Autonomous Navigation for Mobile Robots

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Introduction

Mobile Robots are developed to move in an environment and perform specified tasks. These are especially helpful in industrial warehouses to move around goods efficiently and also in situations where it is unsafe for humans to operate. Making mobile robots autonomous allows the robots to perform repeatative tasks efficiently and without the need of individual control over each robot. Autonomous mobile robots need to be able to sense the environment and navigate through it which can be achieved using Simultaneous Localization and Mapping (SLAM). This project aims to implement SLAM on mobile robots for indoor navigation and improve localization by mapping the robot location on the real world floor plans of the building.

Hardware

Freenect

System Overview

Floor Plan Localization
Uses morphology and template matching to find a corelation between the 2D occupancy grid generated by SLAM and the floor plan of the mapped area.

Kinect Camera

Freenect
Interfaces with the Kinect camera and publishes RGB and depth images.

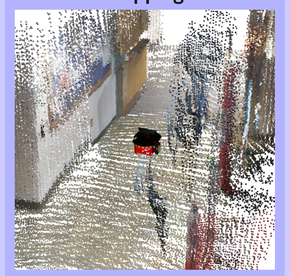
ROS

Robot Chassis

P2OS
Interfaces with the robot chassis and publishes robot odometry data.

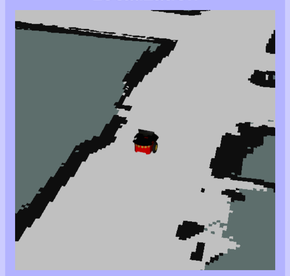
RTAB-Map

Mapping



Generates a 3D map of the environment using depht images from the camera and wheel odometry data from the robot. The RGB images are used to extract keypoints for loop closure and landmark recognition.

Localization

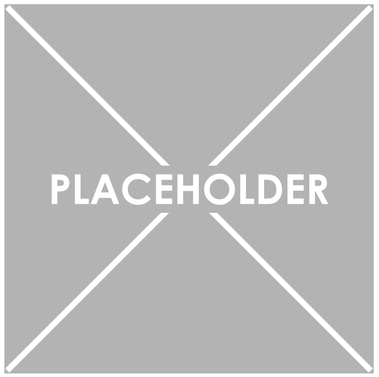


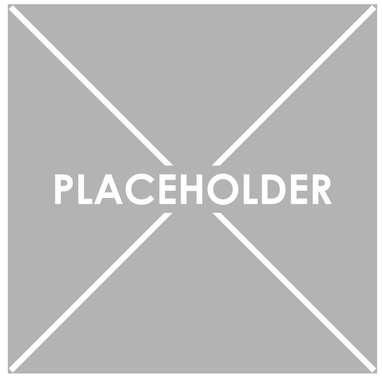
Determines the realtime position of the robot in the stored map by extracting keypoints from RGB images and matching them against the landmarks stored in the long term database updated during the mapping process.

Long-Term Memeory
Stores local and global grid maps generated during the mapping process along with keypoints associated with landmarks. This is helpful for maintaining information across multiple mapping and localization sessions.

https://github.com/introlab/rtabmap

Mapping





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Conclusion

Future Work

[1] Sagarnil Das. “Simultaneous Localization and Mapping (SLAM) using RTAB-MAP”. In: (2018). DOI: 10.48550/ARXIV.1809.02989. URL: https://arxiv.org/abs/1809.02989.
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Mathieu Labbé. “RTAB-Map as an Open-Source Lidar and Visual SLAM Library for Large-Scale and Long-Term Online Operation”. In: 2018.