AI computer Vision for Quality Inspection

Automate defect detection with real-time visual intelligence

TUPL

Operations made simple with AI

Quality Inspection

AI computer Vision for Quality Inspection

Modern manufacturing demands speed, precision, and consistency, especially when it comes to quality control.

AI Computer Vision enables automated, real-time defect detection and classification in manufacturing.

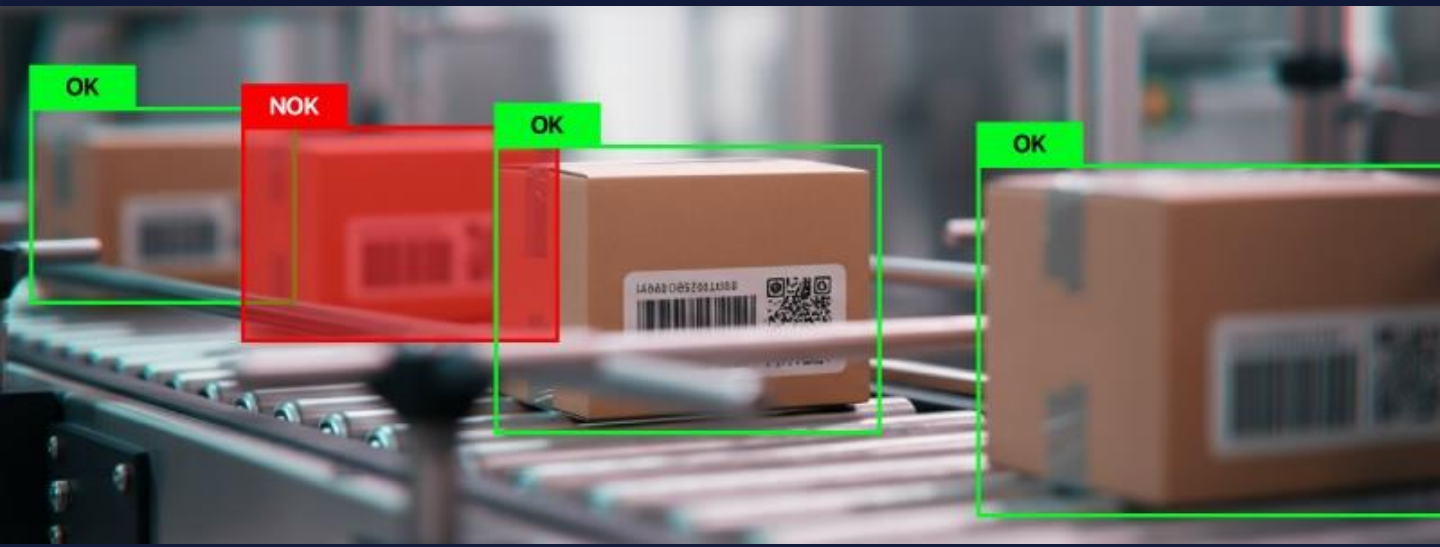
This no-code solution empowers non-experts to train and deploy models easily, providing centralized quality control across production lines without requiring changes to existing systems.

Key benefits

>90%
Defect Detection Accuracy

>90%
Reduction in Quality Control Labor Costs

90%
Real-Time Visibility and Alerts



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Pain points

Prevent Waste and Product Recalls

Undetected defects lead to high waste volumes and costly market recalls.

Human Error and Inconsistent Inspection

Manual inspection is slow, subjective, and error-prone.

High Labor Costs and Operator Dependency

Quality control relies heavily on specialized, expensive labor.

Quality Control Delays Causing Production Bottlenecks

Manual inspections slow down production lines and cause delays.

Limited Visibility and Traceability

Lack of centralized data prevents real-time control and complicates traceability.

Smart Quality Control:
Automation, Precision, and Sustainability across all dimensions of quality control.

Our AI-powered Computer Vision solution transforms quality control by automating visual inspections and enabling real-time defect detection.

Streamlining Visual Tasks with Automation

Our solution automates defect detection with real-time image analysis, reducing human error, ensuring consistent quality, and freeing operators for higher-value tasks. This leads to faster throughput and scalable operations.

