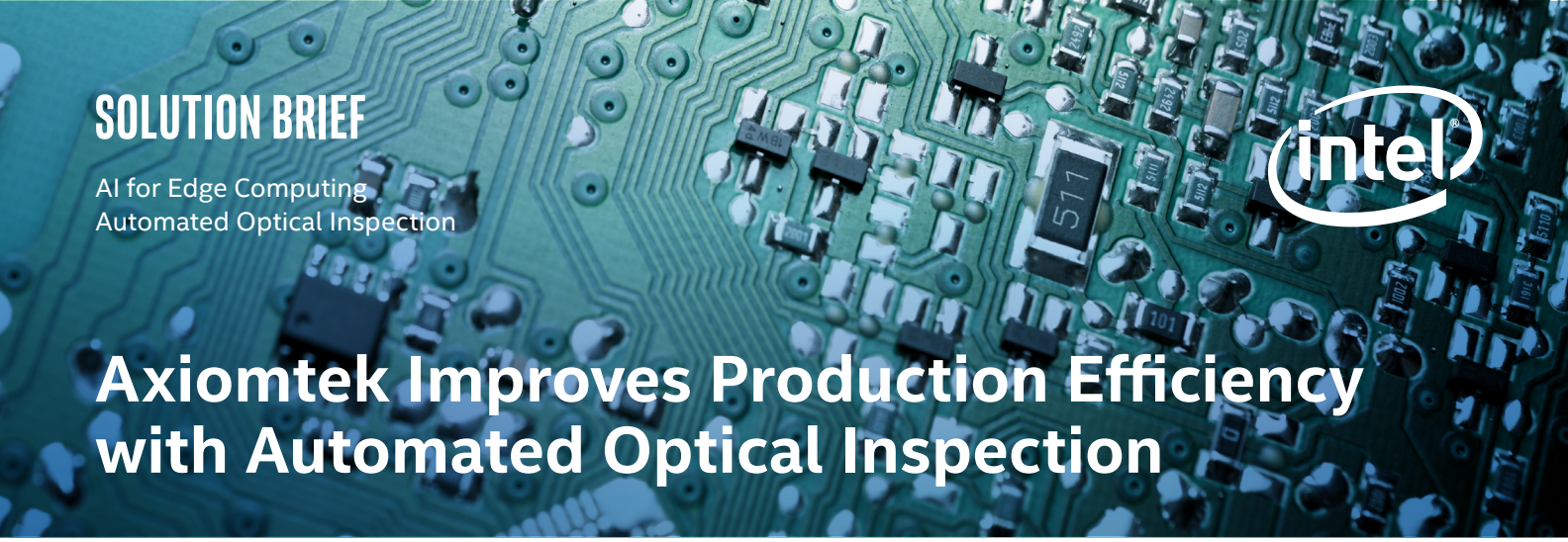

SOLUTION BRIEF

AI for Edge Computing
Automated Optical Inspection

Axiomtek Improves Production Efficiency with Automated Optical Inspection

Solution built with Intel® Edge Insights for Industrial identifies defects for printed circuit board assembly

AXIOMTEK

"Intel® Edge Insights for Industrial, offered through the Intel® Edge Software Hub, accelerates edge computing implementation in the industrial field. It helps create a unified, cost-saving edge platform integrating data from diverse sources to generate actionable insights and optimize production processes. Axiomtek's AI starter kit uses a platform based on Intel® Core™ processors and Edge Insights for Industrial to help users deploy vision applications while saving time and money."

—Albert Huang, CEO, Axiomtek

As AI technology advances, manufacturers increasingly look to machine vision solutions to overcome their business challenges, improve product quality, and increase operational efficiency. For manufacturers engaged in printed circuit board assembly (PCBA), defect detection is critical to ensuring product quality. Now, Axiomtek has built an automated optical inspection (AOI) solution capable of detecting multiple defects with a high degree of accuracy.

Built with **Edge Insights for Industrial**—an Intel® software package designed to enable advanced workloads at the edge for industrial applications—the Axiomtek AOI was designed to enhance traditional machine vision solutions, using deep learning and edge computing to reduce latency and optimize for cost and power efficiency. Originally created for Axiomtek's own factory production line, the company now plans to scale and make the solution commercially available, allowing printed circuit board manufacturers to quickly develop their own quality inspection applications.

