RRT In a Parking Lot
ENPM 661

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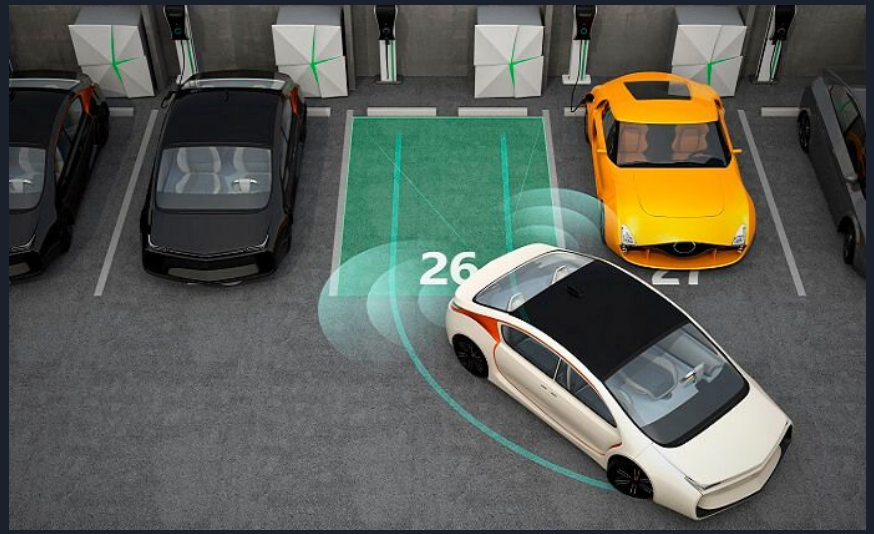
Introduction

- Autonomous parking for a parking lot/parking garage using RRT
- Inspired by smart parking decks and self driving vehicles
- Uses TurtleBot Burger Model, RVIZ, Gazebo, OpenCV, Matplotlib



Methodology

1. Define parking lot in workspace
2. Choose parking space (goal)
3. RRT
    a. Choose random points and check if inside obstacle
    b. Get nearest points from random points, see if path is available between them
    c. Create graph from points, connect points
    d. Repeat until path to goal is found
4. Save nodes to file
5. Read in file, open Gazebo and RVIZ with robot and parking lot environment
6. Draw RRT branches in RVIZ
7. Navigate robot in Gazebo until goal is reached

ROS

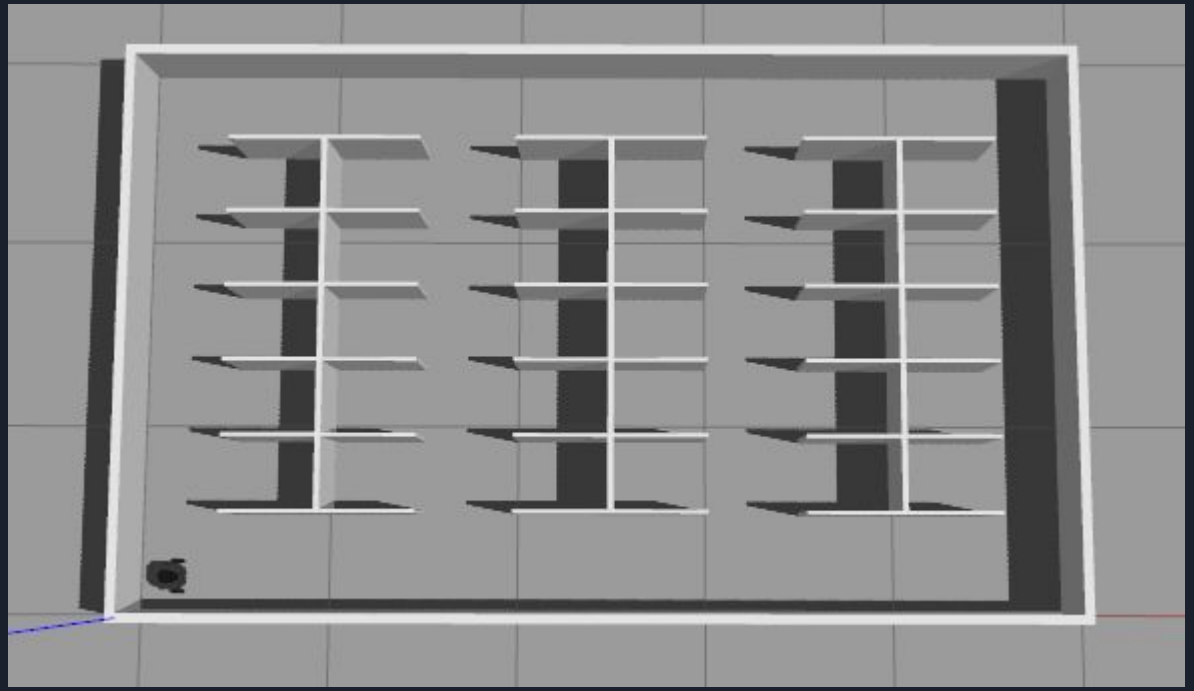
Start Mapping Launch

- Bringup parking world
- Initiate turtlebot3 gmapping for localization and mapping
- Start map server (saved RVIZ map to file for other modules)

