

CASE STUDY

Industry 4.0
Computer Vision in the Factory



Computer Vision Solution for Industrial PCs Helps Improve Defect Detection



Transform the factory by catching defects before products ship, using Shanghai Deepsight's advanced computer vision and deep learning software that runs directly on your industrial PCs

At a Glance:

- Shanghai Deepsight's solution helped improve product quality and control costs
- It delivered 99.9 percent¹ accuracy in defect detection, using cameras and AI on Intel® processor-based IPCs, reducing equipment costs
- The computer vision solution increases detection consistency
- Use of the Intel® Distribution of OpenVINO™ toolkit accelerates computer vision analytics
- Customer complaints dropped by more than 10,000 annually

When defective products leave the factory, the costs are high—customer complaints, product return costs, scrapping costs and damage to the brand can all result. [Shanghai Deepsight's](#) industrial PC (IPC) solution uses the latest innovations in deep learning, computer vision and image processing to help improve defect detection before a product leaves the manufacturing line.

Challenge

Time-consuming manual defect inspection resulted in a well-known tire manufacturer's factory in China shipping defective products, which in turn led to customer complaints and rising labor and transportation costs for returning defective tires to the factory. These costs were cutting into the company's bottom line, and the company's brand reputation was suffering as well.

Solution

The company turned to Shanghai Deepsight to help improve product quality. Shanghai Deepsight has been specializing in the field of computer vision and artificial intelligence (AI) for many years, with strong research and development (R&D) capabilities and rich experience with machine vision solutions. Shanghai Deepsight's Deep Inspect solution reduces equipment costs with Intel® Distribution of OpenVINO™ toolkit running image processing and inference algorithms directly on an Intel® architecture-based IPC. The solution is highly scalable and can quickly adapt when new defects are found. New defect algorithms can be developed and trained, then deployed to the same IPC system to continue adapting to anomalies/defects in the manufacturing process over time.

Results

The solution is based on deep learning and relies on the tremendous computing capabilities of the Intel® Core™ i7 processor and integrated Intel graphics processing unit (GPU). By accelerating Intel processor-based hardware with the OpenVINO toolkit, the detection algorithm runs stably on a single IPC. The solution is much faster than manual inspection (it can keep up with the production line, increasing efficiency), and is not subject to fatigue or inconsistency resulting from human subjective observation. Plus, detection accuracy climbed to 99.9 percent, compared to the average manual inspection accuracy rate of about 90 percent, and helped cut labor costs by approximately USD 49,000 per production line.¹

Catching defects faster and earlier in the manufacturing process made a huge difference to the factory—the solution reduced the number of customer complaints by more than 10,000 each year. The company has now deployed the solution at other production lines and plans to implement it for other related inspection tasks.

Keeping Manufacturing Defects to a Minimum to Control Costs and Maintain Competitiveness

Every factory aims to produce a quality product. But variations in raw materials and equipment-induced errors are inevitable. Historically, manufacturers have used manual inspection processes to find defects. But this approach has its drawbacks.

- **Long training time.** It took up to three months to train personnel on what to look for.
- **Inefficient.** Once trained, manual inspection can be accurate, but time-consuming. Manual inspectors could not keep up with the production line speed, so tires had to be transported to a warehouse for inspection.
- **Fatiguing.** Sometimes inspection takes up to 80 percent of an employee's time, which can be tiring. Some defects are quite small and are difficult to detect. Fatigue can lead to lower accuracy, and can also damage an employee's eyesight over time. Many inspectors leave their jobs quickly, leading to recruitment, training and cost issues.
- **Inconsistency.** Human observations are naturally subjective, based on varying levels of experience or skill—meaning that the accuracy of inspection can vary from person to person.

The China-based factory of a leading tire manufacturer was only too familiar with the limitations of manual inspection. In a challenging economic environment, pressure was mounting to improve productivity and to control labor costs as well as the expenses associated with returning defective products to the factory. In addition, competition is fierce. There are hundreds of tire producers in China, producing up to 800 million units annually (representing about one-third of global tire production), and China is home to 240 million cars. Therefore, tire manufacturers who can produce a better product can enhance customer satisfaction and their brand reputation.

Running Computer Vision and Deep Learning on an Industrial PC

When the tiniest defects can damage a manufacturer's productivity and profitability, everything matters. Seeking a way to speed up defect inspection and improve accuracy, the company engaged with a system integrator, Shanghai Deepsight. Deeply rooted in the industrial field, Shanghai Deepsight has years of experience and many successful deployments of highly accurate and highly stable testing products that help customers solve problems.

Shanghai Deepsight's Deep Inspect solution combines imaging equipment and deep-learning computer vision algorithms, accelerated by the OpenVINO toolkit. The solution runs at the edge, directly on a modern industrial PC, using a high-performance CPU and integrated GPU package. The image data is collected by the imaging system and is

transmitted to the edge device for real-time detection and analysis by software. The detection result is sent back to the production line through the network for product OK/No-Good classification. The solution includes the following components:

- **Imaging system:** Camera, lens, light source and mechanical structures (different types of defects require different imaging systems to obtain the best images)
- **Edge equipment:** Industrial PC, monitor for displaying image analysis and data storage
- **Software:** Shanghai Deepsight's Deep Inspect for defect detection and the OpenVINO toolkit for workload acceleration

The new testing equipment directly replaces the original testing equipment, and the configured interface can be directly connected with the customer's production line. The customer can check the accuracy and stability of the solution through sampling.