Challenges: Detecting defects accurately while keeping costs and power consumption under control

Solder joint defects are a common cause of defective PCBs. Solder defects including short circuits and incorrect amounts of solder can render a PCB inoperable, so inspection is necessary to ensure quality. Traditionally, solder joint quality was ensured with manual visual inspection (MVI), using a human to detect defective solder joints. Today, circuit board components are too small for MVI to consistently detect defects.[1]

AOI solutions, able to detect defects using machine vision and image feature analysis, have been adopted as effective alternatives to MVI. However, conventional vision libraries that worked by sending images to central compute resources for processing led to high latency and power consumption, driving costs upward. To make a machine vision defect detection solution more cost-effective, power consumption must be reduced.

Solution: AI inferencing at the edge for power- and cost-efficient defect detection

To optimize for cost-effectiveness and power utilization, Axiomtek developed its AOI solution for PCBA using edge technology to bring compute resources closer to the devices capturing images. Images are preprocessed, then defects are detected and classified using AI algorithms. Out of the box, the system is able to detect four types of defects: short circuits, too much solder, too little solder, and empty solder. The accuracy of the system to detect defects grows as additional training images are added, with internal tests showing a detection rate of up to 99.9 percent.[2]

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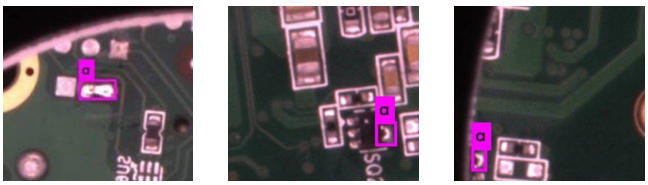
All suspected problematic solder joints are marked with the result shown on a monitor for human inspectors to check. This accelerates the manual visual inspection process by directing the inspector's attention only toward the anomalies, which are the joints suspected of quality issues.

In addition to using its new AOI technology for its own production lines, Axiomtek plans to scale the solution to other manufacturers. These manufacturers will be able to adopt the visual processing and analysis algorithms developed by Axiomtek to detect additional issues based on their unique production needs.



Before boards are manually inspected, the AOI system marks all suspected anomalies and indicates them on a monitor, so visual inspection is streamlined.

Benefits of the Axiomtek AOI solution include:

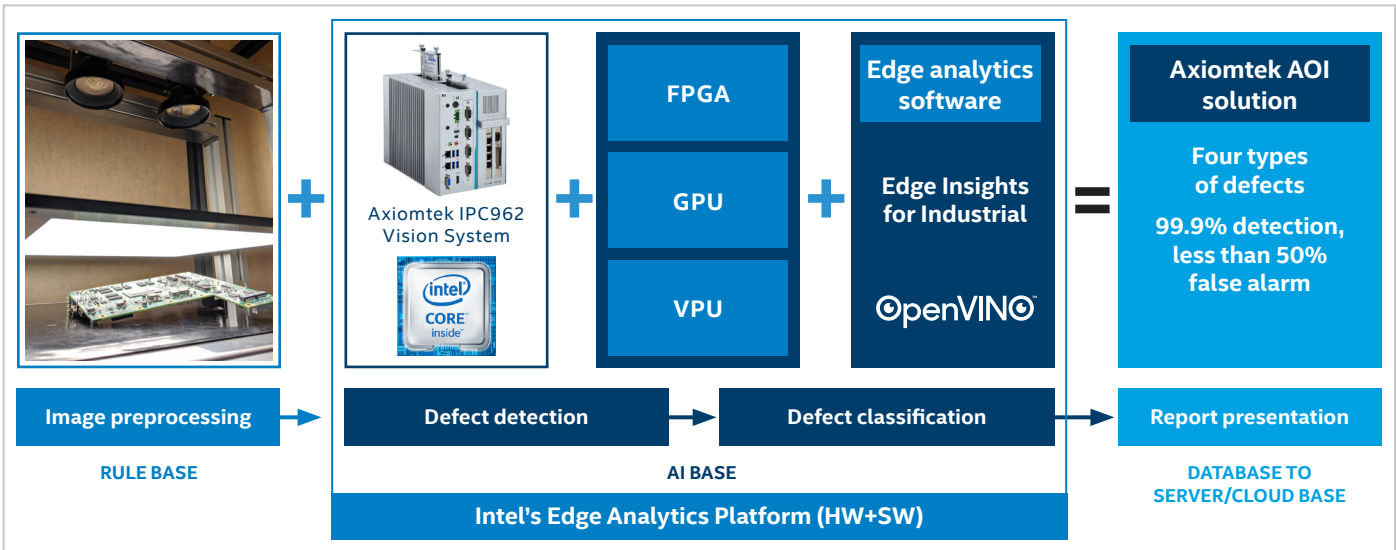
- **Lower costs for data transmission and power consumption:** By moving image processing and defect detection and classification to the edge, the amount of data transmission and power consumption required for AOI is significantly reduced: from 250W power usage using the NVIDIA GTX 2080 to less than 30W with the Intel® Movidius™ VPU.[2]
- **Multiple defects types detected:** A single unit can detect four different types of defects out of the box,[2] and the visual detection algorithms used by the Axiomtek AOI solution can also be used to detect additional defects when trained with images of circuit boards with and without the specified defect.
- **Improved productivity:** Automating defect detection in the production line makes inspection faster[2] and can maintain consistent accuracy without being subject to human fatigue or errors from subjective observation.

