



Continuous further development:
The key indicator cockpit (right)
was recently added to Turck's
pick-to-light system

Assembly Helper

Turck shows system solutions for light-controlled worker guidance in manual assembly processes in the SmartFactoryOWL manufacturer-independent demonstration platform

A product is never launched in industry that was not previously thoroughly tested. This is absolutely essential – just in order to meet the relevant safety standards. However, it is never possible to take into account all eventualities even through intensive testing. Company employees responsible for buying have to rely on the information given by the manufacturers. It is seldom possible for the customer to see new systems in action before they purchase. However, this is where the SmartFactoryOWL provides a solution.

Manufacturer-independent solutions for hands-on testing

The SmartFactoryOWL model factory was founded in Lemgo in April 2016 by the University of Applied Sciences East Westphalia-Lippe and the Fraunhofer Institute. "One aim of the SmartFactoryOWL is to develop different assembly concepts and use the different assistance system technologies or also combine these together," says professor Sven Hinrichsen, who represents the industrial engineering area in the SmartFactoryOWL. The professors, employees and students work there in small teams on the optimization of production processes with the help of new technologies.

Pick-to-light for every requirement

Hinrichsen and his team have been working with the pick-to-light system developed by Turck and its optical sensor partners Banner engineering for two years. The initial aim was to optimize a manual assembly process

with a wide range of variants for a machine builder. The first version of the light-controlled worker guidance system was completed in the same year that the factory was founded, and has been continuously further developed up to today.

The Turck portfolio provides an optimum range of solutions for extensively optimizing the manual assembly process. The worker first of all reads in a 2D

QUICK READ

The SmartFactoryOWL is a demonstration platform that provides support in intelligent automation for small to medium-sized companies on the way to digitized production. As a partner of the SmartFactoryOWL, Turck has been represented since 2016 with a pick-to-light system, to which researchers and students of the OWL University of Applied Science have now added a put-to-light system and a key indicator cockpit. The put-to-light system optimizes the supply of materials, while the key indicator cockpit provides guidance for the worker during the assembly process. The cooperation between Turck, the SmartFactoryOWL and Assembly Solutions enabled the development of a projection-based assistance system using Easy Array light curtains from Banner Engineering.

code via the iVu vision sensor from Banner Engineering. The connected TX513 HMI then shows the assembly process on the start screen. A programmable gateway for the IP67-rated BL67 I/O system acts here as the controller. Turck programmed the pick-to-light application on the gateway with Codesys 3, which contains TargetVisu as an additional program for the visualization of the individual assembly steps. The system was implemented so that users can enter new product configurations themselves without any programming required. The K50, K30 and PVD sensor lights from Banner show the worker the next part to be assembled and thus provide guidance through the entire assembly process. Workers acknowledge that the required part has been picked by triggering the integrated sensor when their hand is placed in the indicated container.

Extension with put-to-light and RFID

In practice, a logistics worker has to go through the different assembly workstations and check whether containers are empty, bring these to the warehouse, fill them and take them back to the workstation. Containers can also be forgotten here or placed in the wrong picking shelf, thus leading to interruptions in the assembly process. Sven Hinrichsen and some of his students took up this challenge in the SmartFactoryOWL model system and developed a put-to-light solution for optimizing material logistics. The system notifies the warehouse automatically of any empty containers.


If a container is emptied during the assembly process, the worker places this on a transport trolley located next to the workstation. An RFID read/write head in the front of the trolley ready the to the warehouse. New containers are filled with the required components in the warehouse.

“Unlike labeled containers, this RFID system enables the actual content of the containers to be written to the tag. Thanks to the fast information transfer, we are able to reduce the number of required containers and therefore also reduce stock levels in the plant,” explains Sven Hinrichsen.

The actual put-to-light process is used back at the workstation. The picking shelf equipped with the pick-to-light system at the front has the corresponding put-to-light system at the back. The logistics worker holds the filled container in front of a read/write head. Depending on the transferred data, the light for the appropriate track on the shelf in which the container is to be inserted turns green. The worker acknowledges the placing of the container in the appropriate track by pressing the lamp. This goes out as a result, and turns red if the worker acknowledges the wrong one.

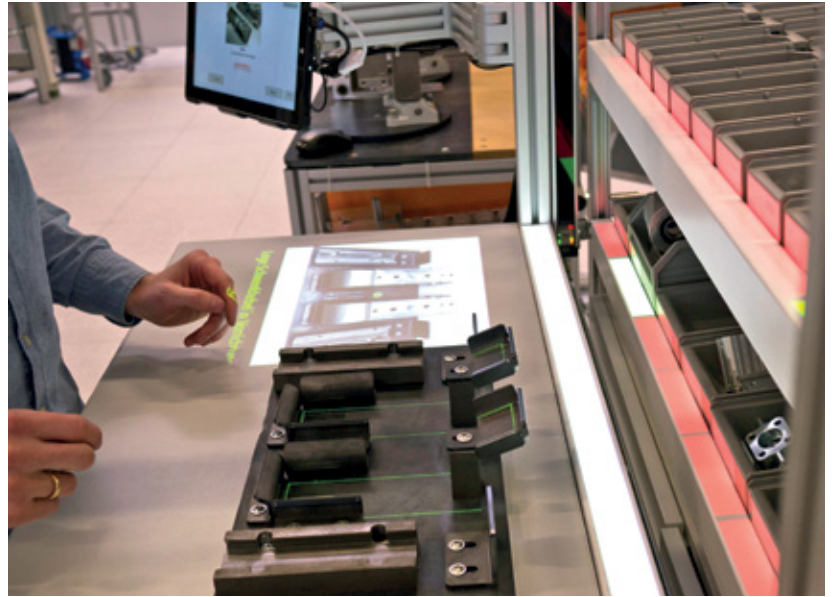
Overview thanks to key indicator cockpit

