Next-Gen Factory Automation with AI-Powered 3D Vision Systems

Transforming Precision Manufacturing

In today's fast-paced manufacturing environment, precision, speed, and efficiency are critical to staying competitive. Traditional inspection methods and manual setups often lead to errors, slower throughput, and inefficiencies that hinder productivity.

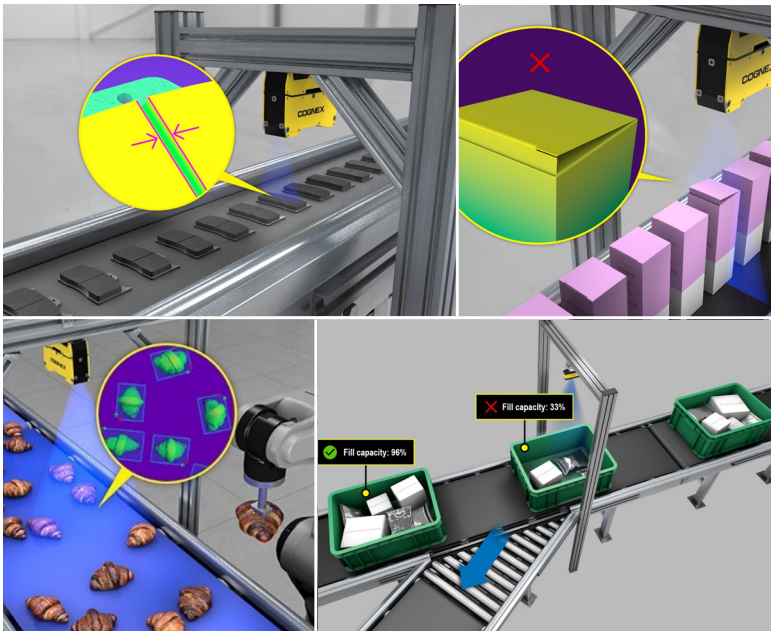
AI-enhanced 3D vision systems address these challenges by delivering unmatched accuracy, reliability, and flexibility. These advanced systems eliminate the need for complex programming, enabling rapid setup. This empowers manufacturers to reduce errors, boost throughput, and optimize quality control – paving the way for smarter factory automation.

What Are Vision Systems for Manufacturing?

Vision systems for manufacturing are advanced technologies that use cameras, sensors, and software to capture, process, and analyze visual data in real-time. Vision systems can identify defects, verify dimensions, guide robotic actions, and provide a host of other capabilities that ensure products consistently meet stringent quality standards, and that processes run smoothly and safely.

By automating processes that traditionally rely on human intervention, vision systems reduce errors, enhance productivity, and maintain high standards of quality—driving smarter, faster, and more reliable production.

- Captures and processes images in factory automation applications
- Solves inspection, process control, measurement, and robot guidance tasks



Wiley event: Advancing Factory Automation with 3D Machine Vision and AI

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AI Enhanced 3D Systems: Accurate, Reliable, Flexible

What is a 3D Vision System?

3D machine vision camera is an optical device used in industrial automation to capture and process three-dimensional images of objects or scenes. By mapping scenes in 3D, these cameras can handle changes in the environment and variations in the objects being analyzed. They are ideal for inspection, process control, measurement, robot guidance, and other applications that require high precision.

Vision Systems: The Eyes of Automation

Manual Inspection

Traditional manufacturing relies heavily on manual inspections, which are prone to human error and inconsistency.

Traditional Manual Inspection

- Prone to human error
- Inconsistent results
- Slower throughput

Automated Inspection

Vision systems reduce errors and inconsistencies by providing automated, objective analysis of products and processes.

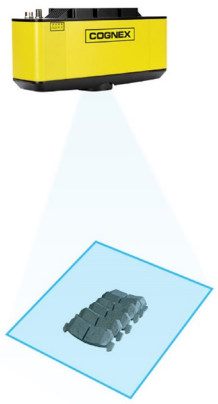
Vision Systems

- Reduced errors
- Faster, more reliable results
- Optimized quality control

Types of 3D Vision Systems

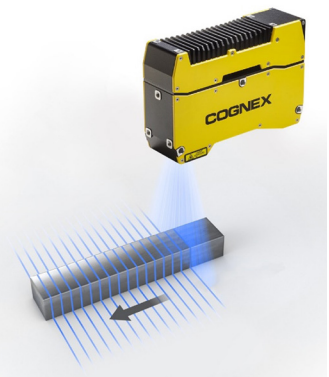
Area scan

Area scan cameras capture an image in a single frame. These cameras are suited for machine vision applications, where the objects are stationary, fixed in size, and relatively uniform in shape.



