

Simplify Smart Factory Transformation with AI Vision for Enhanced Yield and Predictive Maintenance

Case Study

Introduction

The Vision of a Smarter Factory

Predictive maintenance has long been the aspiration of factory management. By implementing predictive maintenance and anomaly detection systems capable of halting equipment when issues are identified, product quality, yield, and productivity can be significantly improved, creating a positive feedback loop for continuous optimization. NXP Semiconductors' smart factory epitomizes this pursuit of manufacturing excellence. Focused on Vision AI and predictive maintenance, it aims to achieve full automation and operational intelligence.

NXP® partnered with ADLINK, deploying SP2-IMX8 ARM-Based Panel PC and EMU-210 programmable IIoT Gateway, both powered by the NXP i.MX 8M Plus applications processor and integrated with the EdgeGo platform as edge device manage-ment and NXP's eIQ® AI training software for Automated Optical Inspection (AOI) enabling real-time AI computing at the production lines. This marks the initial step in the transformation of manufacturing operations, with the ultimate objective of achieving comprehensive predictive maintenance capabilities. By fostering a sustainable cycle of continu-ous improvement, AI-driven systems pave the way for long-term growth and scalability.

Strategic Goals

1. **Utilizing Vision AI to detect production anomalies and improve product yield.**
2. **Reducing maintenance costs through predictive data analysis.**
3. **Building a knowledge base to streamline process development, reducing costs and time to market.**

> To transform manufacturing, set clear goals, invest in the right technology, adopt AI tools, foster collaboration, ensure security, and implement solutions step by step, optimizing as you grow.

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Challenges

Manufacturing and Quality Control

In semiconductor manufacturing, integrated circuit (IC) processes from wafer testing, wafer back-grinding, mounting, die saw, die bonding, oven, wire bonding, molding, marking, ball placement, singulation to final inspection, pack, and shipping are critical steps where precision is paramount. Customers expect nothing less than zero-defect products, making rigorous quality control and flawless execution essential to meet these high standards and ensure customer satisfaction.



To achieve this, the challenges are reaching a False Positive Rate (FPR) and Error Rate at zero, fast response, low power consumption, and ensuring the confidentiality of process inspection technology. Proprietary techniques must remain secure and protected from unauthorized disclosure during the IC packaging.

By adopting edge computing, the factory eliminates the concerns and gains several advantages over the traditional Client-Server Model: real-time performance with low-latency processing at the production line, improved system stability by reducing network dependence, modular scalability for optimizing detection models, and enhanced data security through localized processing.

Benefits

Measurable Impact on Production and Quality

The deployment of edge computing and industrial display solutions integrates 10” mechanical customized panel PCs equipped with a 4K MIPI/USB camera for AOI, enabling machine learning (ML) intelligence directly at the edge. Secured data is then transmitted through a gateway to the cloud for advanced analysis, resulting in measurable improvements across key manufacturing stations:

1. AI-Powered Vision Inspection:

- Wafer Testing: Increased probing efficiency by **5x**, with **100%** detection accuracy and a reduced FPR of **0.001%**.
- Die Bond Anomaly Detection: Real-time inspection with **99.99%** product yield.
- Wire Bonding: Detection of particle anomalies during bonding, with secure cloud transmission.
- Final Product Packing: Eliminated human errors, such as labeling and placement.

2. Centralized Edge Management with EdgeGo software:

- Unified device control and standardization of operations via EdgeGo software.

3. Data Security with Edge Computing:

- Mitigates concerns over transmitting sensitive data to the cloud by keeping it securely on-site.

This fulfills more than unman inspection but utilizes in-depth data from the edge to make AI-driven predictive maintenance possible that reduces downtime and optimized equipment life spans, fostering a virtuous cycle of improved productivity and reduced resource waste.

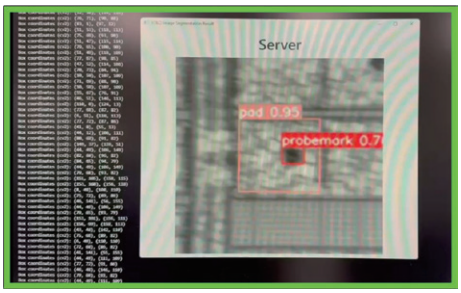
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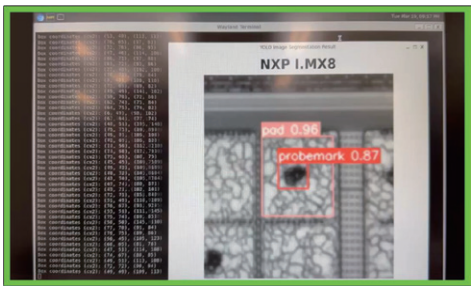
AI Inference Speed & Spec Comparison





