Path Planning And Navigation

Navigation is a fundamental aspect of a mobile robot. A mobile robot must be able to reach certain locations to perform certain tasks. For example a home service robot needs to be able to move from one location to another. It's not a trivial task for a mobile robot, it requires a map of the environment, a robot must be able to localise itself once the map is produced. Then a robot must plan an optimal path to the destination avoiding any static or dynamic obstacles in the environment. In this project a robot travels from source location to pickup location and then to a drop-off location while localising itself in the map produced.

## Robot

The robot used in the project is one which was designed for the earlier projects of the nanodegree. It's a skid steer drive robot equipped with a laser and a camera sensor.

## Simultaneous Localization And Mapping

Packages used: ***gmapping, map\_server, teleop\_twist\_keyboard***

For any mobile robot the first step is to create a map of the environment it operates in and it needs to localise itself with respect to the map that is Simultaneous localization and mapping (SLAM) is needed. For SLAM ***gmapping***  ROS package is used and for saving the generated map ***map\_server*** node is used.

The ***gmapping*** package has a *slam\_gmapping* node that performs the SLAM. The *slam\_gmapping* node takes odometry data and the laser scan data to produce 2D occupancy map of the environment.

The hokuyo laser sensor of the robot sends the scan information which is subscribed by the *slam\_gmapping* node. The robot is controlled using ***teleop\_twist\_keyboard*** that sends translational and rotational speed commands to the robot. The robot publishes transformed odometry data in tf frame which is also subscribed by the *slam gmapping node.*

At the last step the map can be saved using the *map\_saver* node in the ***map\_server*** which produces map.pgm and map.yaml files.

## Navigation

Once the map is produced, the next task is to navigate the robot to different locations.

Packages used:  ***move\_base, amcl, map\_server***

The ***map\_server*** packageis used to load the static occupancy map created using the ***gmapping*** package earlier.

The ***amcl*** package is for Adaptive Monte Carlo Localization that is based on the probabilistic particle filter to estimate the robot’s pose in the given map. The ***amcl*** subscribes to the laser scan, transform messages, map and the initial pose to publish the robot’s pose estimates while it moves.

The ***move\_base*** package actually navigates the robot. Presented with a goal location it tries to move the mobile robot to the goal location. For that task it uses a global planner and a local planner. Corresponding to the two planners the package provides two costmaps: a *local\_costmap* and a *global\_costmap*.

The *global planner* creates a complete trajectory from the source location to the destination. The *local planner* creates small paths for the local areas around the robot. Navfn is used as a global *planner* while Dynamic window approach (DWA) is used for local planning.

Below is an overview of ***move\_base***:

