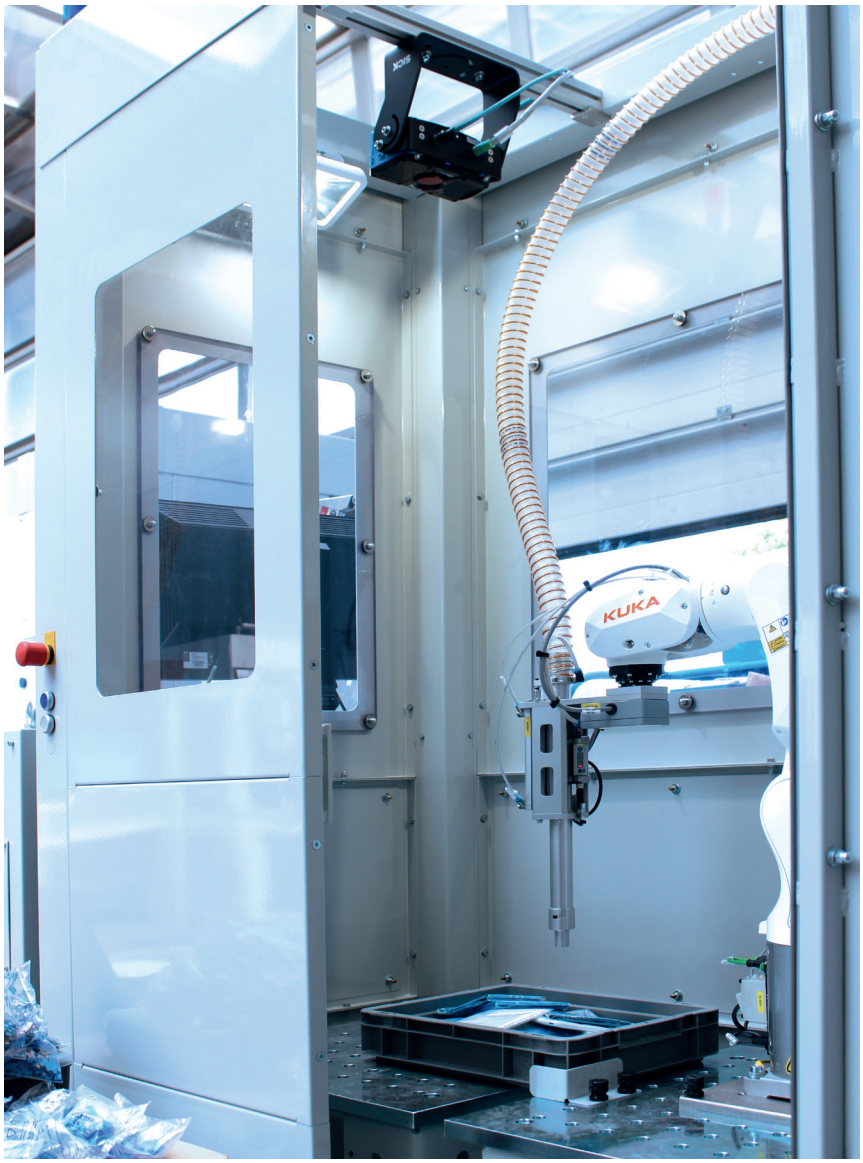
In the cell itself, the application's success is all thanks to the seamless way in which the individual components are able to work together. The 3D data captured by the camera is prepared and converted immediately, right at the point where it is created. To achieve this, the Visionary-T is equipped with ultra-high-performance hardware plus a range of special image processing filters that allow it to reliably detect the spatial positions of dark, transparent, or reflective objects. Once it has precisely identified the positions in this way, it communicates them instantly to the machine controller using straightforward global 3D coordinates, at a rate of up to 50 images per second.

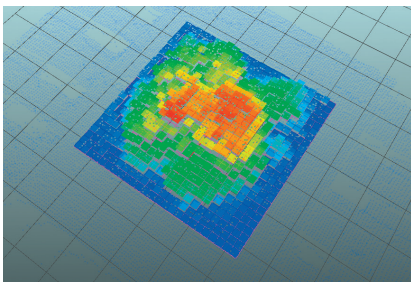
The data is prepared in a way that accommodates a direct link between the camera and the programmable logic controller, which in turn allows the patented gripper to operate at its full potential. With one product successfully integrated into the other, achieving guaranteed singulation of products is now easy.

