HW 3 Problem 4

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Goal for extension:

1. We decide to implement a method to effectively identify and localize a "puddle" on the ground for the turtlebot to cross it or possibly make a detour to avoid walking on it.

2. We are working on incorporating a RRT exploration package from ROS wiki onto TB3 for autonomous exploration.

Method:

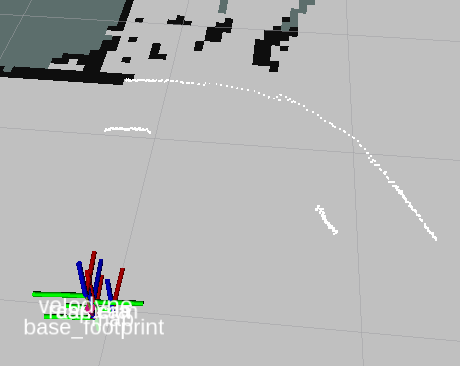
The key part of the first goal is to identify the puddles on the ground. Applying CNN on identifying puddles may not be effective. The reason is that the puddles are on the ground which makes it hard to catch the clear picture by camera. Moreover, we do not have a training model for the puddles. Therefore, we decide to use the Lidar to identify the puddles.

Due to its special material, the surface of puddles are highly reflective of which the intensity is in a specific range. Thus, we can filter the raw data from Lidar to identify the puddles. There are 3 steps:

1. Apply the filter to abstract the point could of puddles

There are three filters. First, by fitting the ground with a plane, all other points above the ground can be removed. Then, a passthrough filter on intensity can keep only points with in a specific range. Lastly, by running Euclidean Clustering, points are clustered into different clusters. By iterating over all clusters, it may be easier to identify the puddles.

The figure below is the filtered points containing two puddles, as two short clusters, and a piece of wall, as the longer cluster.



2. Identify the points of the wall

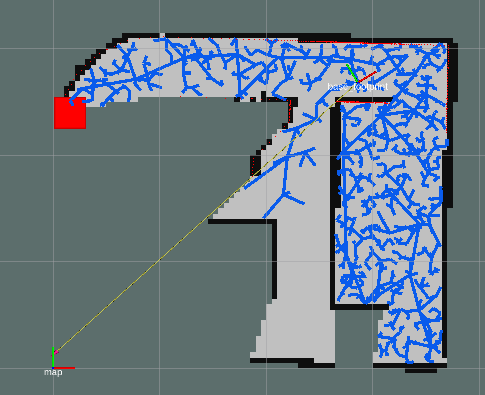
Clustered points may contain puddles and other obstacles such as walls. Thus, a subscriber is created in the filter to get the global location of the detected walls from gmapping. By approximating the center of clusters and comparing with walls detected by gmapping, it is possible to identify non-puddle objects and remove them.

3. Identify the puddles

After classifying the points of walls and puddles, we can confirm the points belong to puddles. Finding the center of data with an additional radius, we can locate the puddles on the map.

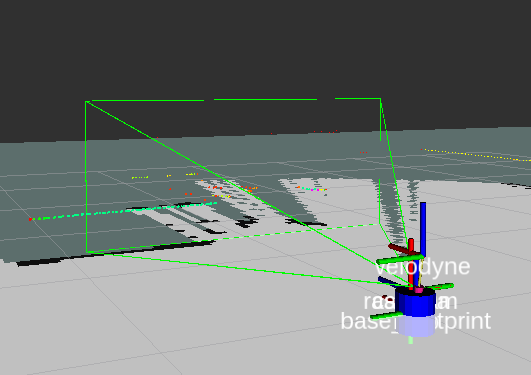
For the RRT exploration, the original package is from the link <http://wiki.ros.org/rrt_exploration>.

