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Transforming Semiconductor IC Substrate Inspection with AI, Powered by PEGATRON and ASRock Industrial

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A global leader in semiconductor packaging, specializing in IC substrate manufacturing, deployed an advanced AI AOI system for second-stage inspection to streamline its post-AVI (Automated Visual Inspection) process. The solution integrates PEGATRON's PEGAAi, an end-to-end AI platform, with ASRock Industrial's iEPF-9030S Robust Edge AIoT Platform. By leveraging edge AI capabilities, the solution performs automatic anomaly detection, significantly reducing manual re-inspection workload, improving inspection efficiency, and enhancing yield stability. The deployment highlights the powerful synergy of smart AI software and rugged, high-performance hardware, accelerating smart manufacturing in the semiconductor industry. Furthermore, the scalable solution has been successfully deployed in more than 13 PEGATRON factories worldwide, with a total of 400 to 500 sites.

Challenges

IC substrate manufacturing is a critical and technically demanding process within semiconductor packaging. As demand for high-performance, compact, and energy-efficient devices grows, the manufacturing needs to meet miniaturization and high-density design, stringent yield and quality control, and managing complex materials and processes. Overcoming these is crucial to ensure reliability and performance of devices across applications from consumer electronics to automotive and high-performance computing.

In quality control process, traditional Auto Vision Inspection (AVI) systems often generate excessive false positives commonly referred to as "overkill", where non-defective units are misclassified, as defective. This results in an unnecessary increase in Vision Repair System (VRS) human re-inspection workload, requiring many human operators to manually review large volumes of samples that ultimately do not contain defects. The repetitive nature of human re-inspection process not only consumes substantial labor resources but also reduces inspection throughput and contributes to operator fatigue. Compounding this issue is the absence of a real-time AI integration framework capable of pre-filtering these false positives at the edge, preventing the intelligent allocation of inspection resources and limiting opportunities for

process automation and continuous improvement.



Solution

To address these challenges, the leading global semiconductor packaging provider implemented a comprehensive AI-driven inspection solution that integrates PEGATRON's PEGAAi platform with ASRock Industrial's iEPF-9030S Robust Edge AIoT Platform to enhance IC substrate quality control. The AI station, powered by PEGAAi platform and iEPF-9030S, performs second-stage screening between the Auto Vision Inspection (AVI) and Vision Repair System (VRS) stages, automatically classifying and filtering out false positives to minimize unnecessary human intervention.

ASRock Industrial's iEPF-9030S, equipped with Intel® 14th Gen Core™ processors, provides the high computing power required to execute AI model training on-site and perform real-time AI inference of defects inspection. The solution further incorporates Auto MLOps workflows for model optimization and AI performance dashboards, enabling continuous feedback from operator re-inspection to refine the AI model. This end-to-end integration not only streamlines the inspection process but also ensures adaptability, scalability, and sustained accuracy in demanding semiconductor production environments.

Benefit

The implementation of PEGATRON's PEGAAi platform in combination with ASRock Industrial's iEPF-9030S Robust Edge AIoT Platform for IC substrate inspection has delivered measurable improvements in inspection accuracy, labor efficiency, and system scalability within high-volume semiconductor manufacturing environments.

Significant Reduction in Manual Workload

By introducing AI-powered second screening before operator involvement, the system reduced

excessive false positives generated by AVI machines. This directly lowered the need for labor-intensive visual re-inspection, cutting manual workload by 50-70% and improving workforce allocation.

Enhanced Inspection Accuracy and Production Quality

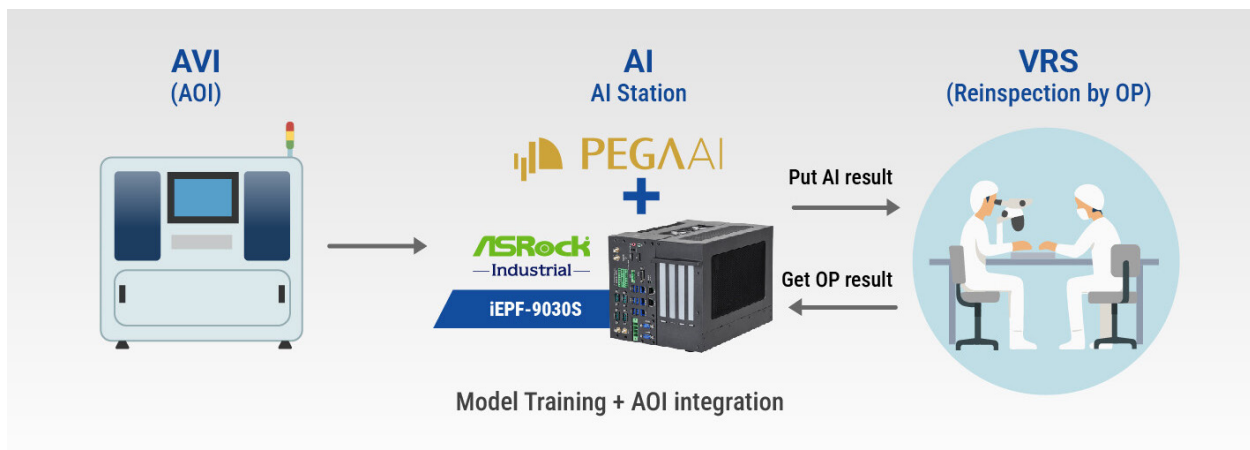
Through accurate anomaly classification and continuous AI model refinement, the solution minimized overkill incidents and false defect identifications. This led to improved defect detection precision, enhanced yield stability, and more consistent product quality.

Streamlined Operational Efficiency with Real-Time AI

The integration of high-performance edge computing enabled real-time inference and on-site retraining, solving delays caused by disconnected or centralized inspection systems. This improved responsiveness and supported faster, more intelligent decision-making on the production line.

Improved System Scalability and Factory-Wide Consistency

The modular architecture allowed the solution to be scaled and deployed across over 13 PEGATRON factories globally, with a total of 400-500 sites. This eliminated the scalability barriers of traditional inspection systems, enabling consistent quality control across multi-site operations.



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