Automating Quality Inspection for Fabricated Steel Parts

GCC Machines | Power BI Insights
Aug 2025

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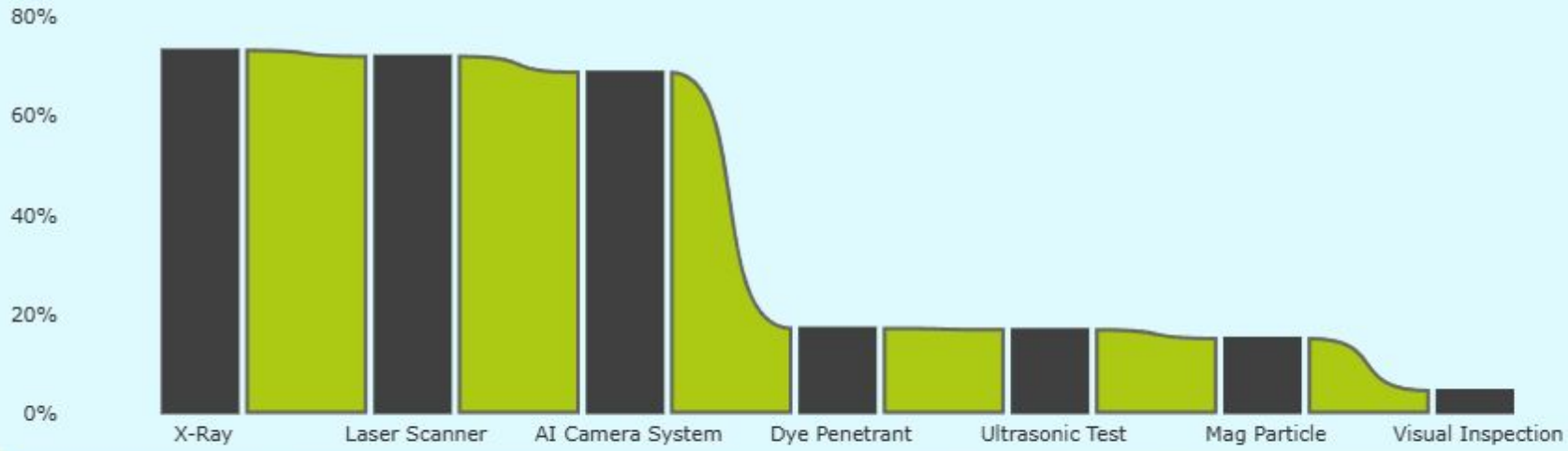
YTD Defects	Avg Inspection Time
159	2.61 hrs

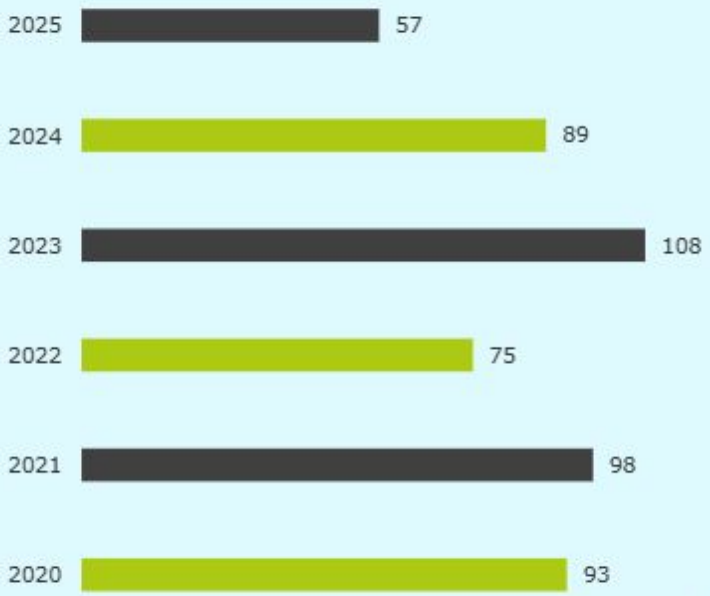
Defect Rate (%)	Last 3 Months Defects
67%	56

Date Hierarchy: All | Steel Part Type: All | Defect Severity Level: All | Technology: All

Defect Detection Accuracy by Method



Yearly Trend of High-Severity Defects



Average Inspection Time by Method

Defect Rate Trend Over Time

Dashboard 1: Summary

Dashboard Summary – This interactive Power BI dashboard presents a comprehensive overview of quality inspection for fabricated steel parts. It enables manufacturing and quality control teams to track defect rates, compare inspection methods, analyze time efficiency, and identify trends in defect severity over time.

