VISION INSPECTION SYSTEM DELIVERS RAPID RETURN ON INVESTMENT FOR INNOVATIVE EV COMPONENTS PROJECT

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Vehicle manufacturers rely on human inspectors to catch defects in complex assemblies. But even with 100% visual inspection, these checks are only 87% effective at catching defects, according to Juran's Quality Handbook, the inspection industry's authoritative reference for quality management and engineering.

In electric vehicle (EV) manufacturing, the drivetrain inverter and converter are two of the most important components in the vehicle build. These units, which are often combined into a single housing, include critical technologies for regulating current in the vehicle battery packs, capturing energy from regenerative braking, and providing voltage to motors during acceleration.

"EV manufacturers inspect carefully," said Norman Granzow, test engineering team coordinator at the Preh Group, a top 100 automotive supplier. "But human inspectors still miss functional defects and that undermines brand reputation and customer satisfaction."

Building Quality and Traceability into a New EV Sports Car

The Preh Group wanted to address such issues as it prepared to implement vision inspection systems for the production of a high-performance sports car's 800V DC/DC multi-converter. Preh, which is headquartered in Germany and has more than 7,000 employees globally, was hoping to use automated visual inspection to promote quality and simplify traceability over the product's life cycle.

The company tasked an EV product team with evaluating available solutions, including automated visual inspection systems offered by some of the industry's leading suppliers. The team found that these systems typically required multiple expensive cameras, specialized lighting stations, and long development schedules to refine traditional rules-based algorithms for complex assembly inspection.

More concerning, testing suggested the systems would struggle under real-world conditions to distinguish between cosmetic defects such as scratches, dents, and shade variations and functional defects such as bent pins on ports and connectors, untightened screws, missing components, and wrong barcodes.

"Parts with considerable variation such as multi-converters are hard to inspect," Granzow said. "They have a hundred inspection points with mixed materials, complex shapes, and hard-

A vision inspection system should be able to distinguish between cosmetic defects, such as scratches, and functional defects.

Functional defects like the broken electrical connector identified in the image on the right can lead to short circuit failure.

to-visualize surfaces. A connector pin with a couple of millimeters of misalignment matters."

Making Visual Inspection Simpler and More Reliable

Throughout this process, the EV product team had been in talks with staff at Kitov about the company's stand-alone visual inspection system, Kitov One. Unlike competing solutions from the large providers, Kitov One had a complete inspection station with a robot arm and an attached off-the-shelf CMOS camera with multiple brightfield and darkfield lighting elements and special software for photometric inspection and capturing 2D images and rendering them into 3D.

"Multiple cameras increase costs dramatically and hinder flexibility" Granzow said. "The robot arm allows the system to use just one low-cost camera while capturing the majority of all six sides of the unit."

The system's robot planner automatically maneuvers the robot and camera without operator input. Onboard intelligence determines where to move the camera, sets the illumination level, and decides how many images to capture for each test point. In production environments such as the EV factory, it can control an external material handling unit that moves parts in and out of the inspection station as needed.

Adopting Visual Inspection Drives Rapid Return on Investment

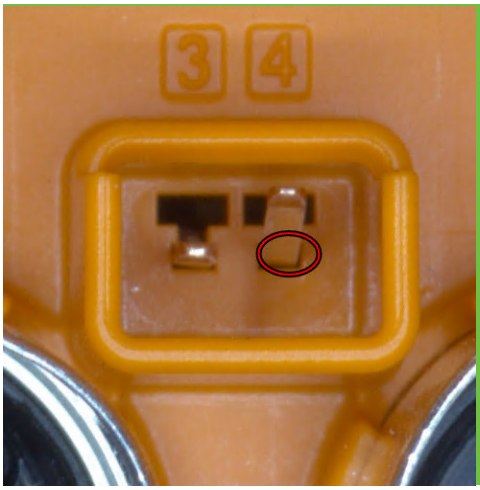
The EV product team found that the Kitov One system was simple to set up. Unlike other systems, it did not require time-consuming integration or training efforts.

Programming requirements were minimal and largely handled by the system's own machine vision algorithms and pretrained deep learning neural networks. This ongoing learning helps the system develop a granular understanding of which defects are significant and which are allowable.

"The system combines classic artificial intelligence with machine learning and deep learning," Granzow said. "No engineer has to calibrate parameters or set thresholds."

Fine-tuning inspection plans is easy. Customer employees can refine detections by entering common semantic terms such as "screw," "port," "label," "barcode," and "surface." Learning a machine vision programming language is not required.

The Kitov One system was able to identify a bent pin on the port on the right.



Inspection data is easily routed to back-end and plant management systems. The EV product team anticipates that this data will yield insights it can use to improve the assembly process, trace components, and increase the efficiency of the manufacturing process.

"The EV project was so successful that Preh Group is likely to deploy the Kitov One system at other manufacturing facilities as well," said Granzow.

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