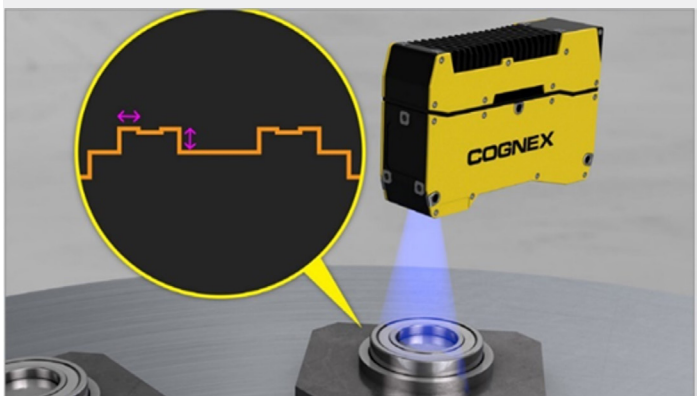
Line scan

Line scan cameras build images line-by-line and require motion to build the image. This makes them ideal for inspecting cylindrical parts and continuous materials, like paper, wood, and rubber.



Laser profiler

Laser profilers inspect height and other profile data by capturing an object's 3D shape from above. They can operate without external lighting and generate reliable profile measurements without being affected by color differences, patterns, and other characteristics of the target object.



What is the Difference Between 2D and 3D vision systems?

Both 2D and 3D vision systems play critical roles in modern manufacturing, each offering unique benefits depending on the application. 2D systems excel in tasks requiring high-contrast imaging. 3D vision systems add depth perception, enabling precise measurement of complex shapes, sizes, and surface variations.

	2D Vision	3D Vision
Output	Two-dimensional mapping (X, Y)	Three-dimensional mapping (X, Y, Z)
Application Requirements	Requires powerful lighting Low to moderate precision	Can operate in low-lighting environments High precision
Use Cases	Defect detection Optical character reading (OCR) Code reading Presence/absence detection	Defect detection Optical character reading (OCR) Measurement Robotic guidance

What are the advantages of 3D machine vision systems?

By adding an extra dimension to image analysis, manufacturers can automate applications once considered too challenging for traditional automation, while gaining all the benefits and features of 2D vision. These benefits include:

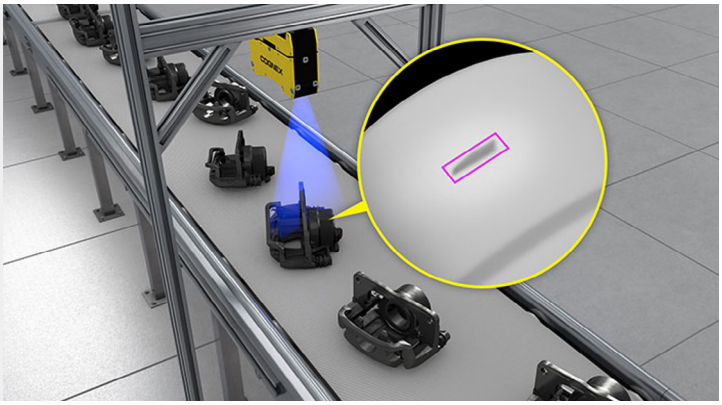
- **Unparalleled accuracy:** Capture depth information for more precise automation
- **Increased quality control:** Detect variable defects and anomalies for higher product quality
- **Enhanced productivity:** Speed up production processes with fast processing
- **Cost reduction:** Save costs by automating complex inspections
- **Optimized logistics and warehousing:** Estimate shipping costs and improve storage utilization and inventory management by measuring the dimensions and volumes of packages

3D Machine Vision Applications

3D machine vision systems are versatile solutions used across various industries to enhance accuracy, efficiency, and automation. By capturing detailed depth and spatial information, they enable advanced applications that improve manufacturing processes. Here are five key areas where 3D vision systems are commonly applied:

