Image recognition to trigger automatic pallet transports

Degree programme: MAS Data Science

This master‘s thesis developed a deep learning-based prototype to automate transport order creation for empty pallets at a pharma production site. A network camera equipped with a YoloV5 object detection model identifies pallet stacks and triggers transport orders, replacing manual processes and reducing contamination risks. The system worked successfully in testing, with potential cost savings and efficiency improvements justifying further development and implementation.

Problem

This master‘s thesis addresses the development of a prototype system to automate the creation of transport orders for empty pallets at a manufacturing site for pharmaceutical products using a deep learning-based approach. The current process includes a manual step for transport order generation, which introduces inefficiencies, increases labor demands, and poses contamination risks.

Approach

The proposed solution involves the installation of a network camera to monitor the area where empty pallets are placed. The detection of pallet stacks was formulated as an object detection problem, addressed by fine-tuning a pre-trained YoloV5 neural network using a dataset of 160 manually annotated images. The model was integrated into an on-camera application capable of analyzing video frames at regular intervals. Upon detecting a correctly placed pallet stack, the system generates a transport order for the existing automated transport system. The design ensures compliance with data privacy standards by processing images locally, avoiding image transmission over the network, and excluding any detection or identification of individuals.

Result

Experimental results demonstrate the feasibility of the system in a controlled test environment, where it successfully automates transport order creation and performs reliably under standard lighting conditions. The system not only reduces manual labor but also eliminates a contamination risk by minimizing humans crossing classification zones. The application’s performance can be further optimized to improve detection accuracy.

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Outlook

A business case analysis was conducted to evaluate the economic and operational impact of the system. The findings indicate that the project delivers significant potential cost savings and efficiency gains, justifying the investment required for its development and deployment. Beyond direct financial benefits, the system represents an important step toward process automation and risk mitigation, while also contributing to the organization’s expertise in implementing deep learning solutions. With remaining optimizations and system expansion, the solution is expected to deliver rapid returns and align with the company‘s long-term strategic goals.
This project demonstrates the practical applicability of deep learning in industrial automation and highlights its potential to improve operational workflows.

Network camera

Pallet stack detection by neural network