Packaging Validation with Precision

Our AI-powered system checks barcodes, expiration dates, and label accuracy in real time, preventing errors, ensuring traceability, and keeping every package market-ready.

Reducing Waste Through Early Detection

Our Computer Vision system detects defects early, reducing waste, energy use, rework, and scrap, while supporting sustainability and cutting operational costs.

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AI Computer Vision
Use Cases

Tupl's AI Computer Vision automates quality checks, reduces inspection time, and ensures consistent product standards with no-code AI.

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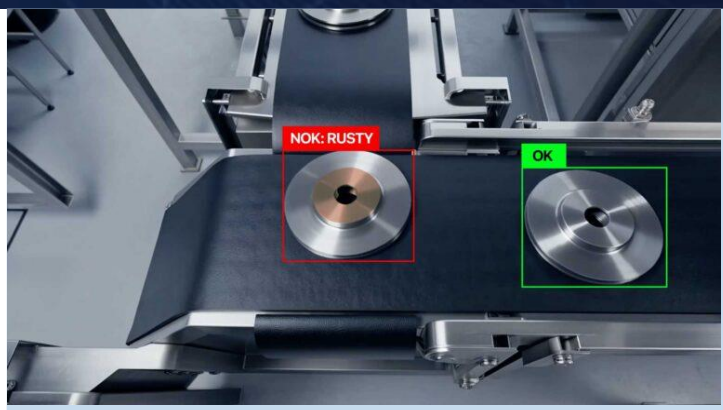
Global manufacturer of automotive components

Manual quality control automation for metal parts production.

The solution is an AI-driven vision system that inspects both sides of metal parts using top and side cameras, automatic flipping, and laser rejection, while offering an intuitive interface for model selection, real-time monitoring, and retraining.



Challenge

- Real-time inspection at a rate of 1 part per second, despite vibrations and random positioning on the conveyor.
- Multi-camera view correlation to inspect both sides and determine part conformity.
- Managing reflections on metal surfaces that conceal micro-defects: custom diffuse lighting to eliminate glare.
- Ensuring consistent inspection conditions for parts ranging from 5 cm to 500 cm in size.
- Integration with laser triggers and ejectors for automatic rejection of defective parts.

Benefits

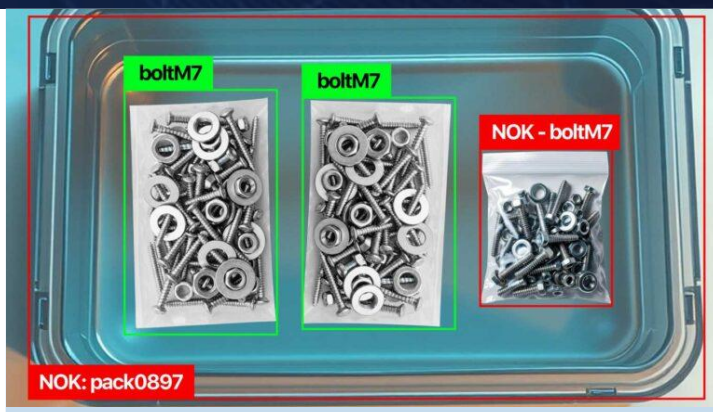
- Reduces the quality control team from 4 operators to 1 per shift (a supervisor), resulting in a total reduction of 12 operators.
- Enables pass/fail decisions in under 1 second, matching the line speed.
- Reduces false rejections and waste by 40% through precise rule-based filtering.
- Eliminates subjectivity by replacing human judgment with consistent AI-driven decisions.

Quality Inspection

Multinational manufacturer of tools and fastening systems

Multimodal AI System for Automatic Package Content Verification

The solution is an AI-based vision system that verifies package contents by combining real-time image and weight analysis. It quickly adapts to new product references with on-the-fly model training, ensuring reliable inspection within minutes without disrupting production or requiring manual labeling.



Challenge

- On-the-fly Model Training Automation with Auto-labeling for New References, Without Interrupting Production Flow
- Real-time integration with cobots, weight sensors, and ERP systems for synchronized data capture and analysis.
- Ensure real-time availability of trained models on a dedicated station for immediate deployment across more than 10 Jetson-based verification stations.
- Guarantee speed, accuracy, and scalability in a high-variability environment where new product references are introduced daily.