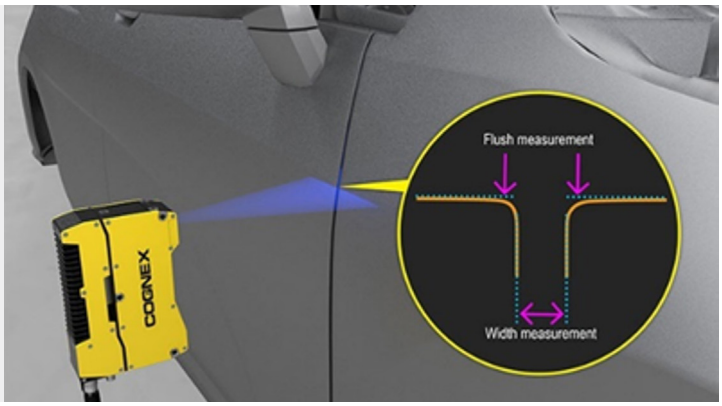
Inspection and Quality Control

3D machine vision ensures error-free production by detecting surface defects, verifying dimensions, and confirming proper assembly—reducing errors and boosting efficiency.



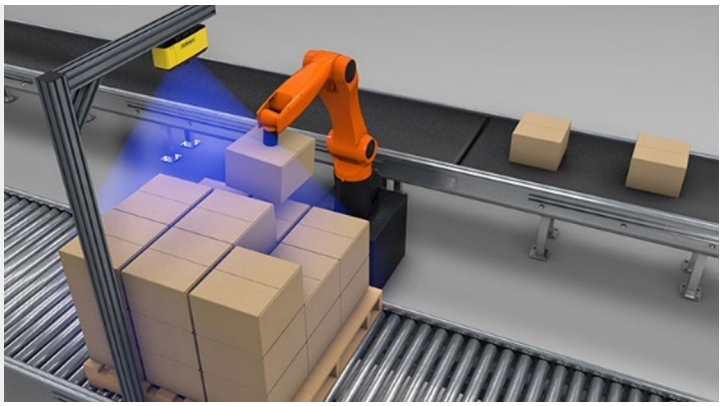
Gauging and Measurement

3D vision systems measure complex geometries and check tolerances with precision, ensuring parts meet strict quality standards in demanding industries.



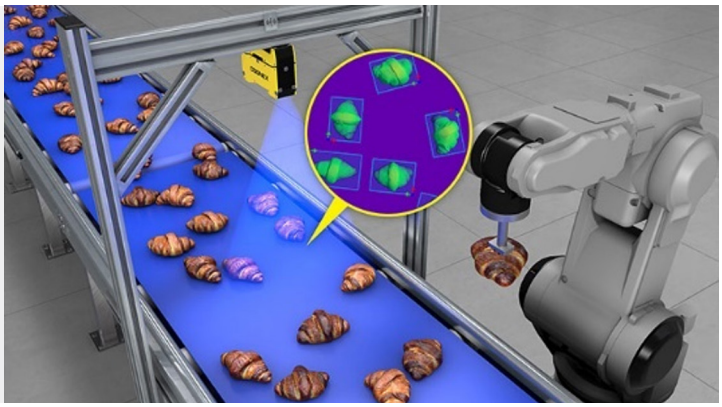
Robotic Guidance

Real-time 3D perception using machine vision enables robots to perform autonomous navigation, object interaction, and reliable task execution.



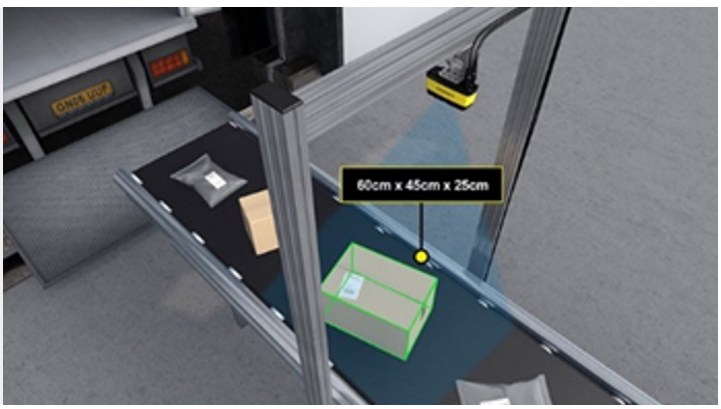
Object Recognition and Location

3D vision identifies and positions parts accurately on production lines, ensuring proper alignment and orientation for seamless assembly and fewer errors.