Key Metrics Displayed:

YTD Defects: 159 – Total defects identified year-to-date.

Total Defective Parts: 1,365 – Cumulative count of defective parts detected.

Defect Rate (%): 67.14% – Percentage of inspected parts found defective.

Last 3 Months Defects: 56 – Recent defect count over the last quarter.

Filters Available:

- Interactive slicers for Date Hierarchy, Steel Part Name, Defect Severity Level, and Inspection Status to allow tailored analysis.

Drill-Through Analysis

- A detailed drill-through table has been added to this dashboard to provide insights, supporting deeper analysis of APIs.

RED SWITCH

Dashboard 1: Core Visual Insights

Defect Detection Accuracy by Method:

X-Ray, Laser Scanner, and AI Camera System show the highest detection accuracy (around 70–80%).

Dye Penetrant, Ultrasonic Test, Mag Particle, and Visual Inspection show significantly lower detection accuracy.

Defect Rate Trend Over Time:

Monthly defect rates range from 60.12% (Aug) to 73.33% (Jul), indicating fluctuations possibly due to seasonal or process variations.

Average Inspection Time by Method:

Fastest methods: Laser Scanner & X-Ray (2.5 units of time).

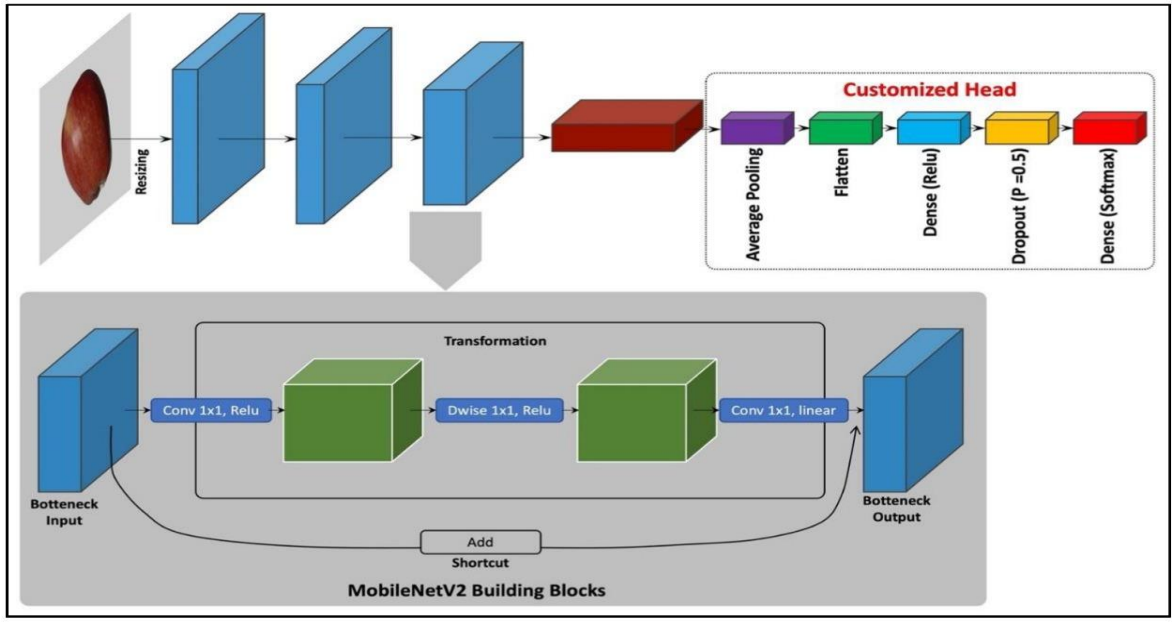
Slowest method: AI Camera System (2.8 units of time).

Yearly Trend of High-Severity Defects:

2023 recorded the highest share (20.77%), while 2025 shows a decline to 10.96%.

Other years vary between 14%–19%, showing moderate changes in severe defect occurrence.