How it works in brief

Detecting defects with the Axiomtek AOI solution begins with ingestion of training data. Thousands of images are used to improve the performance of AI algorithms detecting each defect type. To optimize the effectiveness of detection, the distance and angle between training data objects and cameras must be as close as possible to real-world testing conditions.

The Axiomtek AOI solution uses an Intel® Core™ processor-based platform as well as Edge Insights for Industrial, which allows easy integration of data, devices, and processes in manufacturing applications, enabling near-real-time intelligence at the edge. This allows manufacturers to achieve greater operational efficiency for factory use cases, including defect detection. In addition, the Intel® Distribution of OpenVINO™ toolkit enables the Axiomtek AOI solution to be deployed with existing Intel® hardware, as well as flexible, heterogeneous computing depending on the power and performance required for the needs of each product and process.

Multiple camera types can be used for image intake. USB cameras, Basler cameras, and RTSP cameras can be connected quickly and easily using the camera software development kit included in Edge Insights for Industrial. Axiomtek uses Basler cameras in its own solution. Using Edge Insights for Industrial, Axiomtek was able to develop its own application quickly, allowing the capture of images and camera events. Once the most complex image capture problem has been solved, users can rapidly continue on to training and inference, and eventually deploy the AOI solution to deliver business results.



Conclusion: Improved circuit board defect detection powered by Intel® technology

Ensuring quality in printed circuit board assembly production lines requires AOI technology that works better than the human eye at detecting solder joint and other defects. Axiomtek developed an AOI solution that processes images and classifies defects at the edge, with reduced latency, increased accuracy, and lower power consumption and cost.[2]

Using Intel Insights for Industrial and the Intel Distribution of OpenVINO toolkit, Axiomtek has created a solution for its own factory line, as well as other PCB manufacturers, that allows for adaptable, expandable detection of multiple defects to keep manufacturing quality high.

Learn more

Visit the Axiomtek AOI **solution page** today to discover how Axiomtek can help your factory increase operational efficiency.

To find out more about Intel's software package for enabling advanced AI workloads at the edge in industrial use cases, explore **Edge Insights for Industrial**.

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About Axiomtek

Founded in 1990, Axiomtek is a leading design and manufacturing company in the industrial computer and embedded field. As a leading industrial manufacturer, Axiomtek is devoted to producing state-of-the-art solutions that support users in achieving their goals.

axiomtek.com

1. https://www.researchgate.net/publication/316354133_Solder_joint_defect_classification_based_on_ensemble_learning.
2. Source: Internal Axiomtek testing data.

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