Logistics and Warehouse Automation

3D machine vision optimizes logistics by measuring package dimensions, improving sorting efficiency, and maximizing storage space for smarter inventory management.



Using AI in Machine Vision

Manufacturers are combining the power of example-based AI and rule-based machine vision to improve quality control and optimize efficiency

AI augments rule-based vision

- Solves tasks the human eye can solve that rule-based tools can not
- Solves tasks that are too complicated and time-consuming to program with rules

AI augments rule-based machine vision with image-based analysis. This process of learning to recognize patterns allows automated systems to differentiate between acceptable and unacceptable anomalies in objects under inspection.

Machine vision solutions embedded with AI technology can use natural language processing to read and interpret labels on images. This enables a wider base of users to take advantage of AI for factory automation.

3D + AI

- Streamline workflows by eliminating the need for multiple tools
- Quickly and easily calculate height and isolate orientation
- See features not visible with traditional 2D imaging

Edge Learning

Edge learning takes place on-device, or “at the edge” of where the data originates. The technology is simple to set up, requiring smaller image sets and shorter training and validation periods than traditional deep learning-based solutions.

Edge Learning Benefits

- Fewer images for training
- Automate More Tasks
- Increased efficiency
- No experience needed
- Setup in minutes
- Improve Quality

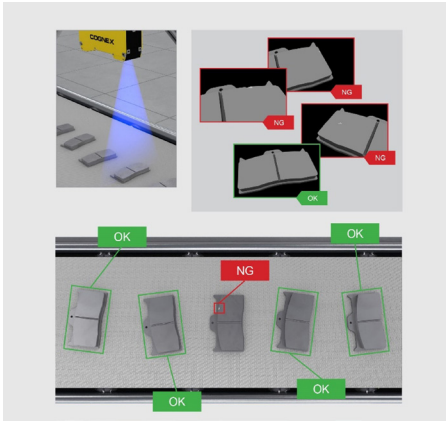
World's first 3D vision system powered by AI

In-Sight L38

Cognex has taken 3D machine vision to the next level through the integration of AI-powered edge learning technology. Edge learning simplifies the AI implementation process by allowing users to train models with minimal data and expertise. This example-based training empowers users to quickly label images and create custom models tailored to specific applications. By combining AI with 3D vision, the In-Sight L38 from Cognex learns and adapts to complex scenarios, improving accuracy and eliminating the need for time-consuming setup.

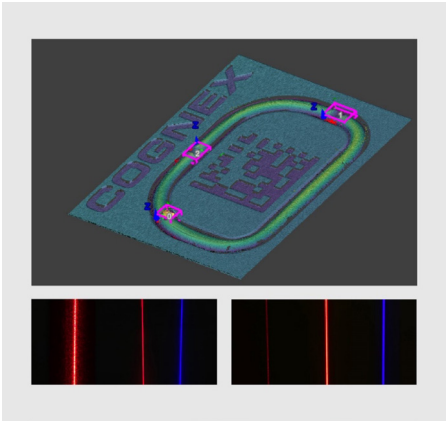
The In-Sight L38 offers fast and reliable inspections through a combination of 3D data capture and AI-driven analysis. Key features include easy deployment with intuitive training, reliable performance with advanced imaging techniques, and scalable automation with a full suite of 3D and 2D vision tools and a common software platform. The In-Sight L38 demonstrates the combined power of 3D machine vision and AI across various applications, including defect detection, gauging and measurement and object recognition and location.

Fast Deployment



- **Intuitive training**
  AI tools can be deployed in minutes using as few as 5 images
- **Simplified setup**
  Example-based training replaces 1,000s of lines of programming
- **Integration of 2D and 3D capabilities**
  Get in-depth 3D results with easy 2D training
- **Results in real-world units**
  Get output in real-world measurements

Reliable Performance



- **Combined power of 3D and AI**
  See features not visible with conventional 2D and 3D vision
- **Powerful optics and advanced imaging**
  Detect subtle anomalies for higher quality control and lower error rates
- **Fast acquisition and processing speeds**
  Increase throughput to optimize productivity

Scalable Solution

- **AI integration**
  Embedded AI learns and improves over time for flexible performance
- **Full suite of 3D and 2D tools**
  3D vision automates complex tasks, while 2D vision offers simplicity for standard applications
- **Unified software platform**
  Single platform provides a seamless experience, allowing users to switch between graphical and spreadsheet programming