Implementing intelligence

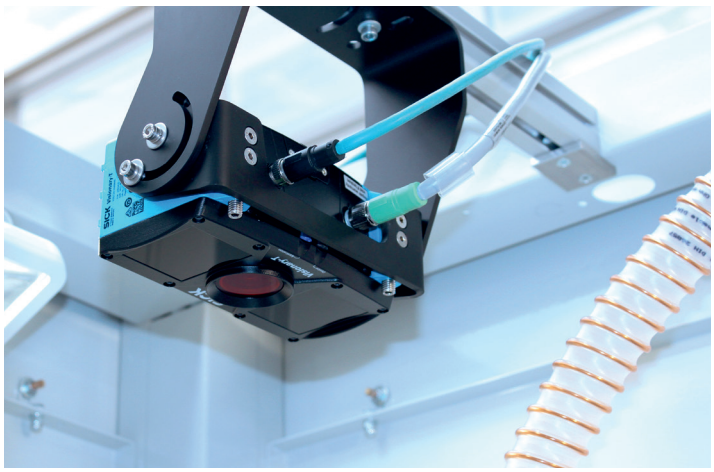
Andreas Frick, project manager and corporate strategist at fpt Robotik, gives his perspective on the technology in this business field: "Robots can do so much. But until now, it just hasn't been possible to use them for automated handling of non-rigid parts, and they haven't always been successful in detecting pouches. Now, we have a gripper and camera working in perfect harmony – which means that we have an actual product that works in an application that used to be impossible for robots to deal with." His words demonstrate perfectly how solving an application like this – the Subito Connect robot cell, in which gripping and setting down need to take place quickly – is a puzzle made up of several small pieces that need to fit together. During their involvement in the project, SICK employees were able to have significant input in the system's intelligence through the camera technology that they introduced. The biggest indicator of the project's success, however, is the way in which the SICK and fpt Robotik teams worked together and kept thinking one step ahead. It is now hoped that the teams will build on this collaborative project to bring about yet more innovative solutions and tangible success stories in the near future. *(mw)*

The Subito Connect A cell from fpt Robotik for pick-and-place applications





The Visionary-T communicates the object positions instantly to the machine controller using straightforward global 3D coordinates, at a rate of up to 50 images per second



The Visionary-T AG 3D camera

AUTOMATION WITH ROBOTS: SAFETY WITHOUT THE NEED FOR PROTECTIVE FENCES

With the help of safety laser scanners from the microScan3 product family as well as a Flexi Soft safety controller, DESMA guarantees the safe operation of a robot on an injection molding machine. The opto-electronic protective devices and the safe control solution allow ergonomic access to the machine for the purposes of process-orientated material staging and removal. As soon as the safety area is clear, the robot automatically picks up the provided raw materials and dispenses the processed silicone and rubber parts. At the same time, the safety laser scanners are especially economical on space and therefore do not impede the work process.

>> The safety concept for the robot on the DESMA injection molding machine was developed in close collaboration between application consultation personnel at SICK and the responsible specialist departments at DESMA. It combines a horizontal 275° protective field used for hazardous area protection in front of the robot with vertical protective fields for hazardous point protection of the work area. When a person approaches the robot, a horizontal safety laser scanner detects this at an early stage, slowing down the robot in a controlled manner so as to avert any possible danger from its movement. As a result, it has been possible to significantly reduce the necessary safety distance between the vertically monitoring microScan3 and the hazardous movements of the robot – and therefore also to minimize the total space required for the machine and its safety technology. A further microScan3 monitors the robot's delivery table. If the machine operator needs to change a tool, for example, and in doing so stands on the table and therefore inside the monitored area, the safety laser scanner will detect this and the robot will be prevented from starting. The entire safety-related application can therefore be operated with automated restart, i.e., without manual restart interlock. Since the safety technology follows the workflows entirely autonomously, workers no longer perceive it as a nuisance, since they are not required to explicitly interact with the machinery by pressing a restart button. The required logic for this as well as the integration of other safety components, such as the emergency switching off button, is provided in the Flexi Soft safety controller. The protection concept jointly developed by SICK and DESMA offers – thanks in no small part to the innovative safeHDDM® scanning technology of the microScan3 – the highest levels of performance and availability for the machines processing silicone and rubber at DESMA.