After students thoroughly tested the assembly system, it was decided to provide the ability to display the actual progress of the assembly process. This information is shown to the worker in real time by the key indicator cockpit next to the workstation. It can also show the produced batch size, the order list and other key indicators. The cockpit acquires its data directly



The picking shelves are fitted with RFID read/write heads from Turck, which identify the inserted containers

Showing the next step: projection-based assistance systems with measuring light curtains from Banner Engineering



from the TX513 of the pick-to-light system via OPC-UA. "Each individual step is logged so that we have continuous status information," Hinrichsen explains the decision. The individual values are calculated in Turck's programmable BL67 gateway. This provides information via Ethernet to the TX513 HMI, which sends the information via OPC-UA to the large display above the workstation.

Key indicator cockpit used for process monitoring

The key indicator cockpit can also be used in industrial applications to identify problems. If the time required for an operation fluctuates considerably, this process step has to be checked. A component may have got stuck at this particular position. However, it is also possible to make inferences about the ergonomics of the workstation or the tool.

Image processing in manual assembly processes

A master's degree project completed by Alexander Nikolenko demonstrated once more the benefits of SmartFactoryOWL. In his master's study, Nikolenko made an in-depth examination of the possibilities for image processing in manual assembly processes. "This is actually an area that was not previously a focus of the system suppliers. Image processing now particularly makes a contribution to ensuring production quality in highly automated processes. As manual assembly processes are becoming more complex and thus more susceptible to errors due to the increasing number of variants and small batch sizes, image processing systems also offer considerable potential in this application field," explains Nikolenko, who now works as a researcher in SmartFactoryOWL. Nikolenko's work focused on the requirements of image processing and documented the necessary optimizations. In his studies he used the VE camera from Banner Engineering.

The camera is not yet a permanent part of the pick-to-light workstation in the SmartFactoryOWL. However, the VE camera will look over the shoulder of

the operator and check whether the components are being correctly used and assembled. If this is not the case, the camera detects this and does not enable the next assembly step.

Projection-based assistance systems from Assembly Solutions

The University of Applied Sciences East Westphalia-Lippe presented a demonstrator projection-based assistance system at the Hannover Messe 2016. The prototype presented at the fair attracted considerable interest. It was this success that caused Daniel Riediger and other colleagues to found Assembly Solutions, a company that develops assistance systems for manual assembly processes.

Assembly Solutions developed a system that projects the current work instructions and the components directly onto the workbench by means of a projector. The projection shows the necessary information for correct assembly using images, symbols and plain text. Light beams, arrows or other markings indicate which component currently has to be fitted and how. This guides the operator continuously through the process, thus reducing the error rate and boosting productivity.

Measuring light curtains detect tool compartments

The projection-based assistance system was implemented at an assembly workstation at which assemblies for an edge milling machine are to be completed manually in different variants. The assistance system also directs the fitter of the edge milling machines with instructions to access the correct component compartments. Two pairs of measuring light curtains from the Turck portfolio, which are fitted horizontally and vertically in front of the picking shelf with the component containers, check whether the correct component has been picked. Banner Engineering's Easy Arrays form a 2D coordinate system, in which the container positions and sizes can be defined and adjusted easily. They



The put-to-light system indicates the row in which the newly filled container has to be inserted



Researchers at the SmartFactoryOWL: Alexander Nikolenko, professor Sven Hinrichsen, Daniel Riediger, CEO of Assembly Solutions (from left)

are therefore independent of the material trolley storing the containers. Easy Arrays communicate via Modbus RTU with Turck's TBEN-S-2COM module, which in turn communicates with the PC-based controller of the application via Modbus TCP.

"The actual communication runs autonomously via the 2Com modules which we have only set via their web servers; no other settings were required," Riediger explains the setup. Unlike many other I/O modules, the TBEN-S-2COM comes with a pre-installed Modbus-RTU client (master) on board. Users of the module do not have to program the module client or purchase an additional Modbus license.

If the operator picks from the wrong container, the Easy Arrays register the hand position and transfer the position data to the 2Com module, which sends it to the controller via Profinet, Ethernet/IP or Modbus TCP. As a result, the "Incorrect container" text is projected onto the work surface and the corresponding container is lit in red. As a specialist for customer solutions, the Turck subsidiary Mechatec also offers this system as a single sourced complete solution.

Partnership

The starting signal for the lasting partnership between Turck, the laboratory for industrial engineering of the OWL University of Applied Sciences and the SmartFactoryOWL was the introduction of the pick-to-light workstation in 2016. The further developments achieved to date and the know-how acquired are testimony to the reliability of the partnership. For Turck,

the cooperation with its Lemgo colleagues provides the opportunity to test new complete systems under realistic conditions and to show what is possible today in the field of digitized production.

The cooperation also gives students, lecturers and companies the opportunity to exchange views and thus also the testing of unusual ideas without any time or cost pressure. Visitors to Lemgo are presented with realistic applications on neutral ground without any sales pressure. The SmartFactoryOWL and the Laboratory for Industrial Engineering have found in Turck a partner that can offer single-sourced complete solutions as well as its wide range of components. The company also has extensive know-how on all levels of the automation pyramid.

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