Business Finland Co-Innovation Project

TwinFlow: Identification, Tracking and Tracing for Indoor Logistics

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TwinFlow

UWB and Multi-Camera Sensor Fusion for Intralogistics Tracking

Introduction

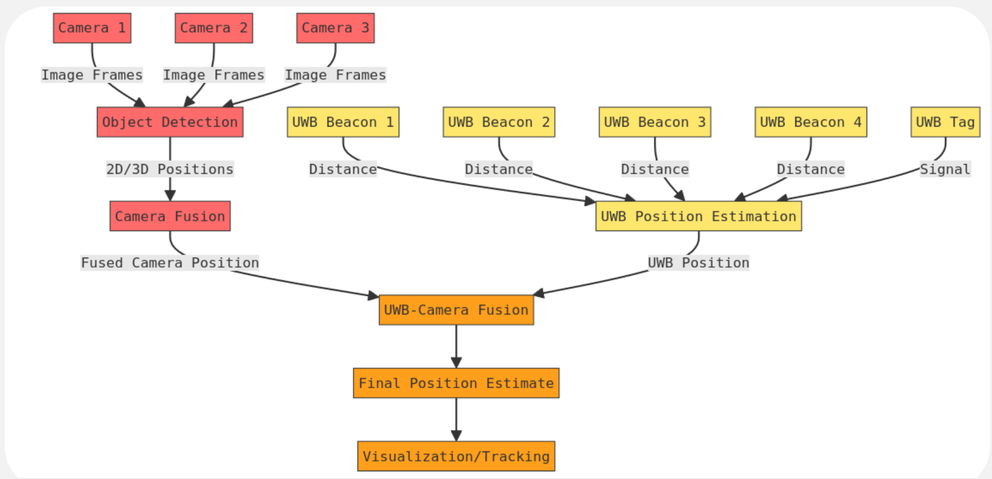
Tracking packages in warehouses or factories is a challenging task due to occlusions and signal interference. This project fuses UWB and multi-camera data to improve accuracy and reliability in indoor logistics tracking.

Methods

- Multi-camera setup: Detects and estimates package position from images.
- UWB localization: Measures distances to a tag for 3D position estimation.
- Sensor fusion: Combines camera and UWB data to reduce errors and improve accuracy and robustness of the system.

Progress & Next steps

- UWB setup is operational, but accuracy is limited (±5 cm).
- Multi-camera setup is installed, and package tracking is functional.
- **Next step:** Configure and test multi-camera tracking to establish a global coordinate system for integration with UWB.



