CASE STUDY

Reinventing the engine assembly cell inspection

Modern engine assemblies are one of the most expensive components in today's new vehicles. One recent study estimates they represent 22% to 24% of the total cost of manufacturing. Defects in an assembly can generate substantial warranty, recall and legal expenses for automakers and suppliers as well as further reduce vehicle profit margins.

Recent recall data from the National Highway Traffic Safety Administration (NHTSA) suggests the manufacturing process is responsible for up to 50% of engine defects. Many manufacturers rely on manual or semi-manual visual inspection to catch defects before an engine assembly leaves the plant. Often, these inspections are very time consuming. However, quality experts estimate these methodologies are only 87% effective even when introducing redundancies.

Automated in station fixed camera systems are not the only solution for high-value assemblies

Some manufacturers are considering automated vision systems as an alternative to labor-intensive manual processes. While this system can significantly improve quality assurance, it may not be the best option for assemblies with large numbers of inspection points.

"Most engine assembly lines have over 20 inspection points per station operation," Karthigeyan Vadivel , automotive industry manager for Omron Asia Pacific says. "Even with multiple cameras, you cannot achieve complete coverage without moving the assembly several times and then re-indexing to capture clear images."

Repositioning within an operation adds significant time to the quality assurance process. It also increases the risk that the assembly may be damaged or modified by a handling error.

A robotic vision system is more accurate and efficient

During a recent engagement with a large engine manufacturer, Omron proposed a new single-camera FH Series configuration that addressed both handling and cycle-time issues.

Suresh Kumar, sales manager for Omron Asia Pacific, learned that the customer had previously installed two robots on either side of the line in station to complete all inspection points. This took up a lot of valuable floor space and the robots created too much localized vibration for a successful image capture. Extensive testing of the Omron configuration proved the Omron Adept Viper was not subject to the vibration issue; however floor space and auditor access remained a concern. The customer also had experimented with collaborative robotic options; however the increased cycle time was a significant issue.

Omron suggested inverting a six-axis Omron Adept Viper 850 robot so that it hung upside down on a 360 degree swivel platform to deliver all 26 points of inspection in a compact open cell that could be modified in the future to work as a collaborative robotic cell. This would allow for full access around the engine assembly to allow one Viper robot and one FH camera system to complete the task, but also eliminated any floor space or conveyor vibration interaction.

Moving the camera is more efficient than moving the assembly

After the proof of concept was accepted, Omron compared the quality assurance performance of two FH Series vision systems: one configuration without

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Business Need

Today's inspection work cells are ill-suited for the more fluid environment envisioned for the future assembly line. Assembly, quality and traceability are built around human capability with a manual "two handed" approach. To make inroads into complex and customized assemblies, solutions are required that allow for a much more highly developed sense of vision and placement within a fully traceable system.

Flexible Solution

Omron's FH Series vision system combined with the Omron Adept Viper robot provides an accurate, affordable, and easy-to-set-up vision inspection solution for complex assemblies and challenging environments. Omron's Sysmac Studio package provides a one-stop solution for control. Combined with Omron's NJ SQL platform real-time traceability is possible.

Customer Benefits

Customers are able to improve throughput, inspection accuracy, and data traceability in a cost effective and compact workspace. Near to Zero defects in high-value and highly customized assemblies ensure compliance with government mandates while avoiding expensive recall and litigation efforts.

a robot with seven fixed cameras mounted from the ceiling and one with a single camera mounted to an inverted Omron Adept Viper robot.

"Both systems did an excellent job checking engine assemblies for defects," Karthigeyan says. "But the robot configuration delivered a 20% faster cycle time in this instance for multiple variants without any changes in setting or positioning."

Changes in engine assembly production also meant the fixed system would be more dependent on operator interventions. When changeovers occurred, for example, it was likely the process would have to be paused while a worker repositioned cameras. With the inverted robot version, the system could make these adjustments on its own and with minimal impact on efficiency and footprint.

Turnkey solution is simpler to own and operate

During this engagement, the customer reviewed automated vision systems from other vendors. But its evaluators had reservations about purchasing these systems since they had been assembled using components from multiple suppliers.

"The customer wanted a turnkey solution from a single vendor," Karthigeyan says. "Concept design, versioning control, maintenance and parts sourcing were big concerns. With Omron, the customer received a complete turnkey system."

Omron's FH-SC04 4 megapixel digital CMOS color camera was selected. Omron's configuration allowed for multiple inspections (quality, 2D, conformance) and specialized inspection techniques (such ultraviolet light for grease detection) with very high correlation coefficients to be employed, allowing for further flexibility.

The FH-1050 Series controller with two image processing cores provides a low-cost way for storing captured inspection images directly in real time to a networked SQL database. The controller features a high-performance networking bus for transferring image data to a backend system via EtherNet/IP connections.

Software includes the Omron Sysmac Studio package, which provides a powerful but intuitive tool for controlling the Omron Adept Viper robot via the NJ MAC. The software's integrated development environment (IDE) and library of prebuilt function blocks accelerate programming time and allow new programs to be tested before deployment.

In addition, the NJ MAC can store multiple Sysmac Studio programs and automatically select inspections points for different assemblies without interrupting the quality assurance process. An Omron Remote Operation Tool supports communication over existing Ethernet networks. Quality assurance personnel can update or change modeling parameters to a core without interrupting the inspection process.

A solution for modern manufacturing environments

Within the first three months of operation, the customer reported zero defects coupled with a 50% cost reduction from alternate systems. A full station "cycle" was eliminated from the line in addition to the reduction in inspection time. The automaker is now pushing to make this solution a standard globally.

"Automakers are very focused on quality and traceability due to regulatory and compliance concerns," says Karthigeyan. "A properly configured solution can deliver a lot of value and help customers protect their investments and profit margins while offering flexibility for the future."

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Omron Automation is a global automation partner that creates, manufactures and services fully integrated automation solutions. We provide controls, vision, safety, motion and robotics for the automotive, semiconductor, food/beverage, packaging, pharmaceutical and infrastructure industries.

For over 80 years, Omron has helped industrial businesses maximize potential by solving problems creatively. Currently headed by President Yoshihito Yamada, our company is 36,000 employees strong—providing products and services in more than 110 countries worldwide.

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