

AI-based visual inspection Solution

AI-Powered · Precision Detection · Smart Manufacturing Enhancement

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Project Background

Challenges in Industrial Component Inspection

As industrial manufacturing advances toward intelligence and large-scale production, sectors such as automotive, aerospace, and engineering machinery face increasingly complex component types and rising demands for dimensional accuracy and quality consistency. Traditional inspection methods are struggling to keep pace with industry development.

Key Challenges:

Low Efficiency

Manual inspection is time-consuming, often taking tens of seconds per part, which cannot match the high-speed rhythm of modern production lines.

Limited Precision

Subject to human factors, measurement errors often exceed $\pm 0.02\text{mm}$, failing to meet tolerance requirements below $\pm 0.005\text{mm}$

Poor Stability

Inconsistent data, lack of unified standards, and difficulties in quality control.

High Costs

Requires extensive skilled labor leading to high personnel expenses, while misjudgments can result in rework and recall losses.

With its efficiency, precision, and intelligence, AI visual technology has emerged as the key solution to overcome these bottlenecks in industrial component inspection.

Automated Inspection Closed Loop

Part 1

Image Acquisition

High-resolution industrial cameras (megapixel to ten-megapixel range) paired with telecentric/industrial lenses and customized lighting systems to meet imaging requirements for industrial parts of varying materials and structures.

Part 2

Image Preprocessing

Algorithms for noise reduction and grayscale conversion to eliminate environmental interference and enhance image quality.

Part 3

Feature Extraction and Analysis

CNN-based convolutional neural networks extract dimensional features and convert them into actual dimensional data.

Part 4

Result Output and Integration

Real-time output of inspection results, synchronized with MES systems to enable automated sorting and parameter adjustments.

Core Advantages:

Precision Improvement 01

AI visual inspection can accurately identify minute defects and dimensional deviations, achieving detection precision at the micron level or higher.



02 Efficiency Multiplication

It processes large volumes of images at high speed, enabling real-time inspection of industrial components.



Cost Optimization 04

By adopting AI visual inspection systems, enterprises can significantly reduce manual inspection positions, thereby lowering labor costs.



03 Stability and Reliability

Unaffected by human factors such as fatigue or emotions, AI visual inspection maintains consistent performance over extended periods and can operate continuously even in demanding conditions.



Application Scenarios

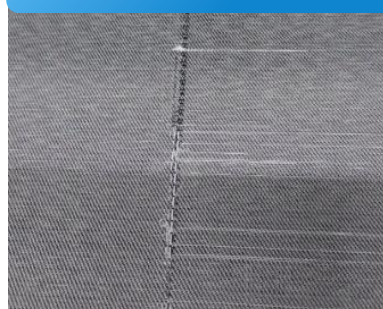
Surface Defect Inspection

Consumer Electronics



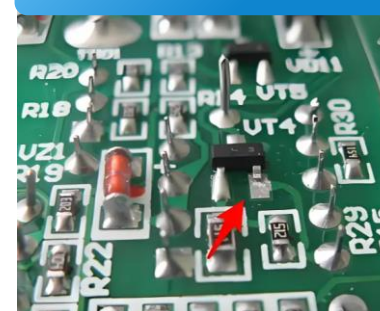
Accurately identify scratches, dents, spots, stains, oxidation, and discoloration on metal casings.

Textile Industry



Inspect fabric for broken warp/weft threads, stains, and color inconsistencies.

Semi/PCB



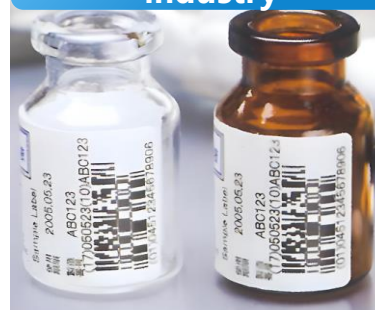
Inspect chip cracks, pin deformations, and solder joint quality.

Automotive Industry



Detect paint defects and scratches on vehicle bodies and components.

Pharmaceutical industry



Detect packaging defects in medicine bottles and label errors.

Food industry

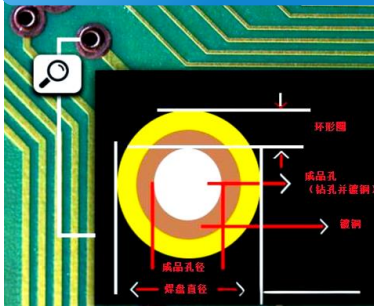


Detect mold spots and surface damage on fruits.