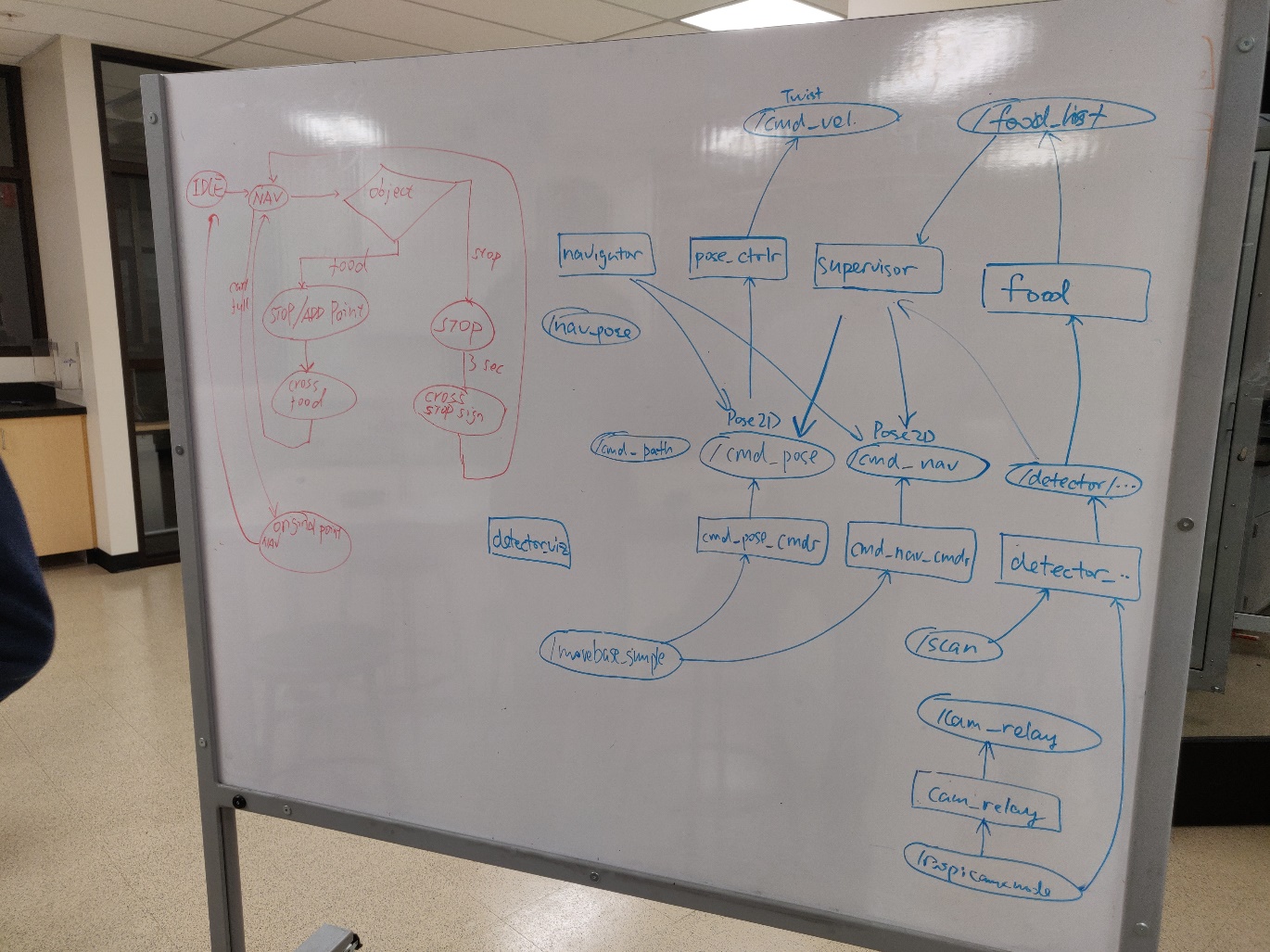
The initial code does not fit the Turtlebot3. Some work need to be done to incorporate the package with the pose\_controller for driving the robot. The screenshot of the simulation in Gazebo is below.



At this stage, the robot’s pose controller is able to receive the goal points from RRT exploration and start to move. But without a proper filter, the exploration speed is not desired. More improvement is being made.

Another progress is that the camera FOV and the markers of the robots are finished in RVIZ. The FOV of the detected objects are being tested and would be ready by the Demo day.





(Nodes & Topics & FSM)