ORLAR
AUSTRALIAN GOODNESS GROWN IN VIETNAM

RMIT UNIVERSITY
School of Science, Engineering & Technology

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Project Title

Integrating LiDAR-Based and Human-Aware Predictive Navigation for Optimal AGV Path Planning.

Background and Motivation

Orlar's existing AGV navigates using a magnetic line and magnetic field sensors, confining it to a single fixed path that must be physically installed and maintained, with no ability to sense its surroundings or collect data. This project upgrades the platform to LiDAR-based navigation on a pre-built map, removing the dependency on physical track infrastructure while keeping the AGV confined to safe, pre-defined routes, and adds an onboard camera that automatically captures crop images as the AGV travels each row.

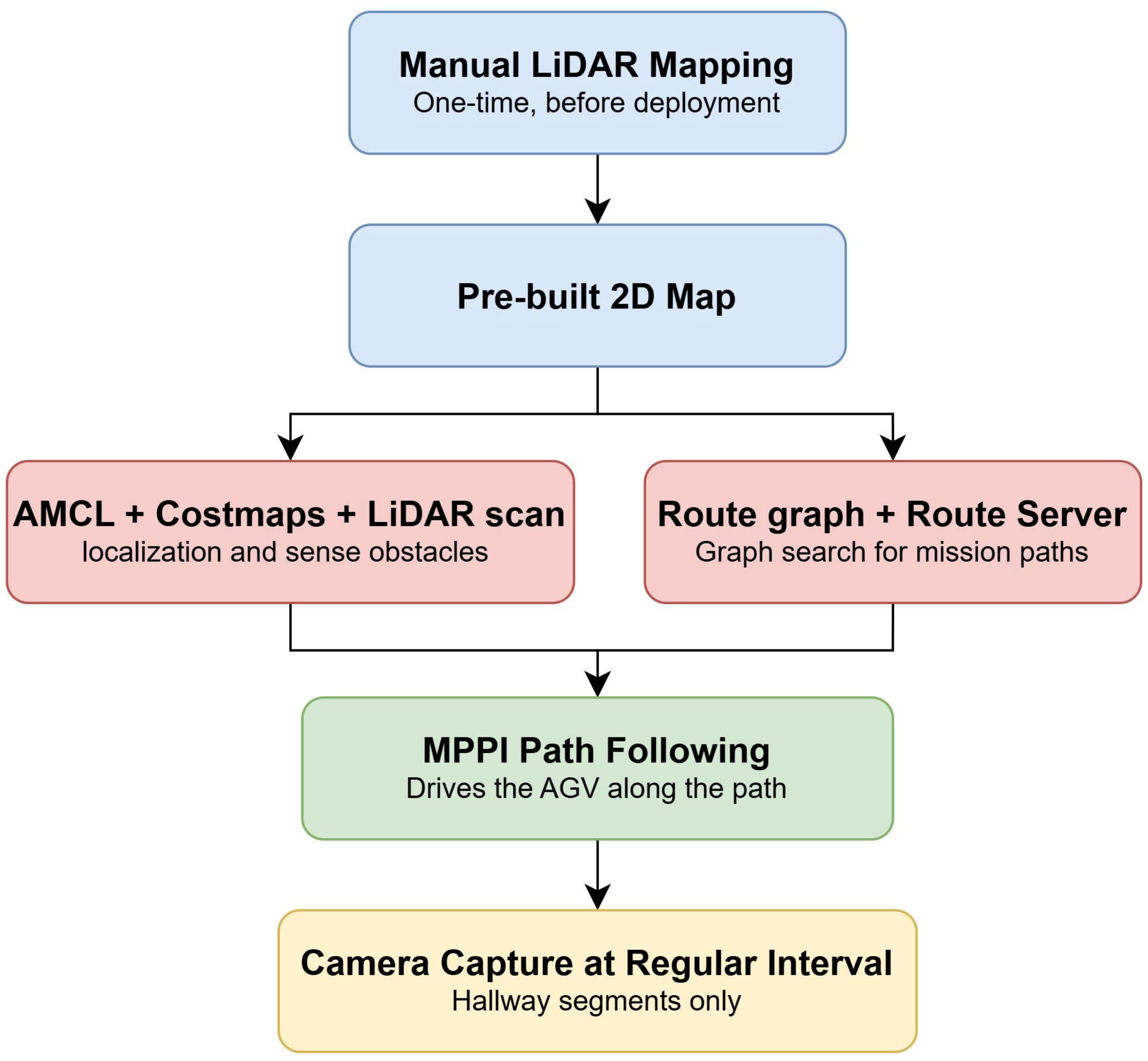
Objectives

- Replace magnetic line-following with LiDAR-based navigation on a pre-built map
- Localise and follow a fixed route graph, with costmap-based obstacle avoidance
- Keep the AGV within safe, pre-defined paths (e.g. never routing beneath crop tables)
- Automatically capture crop images at regular intervals while travelling each row