DESMA: experts in injection molding machines

Premium system-based solutions for a whole host of industries – Klöckner DESMA Elastomertechnik GmbH in Fridingen realizes this ambition through individual turnkey system solutions for the production of technical rubber and silicone molded

articles. With this in mind, the company offers injection molding technology, tool manufacturing, and automation engineering from a single source. It is in this way that the injection molding machines fulfill customer- and industry-specific requirements and enable safe processes, which facilitate the highly profitable production of rubber and silicone molded parts used in vehicles, ships, power supply plants, or medical devices, to name but a few examples.

Human-robot cooperation for automated material supply and removal

Forward-thinking technologies are a key feature of DESMA injection molding machines. The same applies to production methods for technically and economically efficient rubber and silicone processing. One option for improving productivity are work scenarios in which humans and automated machines share the same workspace but work at different times. This human-robot cooperation enables highly optimized workflows and improves plant availability and productivity as well as economic efficiency. That is why DESMA has developed this cooperative workspace for its injection molding machines, which sees a worker supply blanks and the robot act as a production assistant by taking hold of them and inserting them into the machine. Once the blanks have been machined, the robot removes them, gives them to the operator to take away, and inserts the next blanks. The process sequence shows how important it is for workers to have unrestricted access to the machines. This is why the use of protective fences or other mechanical devices around the cooperative workspace was not an option at DESMA.

Horizontal and vertical protection with microScan3 safety laser scanners

The injection molding machine manufacturer has found a solution for this robot application with an electro-sensitive safety system which eliminates the risk of accidents for operators and grants them unrestricted access to the machines. Connected to the Flexi Soft safety controller are a total of four microScan3 – two with horizontal and two with vertical pairs of protective fields. In terms of object resolution, these can be configured in steps between 30 millimeters, for hand detection, and 200 millimeters, for body detection – this means that a single microScan3 is able to work with several protective fields in various resolutions. The integration of these compact and reliable devices is incredibly simple – mechanically, it involves a vibration-resistant mounting system, and electronically, the devices are installed via an 8-pin M12 standard connector. The protective fields to be monitored have a scanning range of up to 5.5 meters and can be easily and directly defined in the machine layout using the Safety Designer software and a laptop. This configuration via USB can then be saved in the safety laser scanner. While in operation, the microScan3 multi-color display shows the operational status of the system – additional information can be called up as cleartext by using the pushbuttons on the control panel.

The technological highlight of the microScan3 safety laser scanners, which meets performance level d in accordance with EN ISO 13849 and SIL2 in accordance with IEC 62061, is their safeHDDM® scanning technology (short for high definition distance measurement). This high-resolution digital process for safety-related time and distance measurement, which sends out more than 100 times as many laser pulses as other time-of-flight measurement systems, offers a number of benefits, especially insofar as the protection of cooperative scenarios, as seen on the DESMA injection molding machine, are concerned.

Unrivaled stable measured values for enhanced productivity

The multi-pulse process in connection with special, digitalized evaluation enables much more stable measured values to be generated and also reliably detects predefined minimum remission values of 1.8 percent, without them being masked by interference signals. The reliable evaluation methods of this scanning technology guarantee maximum availability in the presence of dazzle, dust, or other environmental influences, for example.

Codified pulses prevent mutual interference

The laser pulse time coding of each individual safety laser scanner is particularly crucial if – as in the case of DESMA – many devices are being operated at the same

DESMA found a solution for its robot application with an electro-sensitive safety system which eliminates the risk of accidents for operators and grants them unrestricted access to the machines

When a person approaches the robot, a horizontal safety laser scanner detects this at an early stage, slowing down the robot in a controlled manner so as to avert any possible danger from its movement

time and within close proximity of one another. For area protection around the robot on the injection molding machine, a total of four microScan3 are installed at the robot table at a height of around 200 millimeters. Two of these generate vertical protective fields, which meet at a 90° angle to provide access protection; the third and fourth safety laser scanners are installed horizontally, on and in front of the robot table, to provide area protection. Although the safety laser scanners could be subject to mutual interference, this issue does not arise for the microScan3: The laser pulses of each device are coded by a time delay of a few nanoseconds – and their sequence is additionally modified by an integrated random generator. Therefore, the occurrence of two identically encoded scanner sequences – and with it the danger of mutual interference – is about as likely as a jackpot win on the lottery. Other sensors and sensor systems that use laser LEDs as light sources do not impair the safety function and availability of this new scanner generation.

