RustRadar

AI-Powered Corrosion Detection

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Introduction

The petrochemical industry faces **huge losses** from corrosion

Corrosion costs the global economy **$2.5 trillion annually**, equivalent to 3.4% of global GDP

Traditional inspection methods are **time-consuming** and **prone to human error**

RustRadar: An AI-powered solution that detects corrosion early, preventing costly failures and safety hazards

The Problem of Corrosion

- Metal equipment in petrochemicals → exposure to **chemicals & humidity**
- Corrosion leads to **safety hazards** (explosions, leaks, structural failures)
- Results in **unplanned downtime** and high maintenance costs
- Costs the petrochemical industry **billions in yearly losses** and reduces equipment lifespan by 40%

Current Challenges in Corrosion Detection

⚠ **Manual inspection:** Time-consuming, subjective, and limited access to confined spaces

⚠ **Inconsistent detection:** Varying expertise levels lead to missed early-stage corrosion

⚠ **Reactive approach:** Detection often occurs after significant damage has already developed

⚠ **Resource intensive:** Regular inspections require significant downtime and labor costs

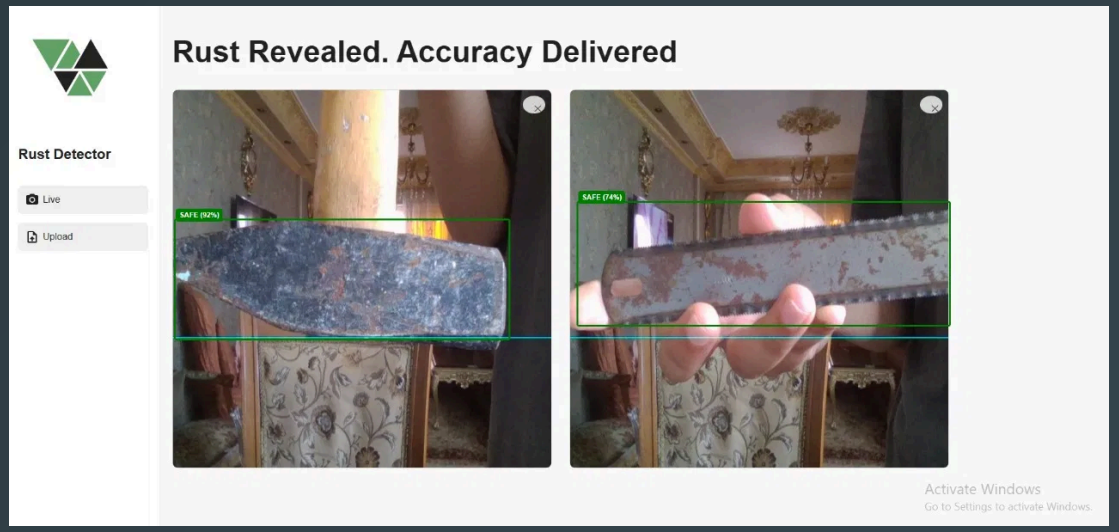
RustRadar Solution

RustRadar: AI-powered corrosion detection system using YOLOv8 object detection

Automatically identifies and highlights corroded areas with **bounding boxes**

Provides **confidence scores** and status indicators (SAFE/ALARM)

Accessible through web interface for **real-time analysis**



> **Key Advantages**
>
> Early detection • Reduced inspection time • Higher accuracy • Consistent results • Accessible anywhere

