

AI Vision-Based Circlip Presence Detection for Error-Proof Automotive Assembly



Industry

Automotive Manufacturing – Steering Gear / Assembly Line Poka-Yoke



Problem Statement

In steering gear assembly, a circlip is a critical retaining component that secures assembled parts in position. If the circlip is missing, improperly seated, or incorrectly assembled, the product can fail during operation, resulting in costly rework, warranty claims, and potential safety risks.

Previously, circlip verification relied on manual inspection, which was:

- Operator dependent
- Time-consuming
- Prone to human error
- Difficult to trace
- Unable to prevent missing circlips before the next process

The customer required an automated vision system capable of verifying circlip presence and interlocking the assembly station with the PLC.



Project Objective

- Detect the presence of the circlip before the assembly cycle is completed.
- Prevent the next machine operation if the circlip is missing.
- Provide instant visual feedback to the operator.
- Send OK/NOK status to the PLC.
- Display inspection status on the Vision Screen and PLC HMI.
- Store inspection results for complete production traceability.



Our Office

Office no 8 and 9, Ground Floor, R Square Building,
Mumbai banglore Bypass Rd,
Motiram Nagar, Warje,
Pune, Maharashtra-411 058



Mobile

+91 9960589944



Email

reddymeghraj@wayzontech.in



Website

www.wayzontech.in

Solution Overview

Wayzon Technology Services Pvt. Ltd. developed an **AI Vision-Based Circlip Detection System** integrated with the PLC and assembly station.

System Flow

1. Operator assembles the component.
2. PLC triggers the vision inspection cycle.
3. Industrial camera captures the circlip region.
4. AI vision algorithm inspects the predefined ROI.
5. The system verifies whether the circlip is correctly present.
6. If the circlip is detected:
 - Vision screen displays **CIRCLIP DETECTED**.
 - Green OK indication is shown.
 - OK signal is transmitted to the PLC.
 - PLC allows the next assembly operation.
7. If the circlip is missing:
 - Vision system displays **CIRCLIP NOT DETECTED**.
 - Red warning appears on the Vision Screen.
 - PLC blocks the machine cycle.
 - Operator must install the circlip before continuing.
8. Inspection status, timestamps, and production data are stored in the database for traceability.

Technical Approach

- AI-Based Object Detection
- ROI-Based Presence Verification
- Real-Time Industrial Image Processing
- PLC Communication
- Automatic Machine Interlocking
- Production Traceability
- Industrial Lighting Compensation
- High-Speed Inspection Logic

Key Highlights

- 100% automatic circlip verification
- Real-time AI inspection



Our Office

Office no 8 and 9, Ground Floor, R Square Building,
Mumbai banglore Bypass Rd,
Motiram Nagar, Warje,
Pune, Maharashtra-411 058



Mobile

+91 9960589944



Email

reddymeghraj@wayzontech.in



Website

www.wayzontech.in

- PLC interlocking for missing circlips
- Green/Red visual indication
- Automatic cycle validation
- Industrial-grade reliability
- Complete inspection traceability
- Fast processing suitable for assembly line cycle time

System Architecture

- Industrial Camera
- LED Industrial Lighting
- AI Vision Processing System (Industrial PC / NVIDIA Jetson)
- PLC Interface (Ethernet/IP / Modbus TCP / Profinet / Digital I/O)
- PLC HMI
- Vision Monitoring Software
- SQL Database
- Manufacturing Execution System (Optional)

Results & Benefits

- ✓ 100% automatic circlip presence verification
- ✓ Eliminated manual inspection
- ✓ Prevented missing circlip assembly defects
- ✓ Automatic PLC machine interlocking
- ✓ Real-time operator guidance
- ✓ Improved assembly quality
- ✓ Reduced rework and warranty claims
- ✓ Complete digital traceability
- ✓ Faster inspection cycle
- ✓ Industry 4.0-ready solution



Our Office

Office no 8 and 9, Ground Floor, R Square Building,
Mumbai banglore Bypass Rd,
Motiram Nagar, Warje,
Pune, Maharashtra-411 058



Mobile
+91 9960589944



Email
reddymeghraj@wayzontech.in



Website
www.wayzontech.in

Technologies Used

- AI & Deep Learning Vision
- Industrial Camera
- PLC Integration
- Industrial PC / NVIDIA Jetson
- Python & OpenCV
- SQL Database
- Industrial IoT Dashboard
- Industry 4.0 Traceability

Conclusion

The **AI Vision-Based Circlip Presence Verification System** developed by **Wayzon Technology Services Pvt. Ltd.** provides a reliable Poka-Yoke solution for automotive assembly lines. By combining AI-powered vision inspection with PLC interlocking, the system ensures that every component is assembled with the required circlip before the production cycle advances. This intelligent inspection solution minimizes human error, improves product quality, enhances traceability, and supports zero-defect manufacturing.

Wayzon Technology Services Pvt Ltd



Our Office

Office no 8 and 9, Ground Floor, R Square Building,
Mumbai banglore Bypass Rd,
Motiram Nagar, Warje,
Pune, Maharashtra-411 058



Mobile

+91 9960589944



Email

reddymeghraj@wayzontech.in



Website

www.wayzontech.in