Increased immunity to dazzle, dust, and deposit formation

Cooperative applications are used in standard production, mounting, and logistics environments. The microScan3 safety laser scanners as a cooperative monitoring solution for the DESMA injection molding machine must be able to cope with the anticipated ambient conditions. With their safeHDDM® scanning technology, they achieve an unrivaled level of ambient light immunity of up to 40,000 lux. They are therefore practically immune to dazzle – no matter whether it is from bright sunlight, high-frequency, artificial ambient lighting or light sources, or reflections shining directly into the optics. What's more, the evaluation by safeHDDM® ensures that the reliability of the detection and protective functions is not impaired either by dust particles in the environment or by deposit formation on the optical interface of the sensors. Furthermore, the microScan3 safety laser scanner features a parabolically curved front screen. This deflects reflections that arrive outside of the optical path of the laser pulses and their remissions into an optical trap – away from the receiver element in the device. This also increases the immunity to dust and deposit formation and the availability of the robot on the injection molding machine.

Extensive expertise in designing safe robot applications

The microScan3 product family has brought about a change in technology in the active scanning safety laser scanners market, delivering benefits with respect to safe and highly available human-robot interaction in particular. The microScan3 as well as the Flexi Soft safety controller belong to a range of sensors and controllers that has developed along with the requirements of safe robot applications over the decades. Safety solutions based on various technologies are becoming more and more intelligent and are constantly making possible new cooperative applications with increasingly demanding requirements. "When it came to choosing SICK as its implementation partner for this cooperative application, the decisive factor for DESMA was the fact that, alongside a wide range of product and system solutions, SICK was also able to offer a high level of consultation expertise in the field of safety technology, as well as comprehensive services with respect to safety concepts," according to Heiko Wolters, Team Leader in Hardware Development at DESMA. *(ms)*

UNIVERSAL ROBOTS AND SICK HEAD TOWARDS THE SMART FACTORY OF THE FUTURE

Outstanding robot specialist Universal Robots (UR) and leading sensor solutions provider SICK have joined forces in order to create two innovative applications for collaborative robots.

>> The applications in question combine both companies' virtues and allow for people and robots to work within the same workspace where the collaborative robot (cobot) takes over all the repetitive and heavy movements while the human collaborator moves freely in a safe environment, adding value through more sophisticated contributions.

The first of these two applications uses two SICK sensors connected to a robot for identification and placement purposes, ideal for pick and place and quality control in packaging and logistic processes. The Lector63x is a 2D vision sensor that informs the robot about the pieces on the conveyor via 2D identification.

"SICK was an early champion of Industry 4.0 before the term even existed", says Jaume Catalán, Industry Manager Automotive & Machine Building at SICK Spain. "Vision sensors, safety and identification solutions as well as Smart Sensors have been the company's backbones for decades. No wonder then that SICK is considered one of the forerunners in all things associated with Industry 4.0 and the Smart Factory."

UR's cobots incorporate 15 safety functions certified by TÜV NORD and thus can operate without a safety fence. They are programmed to stop immediately in case of an accidental contact with a human being or an object in their way. SICK's MicroScan3 safety laser scanner provides a safe environment for the operator by detecting the presence of human beings and automatically reducing the operating speed of the robot upon the intrusion in a defined risk area.

For the second application, the Inspector PIM60 2D vision sensor carries out position detection tasks for pick and place and quality control purposes. The UR robot is able to define the position and orientation of pieces thanks to the data submitted by the sensor. A plug-in developed by SICK integrated in the UR+ platform achieves easier programming and commissioning in less time.

"The combination of technological curiosity and investigative restlessness that characterizes all successful industry providers in this case once again has led to extraordinary results that surely will add value to production processes in years to come," concludes Mr. Catalán. *(cf)*

Thanks to Universal Robots and SICK humans and robots are working more closely together

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