Methodology

Mapping

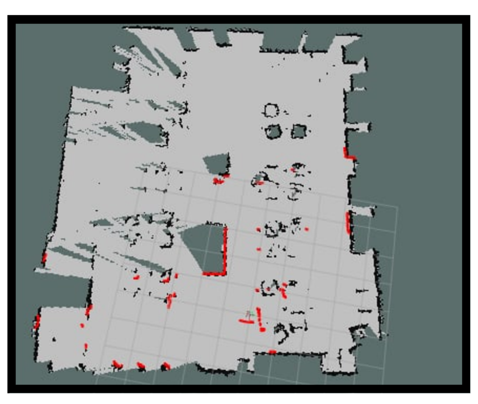
Real-time 2D mapping was implemented in ROS 2 using a SLAMTEC RPLIDAR A2M12. Filtered LiDAR scans were processed with Hector SLAM for local scan-matching-based motion estimation, while SLAM Toolbox provided occupancy-grid mapping and loop-closure correction. The system was validated through rotation, continuous traversal, and repeated return-to-start tests to assess map accuracy, drift, feature retention, and overlap.

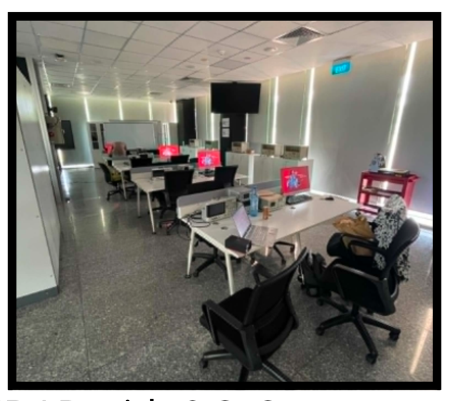


Navigation

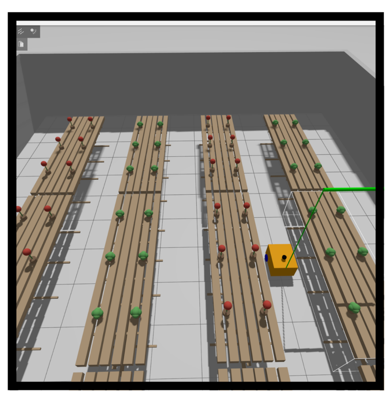
The AGV follows a fixed route graph authored over the pre-built map. AMCL localises the AGV against this map using LiDAR scans, while global and local costmaps provide continuous obstacle awareness. Nav2's route server performs a graph search over the pre-defined path graph to compute the correct sequence of waypoints for each mission, which the MPPI local controller then follows. While travelling along a row, the onboard camera captures an image at regular time intervals

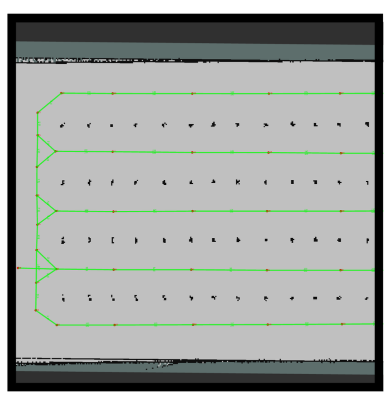
Experiment & Result

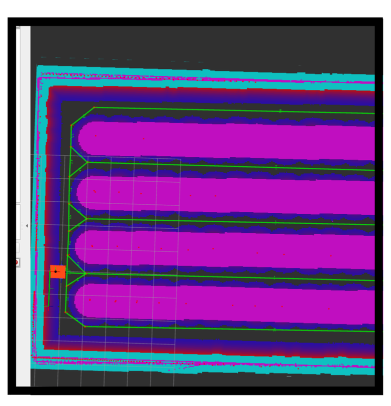




- Best Configuration: A2M12 LiDAR with 0.3–8 m structural filtering, Hector-based local pose estimation, and SLAM Toolbox loop closure.
- Mapping Test: Continuous two-lap return-to-start trials were performed in the indoor test environment.
- Result: The system produced a stable room-scale occupancy map with clear nearby structures. Loop closure reduced accumulated drift and map overlap, although minor misalignment remained when revisiting distant or small features.







- Tested the full navigation and capture pipeline in simulation, from home to each table and back
- Computed the correct path through the route graph for every mission segment
- Followed each path smoothly via the MPPI controller
- Detected obstacles in its path and stopped/steered clear of them accordingly
- Reliably captured and tagged images while travelling each row, correctly pausing during transitions between rows

Conclusion & Future Work

The simulation results were promising, and LiDAR-based mapping, proving efficient for capturing an accurate map. Due to scope constraints, navigation and camera capture were developed and tested purely in simulation this iteration, with real-world LiDAR mapping serving as a supplementary proof of concept rather than a fully integrated system. Future work will focus on integrating the LiDAR and camera onto the physical AGV.