Benefits

- Reduces inspection errors by over 90% thanks to dual-layer verification (vision + weight).
- Cuts SKU onboarding time from days to minutes through fully autonomous model training.
- Decreases rework and returns by up to 40%, improving product quality and reducing operational costs.
- Accelerates packaging cycles by 30% while maintaining output speed.
- Achieves full traceability through real-time ERP synchronization, supporting the company's quality assurance process.

Quality Inspection

PET film manufacturer

Surface Defect Measurement and Classification

The solution is an AI-based vision system designed to detect, classify, and locate surface defects in real time. The system filters out tolerable anomalies, generates structured reports, and integrates with the MES to automatically create repair orders.

Challenge

- Integration with legacy vision systems that capture defect images but lack structured metadata or positioning information.
- Precise defect localization by correlating image timestamps with roller positions through external sources such as APIs.
- Minimization of false positives by filtering tolerable anomalies based on size, position, or type to avoid unnecessary repairs.
- Efficient image storage management, integration with existing NAS systems, and long-term data durability assurance (e.g., automatic cleanup of obsolete data).

Benefits

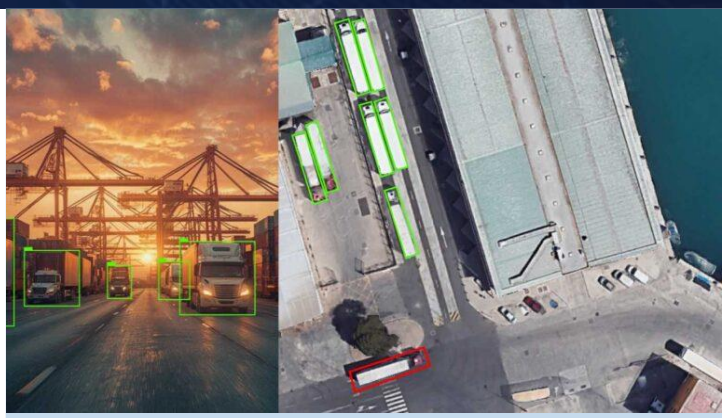
- Reduces operator workload by over 80%.
- Speeds up defect analysis time from minutes to seconds per image.
- Real-time MES integration enables instant repair order generation.
- Minimizes waste by 25% and focuses on critical issues.

Quality Inspection

Port terminal operator

Real-Time Monitoring to Control Truck Access to Restricted Areas

The solution is an AI-based vision system that tracks trucks across multiple camera zones with a consistent global ID, visualizes their location on a real-time zonal map, integrates license plate recognition at checkpoints, and scales easily across terminals with minimal infrastructure.



Challenge

- Continuous tracking of each vehicle across multiple zones despite occlusions, blind spots, or complex maneuvers (e.g., reversing, overtaking).
- Maintaining a consistent vehicle ID across more than 20 camera sources without duplication or loss during transitions.
- Integration of license plate recognition (LPR) and zone-based mapping ensures accurate location updates and access control at checkpoints.
- Real-time processing of large volumes of video data.

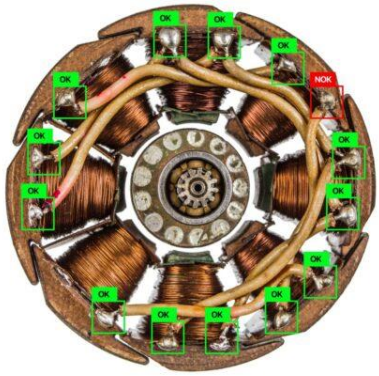
Benefits

- Replaces manual logging with continuous visual tracking of truck movements throughout the port.
- Reduces operator workload by eliminating manual checks and paperwork.
- Enables real-time visibility of all authorized forklifts, streamlining operational decision-making.
- Improves traceability through consistent vehicle ID tracking across all zones.
- Offers a scalable solution ready for over 20 camera streams and future terminal expansions.

Global manufacturer of electromagnetic components

AI-Based Microscopic Quality Inspection for Microcomponents Production

The solution is an edge-based computer vision system that automates the inspection of high-precision microcomponents, detecting small and complex defects in elements like windings and pins. It ensures consistent quality across all shifts and production lines in real time, without disrupting throughput.



