

Image Based Machine Learning for Component Identification for Remanufacturing

Abu Islam¹, Sri Priya Das¹, Nenad Nenadic¹

Everardo FriasRios², Audra Stapella², Sebastian Przybylski²

¹Rochester Institute of Technology, 1 Lomb Memorial Dr, Rochester, NY 14623

²CoreCentric Solutions, Inc, 191 E North Ave., Carol Stream, IL 60188

Primary Topic Area: AI Integration into Re-X

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Abstract

Remanufacturing durable goods presents a significant opportunity to reduce landfill waste and decrease reliance on energy-intensive recycling methods. The first critical step in this process involves sorting and inspecting returned components—referred to as "cores" within the remanufacturing industry. These operations are currently performed manually, making them labor-intensive, error-prone, and ergonomically inefficient. The challenge is further compounded in environments with low-volume, high-variability product mixes, where rapid operator training and adaptation to unpredictable returns and diverse physical conditions are especially difficult. To address these limitations and alleviate staffing constraints, an automated image-based part identification system has been developed. This solution leverages component images to train a neural network using Siamese architecture, incorporating a pre-trained ResNet-18 model as the feature extractor and a triplet loss function. This configuration enables effective training with limited datasets and allows the system to distinguish between visually similar components. A complementary mobile application prototype has been created to streamline the identification process and enable early customer engagement. Users can capture an image of a product using a smartphone and receive immediate identification results. They can approve the result, or modify it, and both correct and incorrect detection is saved with accompanied dataset to automatically create a valuable dataset for future model improvements, and extensions to additional parts. The system architecture is modular, separating end-user interaction from model training and updates, thereby enhancing scalability and maintainability. The concept is currently undergoing demonstration and validation at an industry partner's small appliance remanufacturing facility. The paper provides details on image acquisition techniques, model development workflow, testing protocols, and performance metrics. It will also examine the challenges and opportunities associated with automated defect detection, particularly in products with highly reflective surfaces.

Key words: computer vision, machine learning, remanufacturing