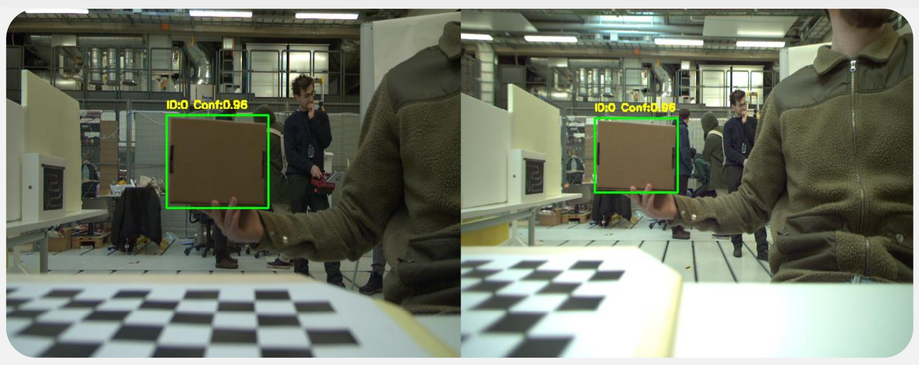


Figure 1. UWB and multi-camera system overview and multi-camera package tracking

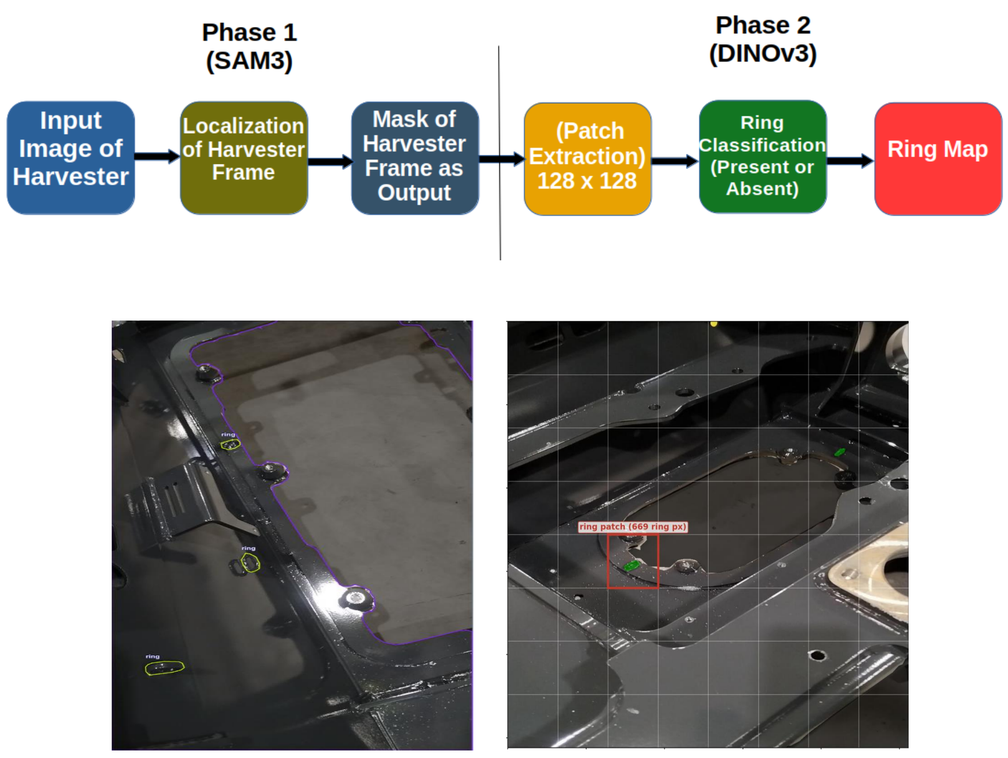


Figure 2. Two-stage Detection Pipeline: SAM3 for harvester mask and DINOv3 for ring classification

Computer Vision Based Quality Inspection Using Synthetic Data

Introduction

Harness rings must be inspected after assembly, however manual inspection is slow, tiring and error-prone. This project aims to train a computer vision model on synthetic data and apply domain adaptation to transfer it to real-world harvester images, reducing the need for large amount of real labeled data.

Methods

- Two-stage pipeline: SAM3 first finds the harvester frame and then DINOv3 checks each 128x128 patch checks whether ring is present or not.
- The model is trained on 4,277 synthetic images, using foundation models to avoid heavy labeling, and fine-tuned with a small set of real harvester images to improve the real-world performance.

Progress & Next steps

- SAM3 finds the harvester frame with 69% IoU on real images; DINOv3 detects rings with 16% recall using combined patch features using synthetic images.
- Next step is to collect 100-200 real harvester images and fine-tune the model to get better results in the real world.

Autonomous Navigation System for Factories Intralogistics

Introduction

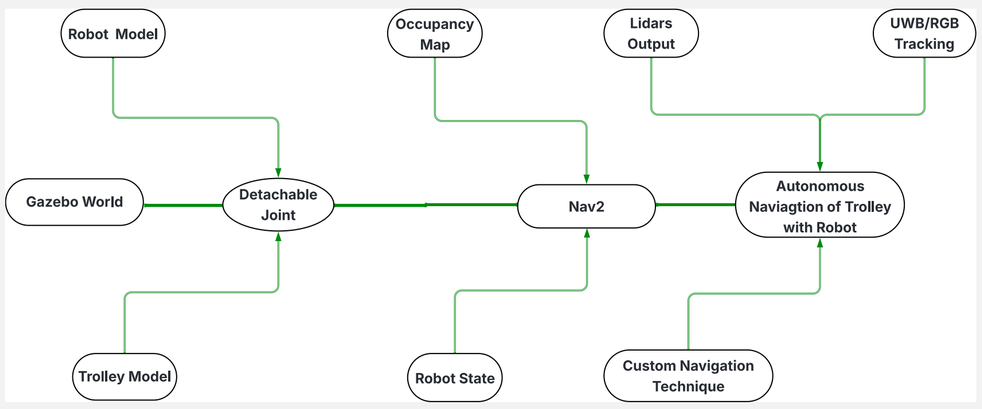
Development of a fully autonomous factory intralogistics system using AMRs capable of transporting loads on their own. This project involves developing a navigation platform in factory environment where an AMR can move around on its own with trolley carrying materials from loading to unloading stations.

Methods

- The project is planned to be conducted both in simulation and real world
- Gazebo is being utilized to create a realistic world environment, while Nav2 is being used with some additions to carry out the navigation in the environment
- Similar setup will be implemented at Crane lab with real robot later on.

Progress & Next steps

- Currently, simulation environment has been developed and customized navigation for the robot is being setup.
- Moving- on this system will be fused with the output of other sensors to track the load carrying trolley effectively



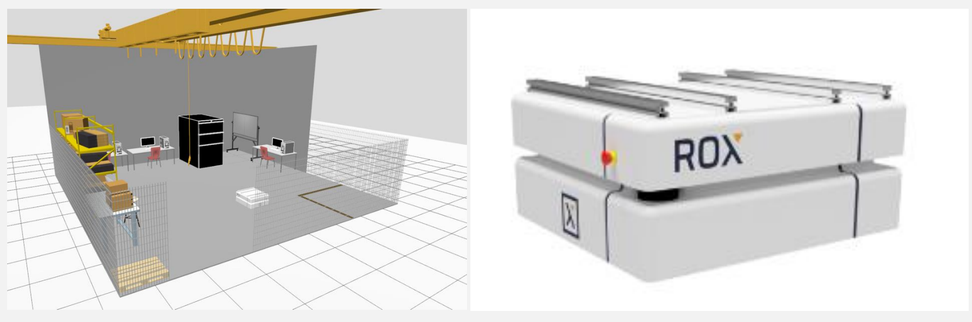


Figure 3. Simulation Environment & Robot Model