Challenge

- Coordination of multi-camera captures (top and side views), identification, and correlation of part features across different images.
- Configurable defect tolerances, including the ability to ignore certain defects based on product or customer standards.
- Management of diverse inspection setups and frequent component changes across more than 10 production lines.
- Real-time AI-based inspections performed in under 2.5 seconds to match production cycle times.
- Integration with PLCs via a custom bidirectional protocol for synchronized operation.

Benefits

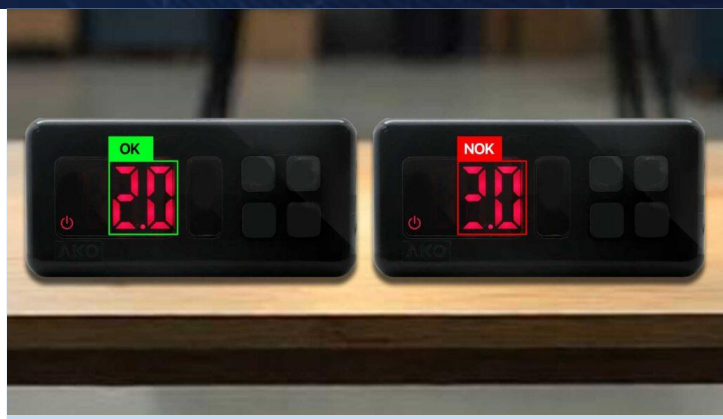
- Reduces labor costs by lowering the number of operators per shift across more than 10 lines, saving over 30 operators company-wide.
- Speeds up inspection cycles to <2.5 seconds per part, maintaining full line speed without compromising quality.
- Improves defect traceability and root cause detection, reducing scrap and rework costs by up to 25%.
- Standardizes quality control across all lines, minimizing shift-to-shift variability and operator bias.
- Reduces setup time for new stations thanks to a scalable architecture and compatibility with station-specific logic.

Quality Inspection

Electronic display manufacturer

AI-Powered Visual Inspection Automation for Electronic Device Testing

Tupl's AI-based vision system automates the visual inspection of electronic displays during functional testing. Fully integrated with the existing Raspberry Pi infrastructure, it synchronizes image capture with test events and accurately verifies various screen outputs.



Challenge

- Screen image capture with precise synchronization, aligned with test button events via Raspberry Pi–Jetson communication.
- Handling of various screen types and test programs, each requiring specific image templates and pass/fail logic.
- Differentiation between expected patterns and actual output, including pixel shifts, color deviations, missing segments, or boot errors.
- Ensures inspection robustness under varying lighting conditions and screen refresh behaviors to avoid false positives/negatives.

Benefits

- Eliminates manual visual checks, reducing operator workload and inspection time.
- Improves consistency and reliability by eliminating human error.
- Enables accurate defect detection to enhance traceability and root cause analysis.
- Provides real-time pass/fail decisions at the test station.

Global Pharmaceutical Distributor

Intelligent Inspection System for Trays and Medicine Boxes

This AI-powered computer vision system automates pharmaceutical batch quality control by inspecting trays for cleanliness and verifying packaging, labels, and product integrity. It offers real-time monitoring, automatic issue alerts, and a digital record for full traceability and compliance.

Challenge

- Real-time inspection of complete trays containing multiple boxes while maintaining dispatch speed.
- Variability in packaging sizes, colors, and materials (cardboard, plastic, blister packs).
- Detection of subtle defects such as misaligned labels, corner damages, or surface contamination.
- Ensuring stable inspection conditions despite artificial warehouse lighting and possible dirt accumulation on reusable trays.
- Integration with traceability systems and ERP to secure digital records of each batch.

Beneficios

- Ensures compliance with pharmaceutical quality and safety regulations (GMP, GDP).
- Reduces the need for intensive manual inspection, freeing personnel for higher-value tasks.
- Minimizes human errors that may lead to returns, penalties, or loss of customer trust.
- Guarantees consistent deliveries to points of sale with products in perfect condition.
- Provides complete inspection traceability, facilitating both internal and external audits.

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