A New Era in the Factory

By using machine-based computer vision to detect defects, the factory can reduce labor cost, the cost of returning defective products to the factory and the cost of scrapping products. Machine vision-based inspection doesn't require lengthy training times. The solution can inspect two tires every second, easily keeping up with the production line, saving time previously spent transporting tires to the warehouse before inspection. The solution is able to inspect more than 20,000 tires per day in real time; higher speed and efficiency translate into lower costs. It is highly objective and is free from fatigue, so it can run continuously and is not subject to fatigue—leading to greater consistency.

Catching defects before shipment can avoid the costs of a product returning to the factory for replacement and damage to the brand reputation. The ability to detect defects earlier in the manufacturing process may seem like a small change. However, it prevents additional—and expensive—manufacturing steps from potentially masking the defect and allowing a defective product to ship to customers. The resulting potential for savings is significant.

AI-based deep-learning inference requires significant computing resources at the edge on the factory line. Traditionally, specialized machine vision-based platforms equipped with pricey and dedicated GPUs have been used to run such workloads. But Shanghai Deepsight's solution is optimized for Intel architecture and uses the OpenVINO toolkit to accelerate the deep-learning algorithms across the CPU cores and integrated high-performance GPU. As a result, the solution runs on a single industrial PC equipped with an Intel Core i7 processor—meaning that the factory can have more automation, higher product quality and enhanced brand awareness without having to increase capital expenses.

Many of these IPC-based deep-learning inference systems also run other workloads using virtualization technologies, allowing multiple workloads to be consolidated onto a single IPC platform. This reduces cost, power, heat dissipation and required network connections when adding machine vision-based deep learning to the factory with the Shanghai Deepsight solution.

Intel® Innovation Drives Industry 4.0

The founders of Shanghai Deepsight used to work in Intel's computer vision lab—so the company has extensive experience in the field of AI vision and is familiar with Intel's latest hardware and software technologies. Intel and Shanghai Deepsight are committed to transforming the manufacturing industry through collaboration and open communication. Working closely with Intel engineers, Shanghai Deepsight developed the Deep Inspect solution to optimally run on Intel® processor-based hardware and to take advantage of Intel's work in the computer vision and deep-learning fields.

For example, the OpenVINO toolkit provides developers with improved neural network performance on a variety of Intel processors—including the Intel Core i7 processor—and helps them further unlock cost-effective, real-time vision applications. The toolkit enables deep-learning inference and easy heterogeneous execution across the CPU cores and the integrated Intel GPU. Shanghai Deepsight chose to use the OpenVINO toolkit because its built-in optimizations allowed them to deploy the solution quickly and it provides significant performance improvements for Intel processor-based hardware and deep learning. This means Shanghai Deepsight could maximize the performance of existing Intel architecture, improve reasoning efficiency, and achieve an extremely cost-effective solution. Besides the Intel Core i7 processor and OpenVINO toolkit, the solution also uses an Intel® Gigabit Power over Ethernet (PoE) network adapter.

Highly Accurate Defect Detection Solution Runs on Industrial PCs

Expensive dedicated GPU-based inference equipment is no longer necessary to run computer-vision workloads in the factory. With Shanghai Deepsight's Deep Inspect solution, factories can improve product quality and reduce equipment costs by using Intel architecture-based industrial PCs to run machine vision defect detection. The solution is fast and provided 99.9 percent¹ accuracy, is scalable, and the machine-learning algorithms can adapt as new types of defects are found. Rugged industrial PCs equipped with Intel Core i7 processors provide the reliability and high availability demanded in the factory environment.

After deploying Deep Inspect, customer complaints dropped by more than 10,000 per year, and the solution has helped drive down labor costs by approximately USD 49,000 per production line¹. The manufacturer benefits from greatly improved customer satisfaction and substantial savings

due to fewer defective products returning to the factory. Based on the success of the initial deployment at the factory in China, the company is now deploying the solution at other production lines and plans to use it for other, related inspection items across the organization.

Before adopting the DeepSight computer vision solution, there were more than 6,000 defective tires returned within half a year. After deploying DeepInspector, only a few dozen of defective tires were returned in the first half of the year, which not only greatly improved customer satisfaction, but also saved substantial transportation costs.

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Spotlight on Shanghai Deepsight

Shanghai Deepsight's founders cut their teeth in Intel's computer vision lab—meaning that the Deepsight team is expert at solving defect detection problems for customers through imaging and artificial intelligence (AI) technology innovation. Founded in 2017, the company specializes in imaging and AI vision algorithm innovations, providing unique products and solutions for the unsolved problems in the machine vision industry. For more information, visit www.deepsight.ai.

Solution Ingredients

- Shanghai Deepsight Deep Inspect
- Intel® Core™ i7 processor
- Intel® Gigabit Power over Ethernet (PoE) network adapter
- Intel® Distribution of OpenVINO™ toolkit

Learn More

You may find the following resources helpful:

- [Shanghai Deepsight home page](#)
- [Intel® Distribution of OpenVINO™ toolkit](#)
- [Intel® Core i7 processor](#)
- [Intel's artificial intelligence home page](#)

Find the solution that is right for your organization. Contact your Intel representative or visit <https://www.intel.com/iot/industrial>.

Ready to talk?



¹ 99.9% accuracy as measured by Shanghai Deepsight.

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