Server **VS** Edge Computing

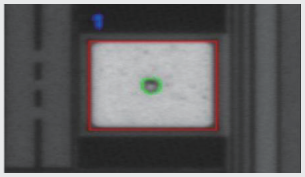




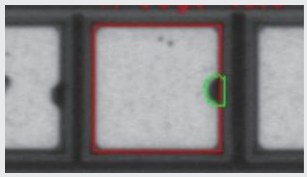
Type	Server	SP2 Panel PC with I.MX 8M Plus
Speed	280 ms/frame	30 ms/frame
CPU	Intel® i9-14900 24 Core, 5.8 GHz	ARM Cortex-A53 4 Core, 1.8 GHz
GPU/NPU	Intel® UHD Graphics 770 1.65 GHz	GPU OpenGL ES3.1/3.0, Vulkan + NPU 2.3 TOPS
RAM	128 G	8 G
Power	1200 W (High Power Consume)	1.7 W (Ultra Power Saving)
Cost	6x	1x

Wafer Testing

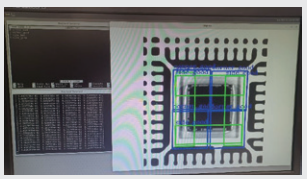
Die Bond Inspection



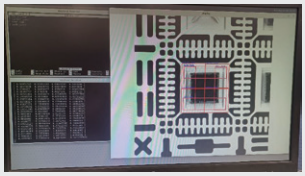
PASS



NG



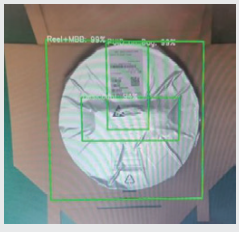
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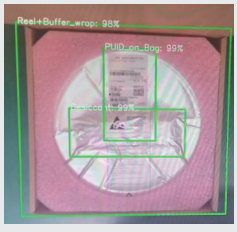


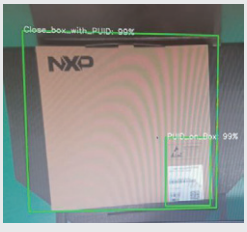
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Final Product Packing









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System Description

ATKH Smart Factory





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Highlight

Solutions and Technologies

ADLINK

SP2-IMX8 ARM-Based Panel PC:

- High-performance, energy-efficient design tailored for industrial HMI needs.
- Compact 7”-10” panel with Pico-ITX and customizable edge I/O.
- Multi-OS support (Linux, Windows, Android).

Learn More



EMU-210 IIoT Gateway:

- Arm-based, wireless, and customizable open platform for edge computing.
- Scalable design supports AI processing and cloud integration.
- Supports Modus TCP/RTU, MQTT, OPC UA and Restful.

Learn More



EGiFlow

EdgeGo® Platform:

- Streamlined device management with real-time monitoring.
- Efficient script deployment, rule-based alerts, and robust security.
- Exclusive Features: SEMA® and ASD+ enterprise SSDs to boost device performance.

Learn More



EdgeGO

NXP

i.MX 8M Plus Applications Processor:

- Neural Processing Unit (NPU) delivering 2.3 TOPS for AI tasks.
- Dual 12MP ISPs for precise quality inspections.
- Advanced multimedia support for seamless real-time monitoring.

Learn More



eIQ® ML Software:

- Simplifies AI development with pre-trained models and GUI-based tools.
- Compatible with popular frameworks like TensorFlow™ Lite.
- Comprehensive Resources: Provides templates, sample code, and end-to-end workflows.

Learn More

eIQ

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Why Choose ADLINK?

> **"NXP has full confidence in our chips, with a 15-year guaranteed product lifecycle, and ADLINK's panel PC and gateway designs align ideally with the stringent requirements of industrial automation. With their extensive expertise in system integration, this collaboration is truly a win-win. We have confidence in ADLINK." — Bond Chen, IT Director of A&T Smart Factory Solutions, NXP**

Green Transformation: Smart City and Manufacturing

Module	Starter kit	Panel PC	Edge Computing Platform	
				
LEC-iMX8/9 Series SMARC	**I-Pi SMARC Devkit** SMARC Starter Kits	**SP2-IMX8** Open Frame Panel PC	**MXA-200** IoT Gateway	**EMU-210** IoT Gateway
				
OSM-iMX8/9 Series Open Standard Module	**I-Pi OSM Devkit** Open Standard Module	**SP2-IMX8 SBC** Single-Board Computer	**ADM-IM10** Fleet Management Gateway	**AVA-1000** T2G Onboard System

● NXP i.MX 95 ● NXP i.MX 93 ● NXP i.MX 8M

ADLINK is a leading industrial display solutions provider, delivering comprehensive, value-added customization through expert support to optimize edge visualization. As a Titanium Tier member of the Intel® Partner Alliance, Gold member of NXP, and in collaboration with AUO®, we ensure exceptional product quality and reliability. These strategic partner-ships enable customers to reduce total cost of ownership (TCO) while accelerating time-to-market. In addition to its advanced IIoT gateway, the EdgeGO® software platform provides secure, scalable device management, real-time moni-toring, and seamless connectivity. Together, our comprehensive hardware and software solutions empower businesses to optimize performance and drive innovation in IIoT and edge computing.

For more details on ADLINK's NXP-based solutions, scan the QR code or visit **here**.

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