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ADLINK and LEDA Technology Create AI-Enabled Contact Lens Inspection Solution

Automated inspection, optimized with the Intel® Distribution of OpenVINO™ toolkit, leads to faster, more accurate results

ADLINK
Leading EDGE COMPUTING

LEDA
TECHNOLOGY

"The ADLINK AI contact lens inspection solution, based on well-validated, cost-effective Intel® hardware and optimized with the Intel® Distribution of OpenVINO™ toolkit, offers contact lens manufacturers a reliable all-defect inspection solution with 95 percent accuracy."[3]

—Tim Juan, Senior Director,
ADLINK Smart Factory Business Center

50X
faster
inspection[2]

OpenVINO™

A clear advancement for machine vision

As demand for contact lenses grows, automating inspection processes is critical for manufacturers under pressure to increase throughput. Using ADLINK's AI machine vision system, optimized with the Intel® Distribution of OpenVINO™ toolkit, AI software partner LEDA Technology created easy-to-use contact lens inspection software that replaces human visual inspection. Using a smart inspection solution massively scales the number of lenses that can be inspected in a day.

The flexibility of the Intel Distribution of OpenVINO toolkit creates opportunities for software partners and manufacturers to develop tailored, smart solutions that solve unique customer challenges in the healthcare manufacturing industry.

Challenges: Bridging the gap between human and machine inspection

Inspecting contact lenses for manufacturing defects presents several unusual challenges. While most manufacturers can use a sample of products, contact lens manufacturers must inspect each individual lens. With 4,000 lenses inspected per day by each inspector,[1] human visual inspection creates a production bottleneck with high rates of false discovery and missed detection.

Due to the transparency of contact lens material, machine vision–based inspection has been very challenging for the industry. Conventional machine vision automated optical inspection (AOI) relies on fixed geometric algorithms to discover defects, but acquiring quality images from high-transparency objects resulted in unacceptable inspection performance. Manufacturers seeking machine vision solutions want a faster way to accumulate data and train new algorithms, which has historically been a time-consuming process with impacts that result in increased operating expenses.

Solution: 50x faster inspections[2] with 3x improved accuracy[3]

LEDA Technology adopted ADLINK's AI machine vision technology to build a smart inspection solution. In addition to more accurately identifying lenses with manufacturing defects, the solution also collects data from inspection devices to train AI and iterate on inspection performance gains and maintains inspection logs for customer reference. LEDA Technology provides a reliable multidefect-inspection solution, identifying defects including burrs, edges, particles, bubbles, scratches, and more.

LEDA Technology's AI contact lens inspection solution uses the well-validated EOS-i6000-M Series vision system, supporting a wide variety of deep learning applications. The system features a 9th Gen Intel® Core™ i7-9700E processor and four add-in accelerators based on Intel® Movidius™ Myriad™ X VPUs, optimized

with the Intel Distribution of OpenVINO toolkit. The toolkit offers a validated AI development platform for fast testing, development, and deployment of machine vision applications.

To accelerate machine learning efforts, LEDA's inspection system collects data from the production line, labeling it with an easy-to-use toolchain to complete AI model training and deploy to the AI machine vision platform. The toolchain continues to collect additional data, allowing manufacturers to reinforce model performance.

ADLINK's EOS-i6000-M vision system offers a built-in industrial Gigabit Ethernet (GbE) camera interface and image capture app to connect quickly to other equipment and the cloud, making it faster for software partners like LEDA Technology to deploy new solutions.

The AI vision system integrator used the Intel Distribution of OpenVINO toolkit, designed to accelerate development of high-performance deep learning inference into AI applications used from edge to cloud. The toolkit was used to optimize a business-specific AI model, using its built-in Model Optimizer.

Workloads are automatically dispatched to dedicated 9th Gen Intel® Core™ processors, as well as Intel® Movidius™

VPUs. With the Inference Engine in the Intel Distribution of OpenVINO toolkit, automatic load balancing and asynchronous execution deliver cost-effective performance, while heterogeneity support allows seamless execution across cloud and local servers, as well as edge AI vision devices.

Benefits of LEDA Technology's machine vision inspection system include:

- **Improved inspection accuracy:** Accuracy of traditional machine vision solutions without deep learning was only 30 percent—not acceptable to the industry. By reducing rates of false discovery and missed detection with the deep learning model, 95 percent accuracy was obtained—more than 3x better than previous machine vision systems.[2]

- **Increased throughput:** Each individual inspection machine can inspect 50x the number of lenses compared to previously used human visual inspection processes.[1]

- **Automatic product records:** Inspection logs for customer reference offer an audit trail for full visibility into manufacturing processes.