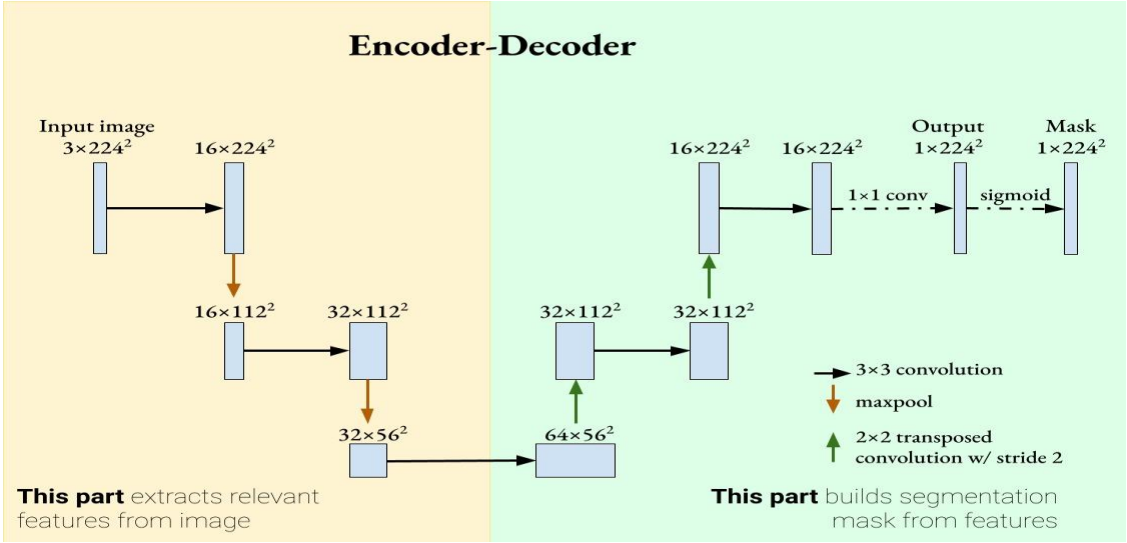
Model Implementation – Classification



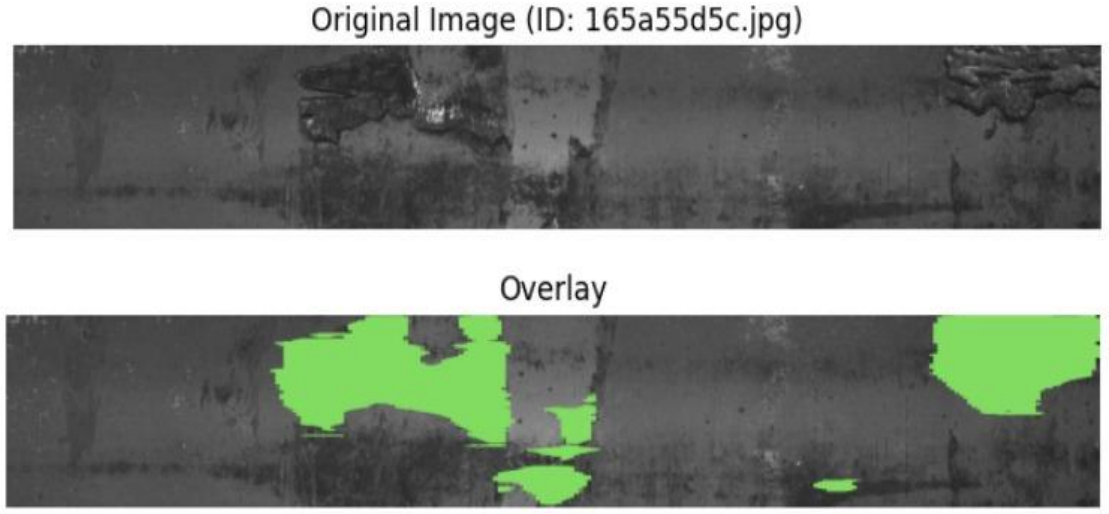
- **Model Choice –** We tested multiple models, but MobileNetV2 gave the best balance of speed and accuracy.
- **Why MobileNetV2 –** It's lightweight, fast, and accurate, making it ideal for real-time inspection.
- **Advantage –** Runs efficiently on GPU or even low-powered devices, unlike heavier models that are slow or memory-hungry.

- The surface of the steel sheet is shown here in an X-ray–style image for inspection.
- The AI has marked irregular patterns as defects, meaning the sheet has imperfections or damage.
- The warning symbol signals that this sheet needs extra inspection before use.

Image Segmentation



- After finding a defect, we need to show exactly where it is on the steel sheet.
- We use U-Net, a model that can draw clear outlines of defects, even if they are small or oddly shaped.
- U-Net gave the best and cleanest results, better than other methods, which helps in proper quality checking.



Automated Surface Damage Detection using AI

- **Original Image:** Shows the actual metal surface with visible wear, corrosion, or rust.
- **Overlay Image:** Highlights damaged regions automatically in green using AI-based image analysis.
- **How it works,** AI scans the surface image pixel by pixel, Damaged or corroded areas are detected using trained models, Detected areas are overlaid with a marker color for easy visualization.
- **Benefit:** Eliminates manual inspection, speeds up defect detection, and improves accuracy by reducing human error.


Thank
you!!!