Technology Behind RustRadar

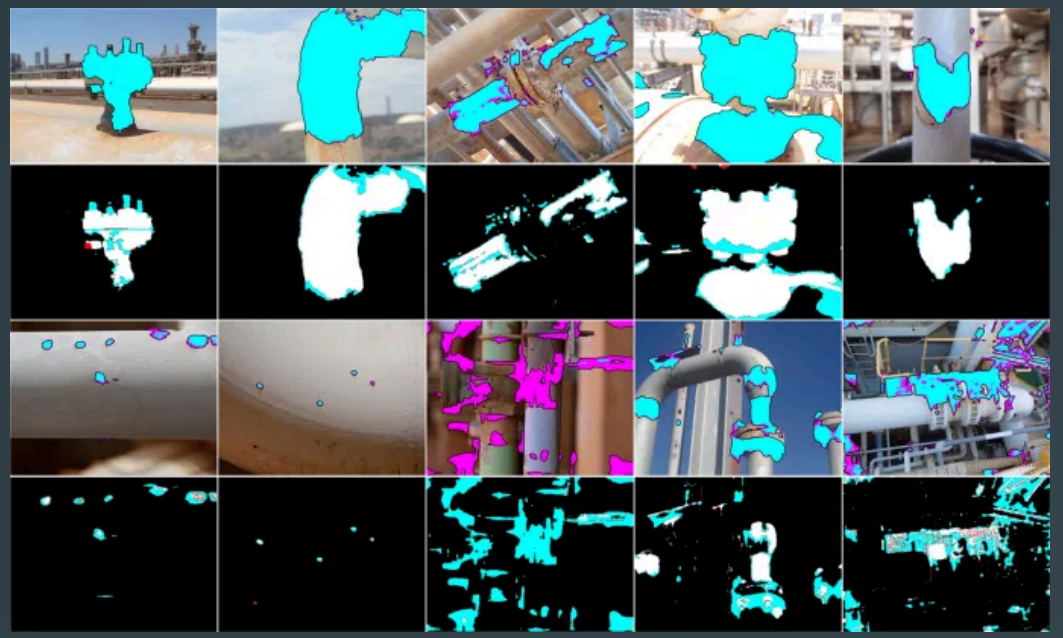
YOLOv8 Detection Model: State-of-the-art object detection architecture optimized for real-time performance

Trained on **custom corrosion dataset** with labeled images of rusted surfaces

Advanced **feature extraction** capabilities identify subtle corrosion patterns that human inspectors might miss

Confidence threshold system:

- ≥0.7 → SAFE (low corrosion risk)
- < 0.7 → ALARM (significant corrosion detected)



Training Specifications

Model trained with 50 epochs on GPU-accelerated environment using Kaggle, achieving high precision in corrosion identification

System Architecture

Dataset Preparation: Images labeled for corrosion using Roboflow, exported in YOLOv8 format

Model Training: YOLOv8 Large trained for 50 epochs with GPU acceleration

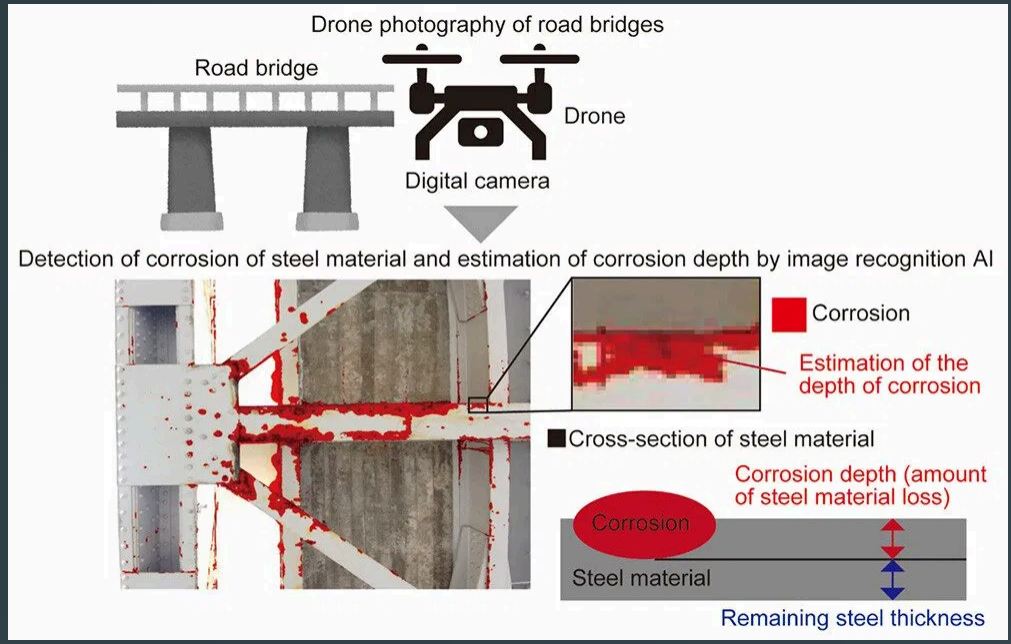
API Deployment: FastAPI backend deployed on Hugging Face Spaces via Docker

Frontend Application: Web interface for image upload and visualization

The system processes images through the pipeline, applying confidence thresholds:

≥0.7 → SAFE

<0.7 → ALARM



Demo & Results

RustRadar successfully **identifies corrosion** across various industrial objects and surfaces