- **Continuous improvement:** Machine vision algorithms get smarter with exposure to more data, for strengthened inspection performance over time.
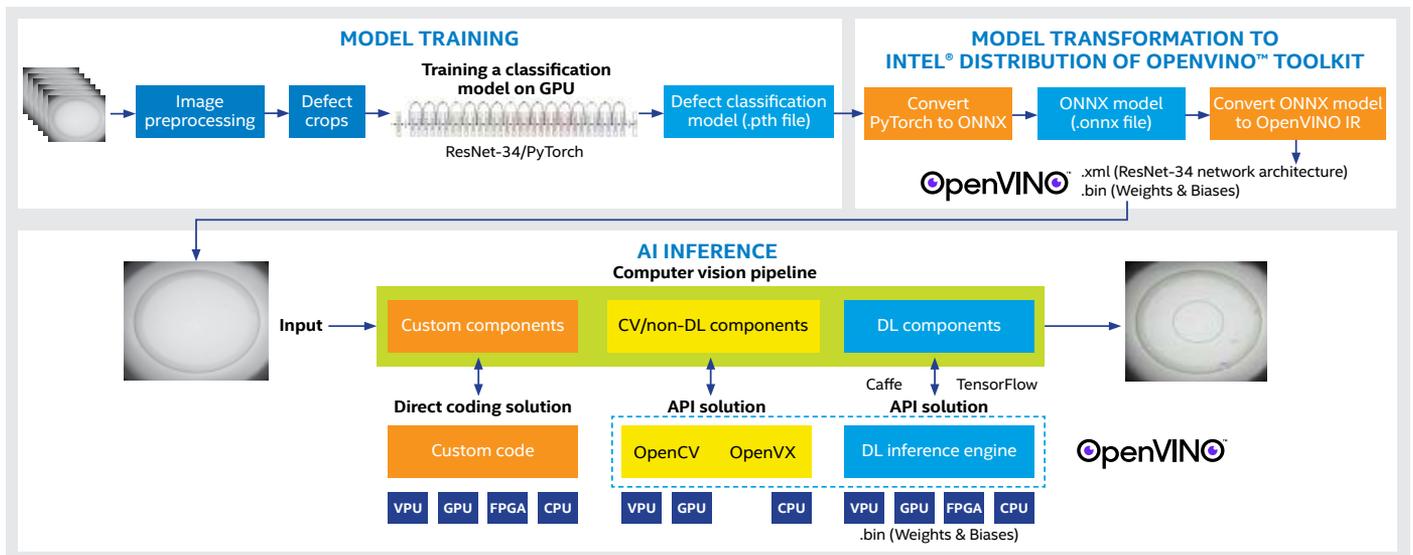
How it works in brief

First, the Intel Distribution of OpenVINO toolkit was used to optimize a deep learning AI model using the Model Optimizer. Deep learning was used to drive higher accuracy rates. In order to train the deep learning model with the necessary massive quantities of patterns and defects, data was gathered concurrently from human inspectors and production line and customer servers. It took just three weeks to convert from the previously used machine vision system and parallel computing platform to using the Intel Distribution of OpenVINO toolkit.

Intel Movidius VPUs offer robust acceleration for edge inference, with a highly efficient performance-to-watt ratio to drive cost-effective automation. The Intel Distribution of OpenVINO toolkit balances workloads to optimize the AI vision system for maximum efficiency and full system

utilization. In addition to providing automated machine vision, the AI automatically optimizes inspection processes and IoT connectivity.

Using the ADLINK EOS-i6000-M solution, powered by 9th Gen Intel Core processors and the Intel Distribution of OpenVINO toolkit, LEDA Technology can more securely deploy the optimized AI model from cloud or private local services remotely to inspection devices.

LEDA used the proven capabilities of ADLINK GigE Frame Grabber technology to improve image and video quality from industrial GbE cameras. With improved image capture and deep learning models for machine vision, the contact lens manufacturer was able to relocate personnel to increase overall equipment efficiency (OEE).

MODEL TRAINING

Image preprocessing → Defect crops → **Training a classification model on GPU** ResNet-34/PyTorch → Defect classification model (.pth file)

MODEL TRANSFORMATION TO INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Convert PyTorch to ONNX → ONNX model (.onnx file) → Convert ONNX model to OpenVINO IR

OpenVINO™ .xml (ResNet-34 network architecture) .bin (Weights & Biases)

AI INFERENCE
Computer vision pipeline

Input → Custom components | CV/non-DL components | DL components

Caffe   TensorFlow

Direct coding solution | **API solution** | **API solution**

Custom code | OpenCV   OpenVX | DL inference engine   OpenVINO™

VPU GPU FPGA CPU | VPU GPU CPU | VPU GPU FPGA CPU

.bin (Weights & Biases)

LEDA used ResNet-34 batch size 8 to train the model and get inference results of 95 percent accuracy.

Conclusion: Working together to advance machine vision in manufacturing

ADLINK and its software partner LEDA Technology created a smart manufacturing solution to accelerate contact lens inspection and production, using Intel® processors, Intel Movidius VPUs, and the Intel Distribution of OpenVINO toolkit to power state-of-the-art machine vision for inspection of transparent material.

By increasing the accuracy of the inspection process by 65 percent and increasing throughput by 50x, LEDA's AI-enabled machine vision inspection system eliminates the need for human inspectors while continuously training to improve results further.

Learn more

To discover how the ADLINK EOS-i6000-M works to optimize GigE vision systems for the edge, visit the EOS-i6000-M **product page** today.

About ADLINK

ADLINK delivers leading-edge, robust, and reliable hardware and software solutions that directly address mission-critical business and technology challenges.

Learn more at **adlinktech.com**.

About LEDA Technology

LEDA is a software and services company that is devoted to developing and supporting optical lens and thermal design. LEDA currently focuses on technology development and system applications incorporating AI-enabled machine vision for the manufacturing industry, including defect inspection of LED, metal work pieces, and contact lenses.

Learn more at **leda-creative.com**.

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