THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY | DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

UGVs Package Delivery (SL05b-22)

LIU Hanmo, DU Xiawei, ZHENG Zhinan **Supervisor: Professor SHI Ling**

Overview

Autonomous vehicles are vehicles incorporating the ability of self-government. Their pre-implemented programs and algorithms enable them to imply different controls during operation with limited or without human intervention.

Possible controls include:
- sensing uncertainties in their surrounding environment,
- making corresponding decisions or adjustments to optimize the result, and
- compensating for probable system failures to ensure satisfactory performance.

Situation: most of delivery robots are moving on sidewalks or traveling between buildings.

Problem: recipients need to collect their parcels either at certain designed public areas or outside the building.

Need: indoor last-mile delivery robots that can deliver parcels inside buildings.

Objective

To design an indoor last-mile delivery robot:

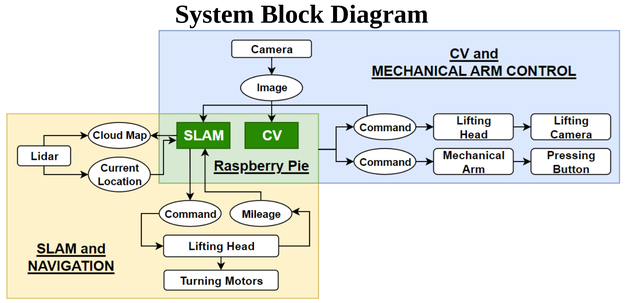
Indoor navigation: indoor localization, mapping, and navigation.

Cross-platform movement: moving between floors using elevators.

Methodology

SLAM and Navigation	Mechanical and Embedded System
System Description	
• Indoor positioning and mapping function using Lidar sensor in known or unknown environment. • Navigation algorithm to perform stable indoor movement.	• Robust robot mechanical frame and structure to accommodate all essential components. • Embedded system to control the motion of robotic car.
Objective Execution	
1. To research and compare the SLAM and navigation algorithm to select the optimal algorithm. 2. To simulate the SLAM and navigation algorithm to verify its feasibility. 3. Implement the point cloud algorithm to compare the current data with the dataset to locate itself. 4. To implement the self-governing algorithm to the robot to ensure reliable indoor moving.	1. To design a proper hardware platform that can accommodate all essential devices and sensors. 2. To select and order the pieces of mechanical equipment and assemble all the pieces into a vehicle that can achieve the utility goal. 3. To fabricate the hardware structure of the robot to install a robotic arm and carry small-sized goods. 4. To design an embedded system to control the car's movement.

System Block Diagram

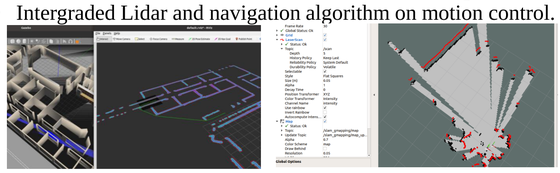


Results

Mechanical Design
- Designed and fabricated the mechanical structure of the robot car.

Embedded System
- Implemented the embedded system of stm32 communicating Raspberry Pi.
- Implement the communication protocol of ROS with lower level control.

SLAM and Navigation
- Researched and launched simulation of g-mapping and navigation algorithm with robotic car.
- Utilized the Lidar sensor as the core sensor for navigation.
- Intergraded Lidar and navigation algorithm on motion control.



Evaluation

Mechanical Design and Embedded System
- All the desired goals are achieved.

SLAM and Navigation
- Accomplished more than 70% of our objectives, while
- Navigation control still need tunning and future work to enhance its performance.

Conclusion

This project aims to design an unmanned delivery robot, which utilizes and modifies the existing indoor navigation technologies to deliver parcels indoors. Future work can be done to hence the performance and fully implement the desired functionalities.