Application Scenarios

Automated Geometric Dimension Measurement

PCB



Measures circuit line width, spacing, pad dimensions, and hole positions.

Connectors



Measures pin coplanarity, spacing, and length.

Injection Molding & Stamping



Measures product length, width, height, aperture size, etc.

Automotive Industry



Measures piston diameter, crankshaft journal diameter, and gear module.

Medical Devices



Measures surgical instrument blade angles, cannula diameter, and dimensions of microstructures.

Application Scenarios

Assembly Integrity Inspection

Consumer Electronics Assembly



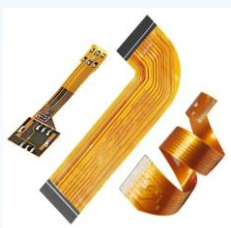
Internal Component Presence Check

Detects missing or misplacement of chips, capacitors, resistors, connectors, etc.



Screw Fastening Check

Verifies if screws are tightened properly, checks for missing screws, thread stripping, or incorrect models.



Connector and Cable Assembly

Inspects whether FPC cables are fully inserted, clasps are securely fastened, and interface covers are properly installed.



Labels and Insulation Materials

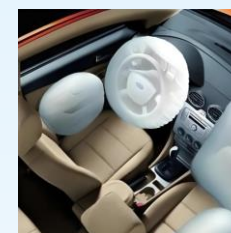
Checks if IMEI labels, network access labels, insulating sheets, and thermal silicone pads are correctly applied without wrinkles or omissions.

Automotive Parts Assembly



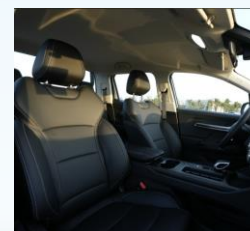
Engine/Transmission Assembly

Inspects whether sensors, wiring harness connectors, vacuum tubes, and bolts are fully and correctly installed.



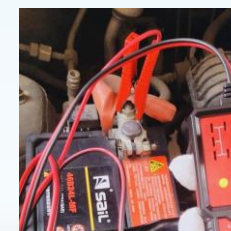
Airbag Module

Checks the assembly completeness and correctness of the airbag body, mounting brackets, and initiators.



Door/Seat Interior

Verifies whether audio speakers, armrests, control panels, safety buckles, etc., are properly installed without missing parts.



Electronic Control Unit

Inspects whether relays, fuses, and connectors on the circuit board are correctly installed.

Application Scenarios

Assembly Integrity Inspection

Home Appliance Final Assembly



Washing Machine

Inspects whether the balance block, shock absorber, and door seal ring inside the drum are installed, and whether buttons and knobs on the control panel are fully assembled.



Refrigerator

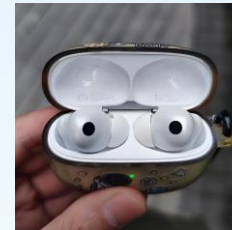
Checks if internal shelves, drawers, light covers, and door seals are properly installed without deformation.



Air Conditioner

Verifies the installation of airflow deflectors, display screens, and filter nets, as well as the tightness of hose clamps on connecting pipes.

Smart Hardware & Wearable Devices



TWS Earbuds Charging Case

Detects whether internal charging contacts, magnets, and indicator light columns are correctly positioned.



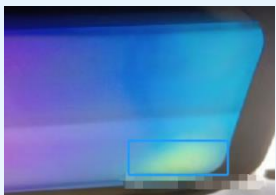
Smart Watch

Inspects the assembly gaps between the heart rate sensor module, strap buckle, buttons, screen, and housing for uniformity.

Application Scenarios

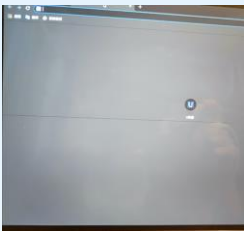
Optical Performance Testing

Display/Screen Optical Testing



Mura Defect Detection

Identifies uneven brightness or chromaticity under solid-color screens (e.g., clouding, edge dimming, yellow spots).



Point/Line Defect Detection

Detects dead pixels, bright spots, dark spots, short-circuit lines, etc.



Color Accuracy Testing

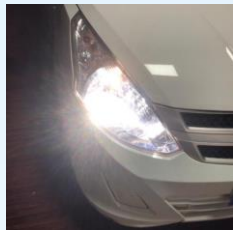
Measures chromaticity coordinates, color temperature, and color gamut coverage, comparing results with standard values.



Flicker and Response Time Testing

Analyzes screen flicker and pixel switching speed via high-frequency image capture.