Navigation Launch

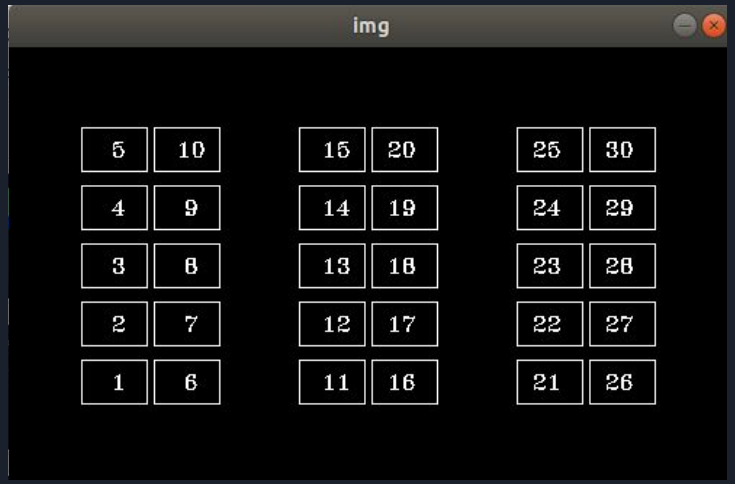
- Starts localization with amcl to determine robot position
- Sends goal to robot to follow from RRT

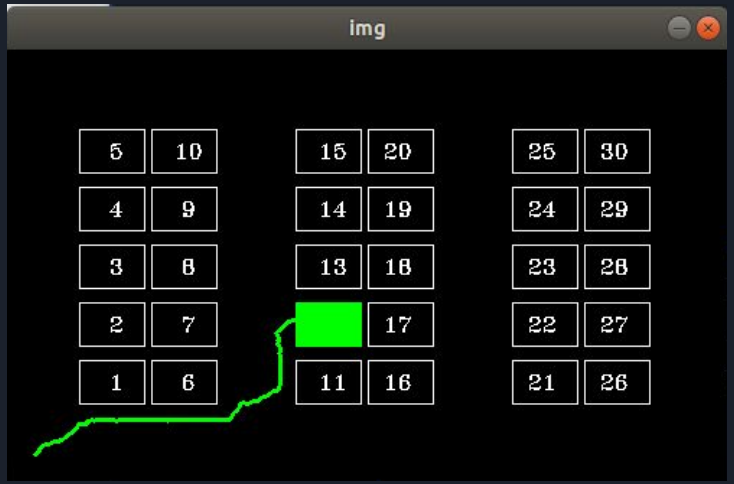
Gazebo Environment



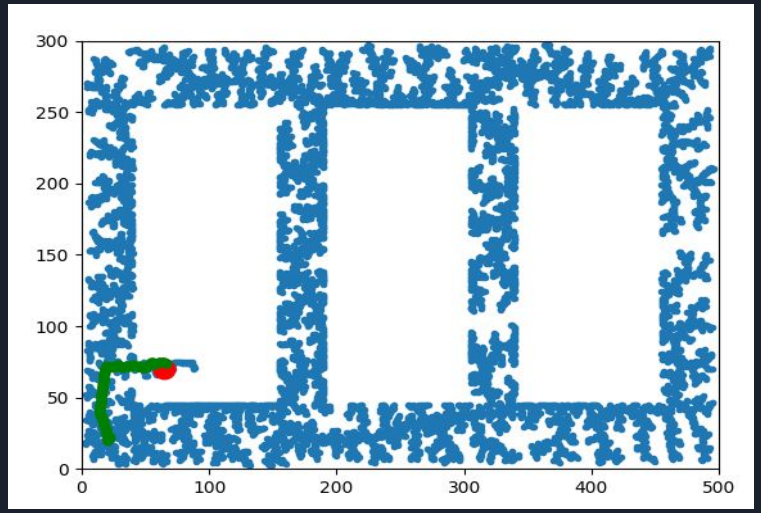
User Input

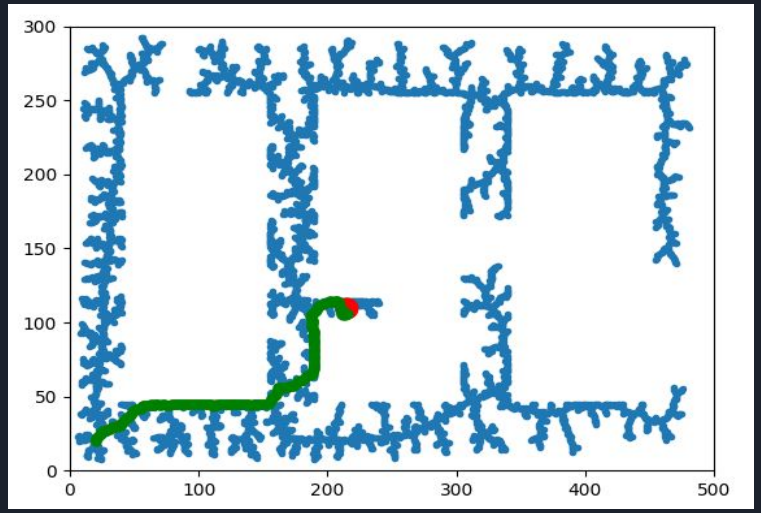
- User has the ability to choose which parking space robot will park in
- Shown a map with parking space numbers and then shown the path that robot took to get to that parking space, with chosen parking space highlighted





RRT Graphs from Testing





Demo

Work Still To Do

- Add Visualization in RVIZ
  - After generating the path in the main script, the program will take the array of nodes in order to display the branches inside RVIZ while the robot is traversing to its goal
- Drive the robot from start point to parking space

References

S. Klemm *et al*., "Autonomous multi-story navigation for valet parking," *2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC)*, 2016, pp. 1126-1133, doi: 10.1109/ITSC.2016.7795698.

Correa Vila, Alejandro & Boquet, Guillem & Morell, Antoni & Lopez Vicario, Jose. (2017). Autonomous Car Parking System through a Cooperative Vehicular Positioning Network. Sensors (Basel, Switzerland). 17. 10.3390/s17040848.

https://theclassytim.medium.com/robotic-path-planning-rrt-and-rrt-212319121378