# Toward Intelligent Automation: Industry Use Case of CiRA CORE for Automated Shipping Container Defect Detection

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*Abstract*— **This paper presents a practical implementation of the CiRA CORE platform through an automated shipping container defect detection system deployed at a real-world logistics site. CiRA CORE, a low-code visual programming environment, enables integration of ROS, AI models, and industrial hardware with minimal coding. The system comprises four modular components: Container Detection, OCR, Defect Detection, and Data Processing. Leveraging real-time camera feeds, a custom-trained YOLOv8 model detects shipping containers and records images for further processing. The Optical Character Recognition (OCR) module extracts container IDs and ISO codes, while the Defect Detection module classifies and grades defects using segmentation and AI-based inference. Finally, the Data Processing module compiles results into automated inspection reports. This application showcases CiRA CORE's ability to simplify complex industrial automation workflows, bridging AI and robotics for intelligent logistics operations.**

***Keywords*** — *Low-Code Development; Visual Programming; Industry 4.0; ROS Integration; Robotics Education; Human-Machine Interface; Intelligent Automation*

## I. Introduction

The digital transformation spurred by Industry 4.0 has reshaped the landscape of manufacturing and industrial operations. As smart factories adopt AI, robotics, cloud computing, and data-driven systems, there's a growing need for platforms that bridge complex technologies and end-users. CiRA CORE addresses this need by offering a central platform that simplifies AI and robotics development via a low-code environment.

Traditional robotics development often demands strong programming skills and deep knowledge of control systems, ROS (Robot Operating System), and industrial hardware interfaces. CiRA CORE removes these barriers with a user-friendly, node-based graphical programming approach that minimizes coding. This lets learners, engineers, and SMEs rapidly develop, simulate, and deploy intelligent systems.

The platform supports various hardware—cameras, sensors, robotic arms—for real-time applications like visual recognition and motion control. It also offers educational and professional training where users can explore and build solutions virtually or physically.

As the industry moves from mass production to customization, platforms like CiRA CORE enable scalable, agile, cost-effective solutions. By providing foundational infrastructure and training, CiRA CORE empowers a new generation of innovators to implement automation tailored to specific needs.

## II. Developed Modules

Supported by the SMCS TEAM Program Award, CiRA CORE has achieved milestones through the design and implementation of core training modules. These modules progressively build skills in robotics, AI, and automation using a hands-on, low-code approach.

### A. *Module 1 – Introduction to CiRA CORE and Visual Programming with ROS*

This foundational module introduces the platform's core features. It emphasizes visual programming through a node-based interface, enabling integration and control of components like sensors and actuators with minimal code. It also simplifies ROS, letting learners focus on system design over software complexity.

### B. *Module 2 – Application of 3D Printing and 6-Axis Industrial Robotics*

This module provides hands-on experience with 3D printing and robotic arm systems. Users learn to design robotic movements and build functional components such as grippers, bridging the gap between mechanical design and industrial robotics. Simulation tools are also introduced to test and validate robotic workflows before deployment.

### C. *Module 3 – Integration of AI and LLMs for Intelligent Automation*

In this module, users are introduced to AI model development for tasks such as object detection, image classification, and OCR. These models are integrated with robotic systems to perform perception-based tasks. The module also introduces the Ollama module, which allows users to embed Large Language Models (LLMs) into visual workflows. LLMs are used to process and analyze text-based data (e.g., document summarization or information extraction), creating richer automation pipelines without requiring backend coding.

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*D. Module 4 – Bin-Picking Automation Using Integrated AI and Vision Systems*

This module brings together concepts from earlier modules to solve real-world bin-picking challenges. It involves the use of 3D printing to create custom end effectors, deep learning models for precise object identification, and robot vision systems to guide picking actions. This module demonstrates how CiRA CORE can support complex, multi-layered automation tasks within a simplified development environment.

## III. AUTOMATED SHIPPING CONTAINER DEFECT DETECTION

This system includes four key CiRA CORE modules: Container Detection Module, OCR Module, Defect Detection Module, and Data Processing module. A camera was set up at IMT3@Northport, Klang to capture live streams of shipping containers, accessed via Real-Time Streaming Protocol (RTSP). The Container Detection Module monitors incoming traffic and records image of shipping containers, then pipes its output to Defect Detection Module and OCR module for defect inspection, and finally summarized by the Data Processing Module.

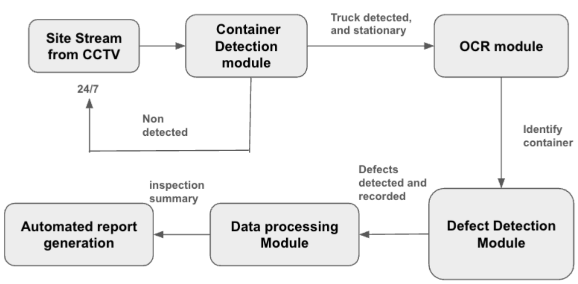


*Figure 1Pipeline of Automated Shipping Container Defect Detection*

*A. Container Detection Module*

This module used pre-trained YOLOv8 model to detect trucks and track its position over time. Next, A custom YOLOv8 model trained in Cira CORE, is then used to identify the coordinates of the shipping container. An image of the shipping container is recorded when the module detects one stopping at the bay as shown in Figure 1.


*Figure 2 Image recorded by Container Detection Module*

*B. OCR Module*

The OCR module extracts container codes from image recorded by container detection module. The module determines text orientation and rearranges the characters to obtain accurate container IDs and ISO codes. The output of the OCR module in CiRA CORE is as shown in Figure 2.

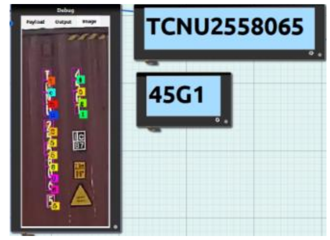


*Figure 3 Container ID and ISO code detected by OCR module.*

*C. Defect Detection Module*

The module processes image recorded by container detection module to identify defects and assign quality grades. It classifies defects into major (e.g., perforation, concave dents) and minor (e.g., rust, minor dents), using YOLOv8 models trained on public datasets. A simplified version of SAHI (Slicing Aided Hyper Inference) was developed in CiRA CORE, allowing the model to analyze image segments individually before merging results. Finally, a grading algorithm calculates defect area across sections and assigns a grade from A to D.

*D. Data Processing Module*

The data processing module serves as the final stage in the defect detection pipeline, organizing and presenting results from the other three modules. After the container's defect and identification details are extracted, this module compiles the findings—such as container ID, defect types, and grading—into a structured format. An automated report generation function is developed in CiRA CORE to generate inspection outcome report.

## IV. CONCLUSION

The CiRA CORE platform has made significant progress as a comprehensive training and deployment ecosystem for AI-powered robotics in industrial environments. The design and simulation of a 6-axis robotic arm, along with modular training content, have laid a strong foundation for broad educational and industrial adoption. Through three core training modules, the platform has proven its ability to simplify complex robotic and AI systems, offering an accessible solution for learners and professionals.

Leveraging CiRA CORE's modular framework, the automated shipping container defect detection system integrates object detection, OCR, and defect grading with minimal manual coding. The platform supports live camera streaming, streamlined YOLOv8 training on custom datasets, and simplified data pipeline management for real-time inference and reporting. Entirely built within CiRA CORE, the final solution enables end-to-end container assessment—from detection to grading and report generation—demonstrating its practical value in industrial logistics.

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