Automotive Lighting Optical Testing



Light Distribution Performance Testing

Evaluates the clarity and regulatory compliance of cut-off lines (low beam, high beam, DRL) and light pattern distribution.



Brightness and Uniformity Testing

Measures brightness distribution across the entire light strip or surface to ensure no over-bright or dark spots.



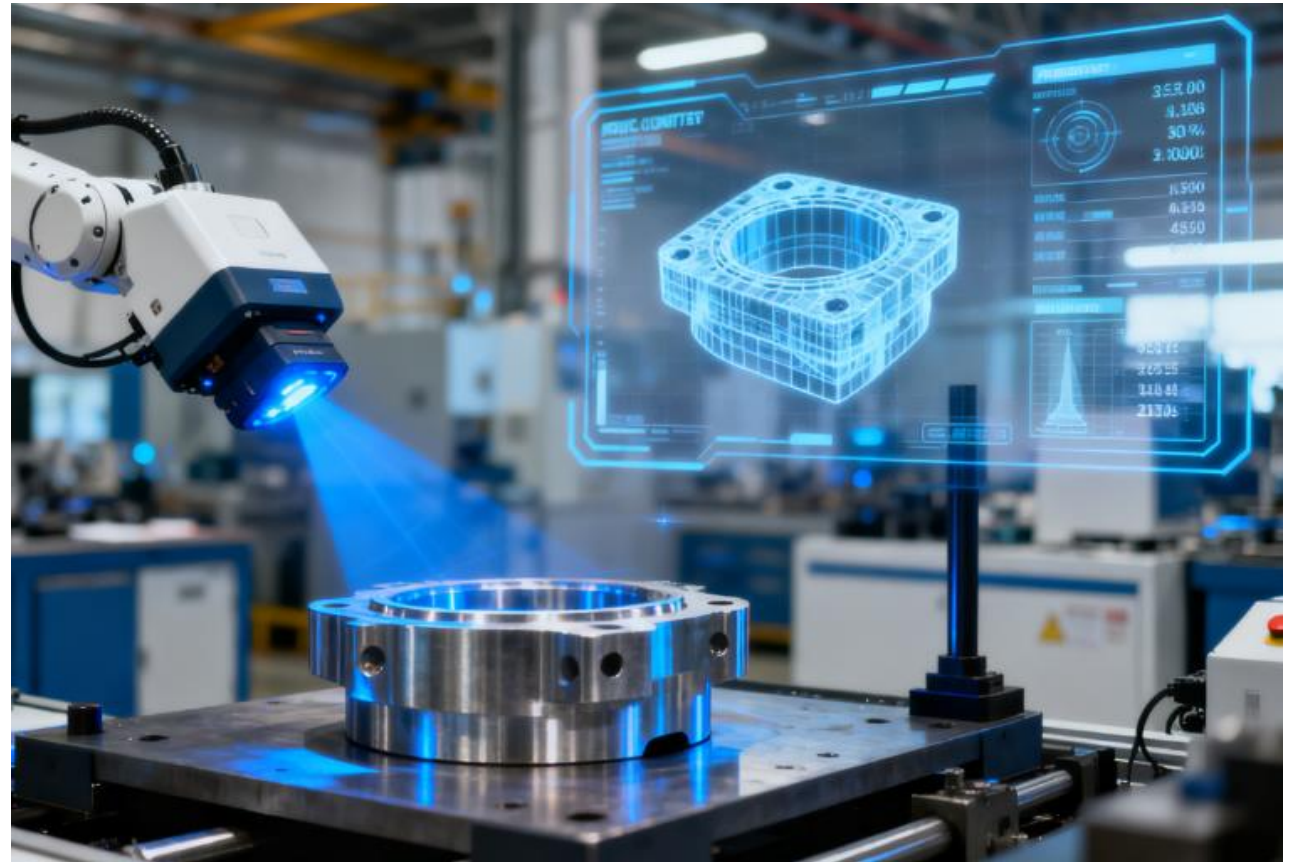
Color Consistency Testing

Ensures uniform color across all LED sources (e.g., DRL white without blue/yellow deviation).

Conclusion

Embracing the New Era of AI Visual Inspection

AI visual inspection is reshaping industrial component inspection with transformative power, demonstrating clear advantages in efficiency, precision, and cost control. As the technology continues to evolve, it will become deeply integrated into the process of industrial intelligentization, injecting powerful momentum into high-quality manufacturing development and ushering in a new era of inspection.



Thank you for your attention!

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