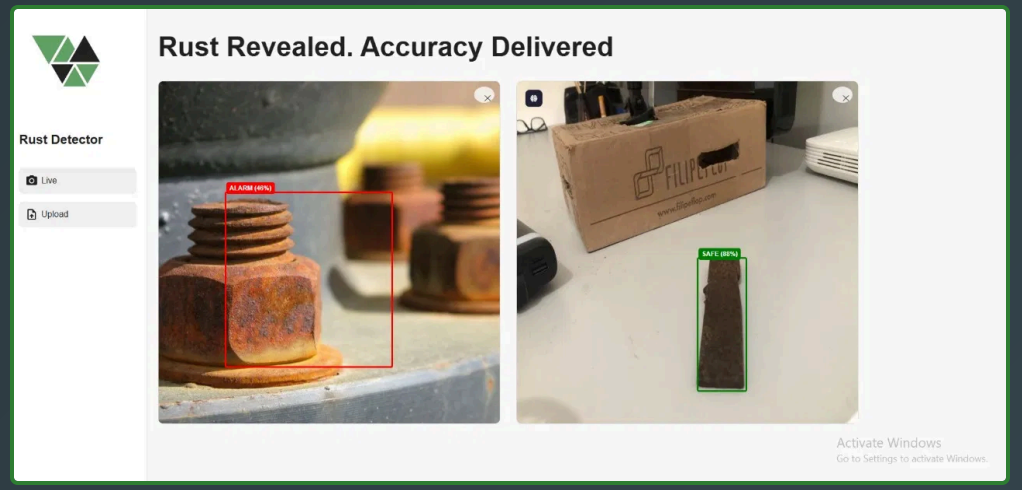
Detection includes **confidence scores** showing the system's certainty level

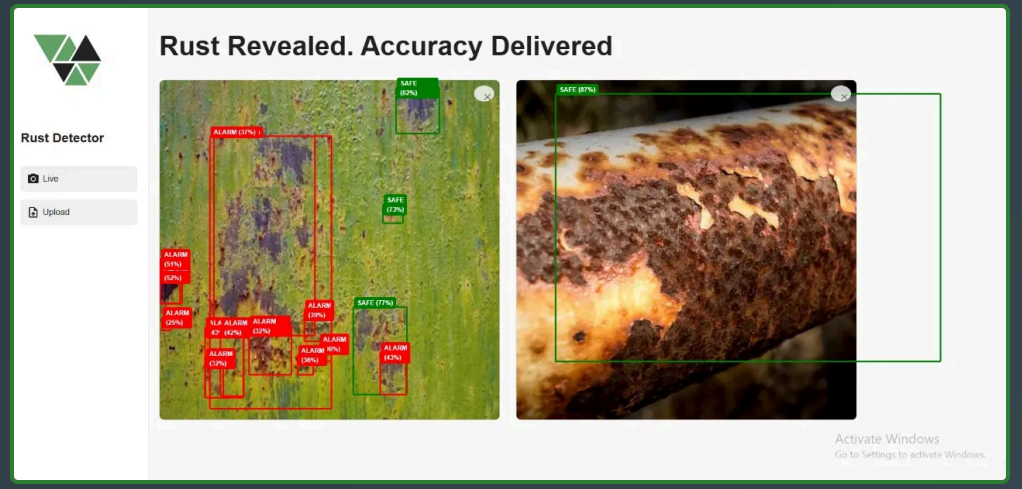
Color-coded bounding boxes provide **instant visual feedback**:

- Green boxes (SAFE): Low corrosion risk areas
- Red boxes (ALARM): Significant corrosion detected

System processes images in **real-time**, enabling immediate decision-making for maintenance teams

SAFE (≥70% confidence) ALARM (<70% confidence)





Benefits for Petrochemical Industry

- **Enhanced Safety:** Early detection of corrosion prevents catastrophic failures, protecting personnel and environment from hazardous leaks and explosions

- **Cost Reduction:** Up to 35% reduction in maintenance costs through preventive rather than reactive maintenance

- **Extended Equipment Lifespan:** Proactive maintenance extends asset life by 15-20%, maximizing return on investment

- **Operational Efficiency:** Minimized unplanned downtime and optimized maintenance scheduling increases overall plant productivity

Conclusion & Future Enhancements

RustRadar successfully demonstrates an **end-to-end pipeline** for AI-powered corrosion detection

The system enhances safety and efficiency by **automating detection**, reducing reliance on manual inspections

Future Enhancements

Expanding the dataset with more diverse corrosion examples

Real-time video stream analysis for continuous monitoring

Mobile application for field inspections

Integration with maintenance management systems

Preventing costly failures through early detection