Progress Review 9

Individual lab report – 08 | February 24, 2016

TEAM DAEDALUS

Submitted by:

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Team Members:
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1. Individual Progress

The following responsibilities were taken up by me:

- Creating maps of different environments
- Testing waypoint navigation subsystem.
- Developing architecture for simulation environment and path planning heuristics.
- Integration of multi-agent planner with communication subsystem.

MAPPING SUBSYSTEM

In order for autonomously navigating the platform, a 2D floor plan of the environment is required. The ROS package **gmapping** was used to create the map which was visualized using RVIZ. gmapping fuses odometry and laserscan data using a Rao-Blackwellised particle filter approach. Since, the Oculus Prime mobile platform has depth camera instead of LiDAR, the ROS depthimage_to_laserscan package was used to convert the depth data to laser scan data. After trying different environments, the results were not consistent and satisfactory. Hence, a makeshift parking lot was constructed outside the lab on B level and multiple iterations of mapping were done and different features were introduced in the mapping area. Once a sufficiently accurate map was created, the map was brushed up using a bitmap editor to remove noisy artifacts and add some detail. Figure 1 shows the original map and final one after brushing up.

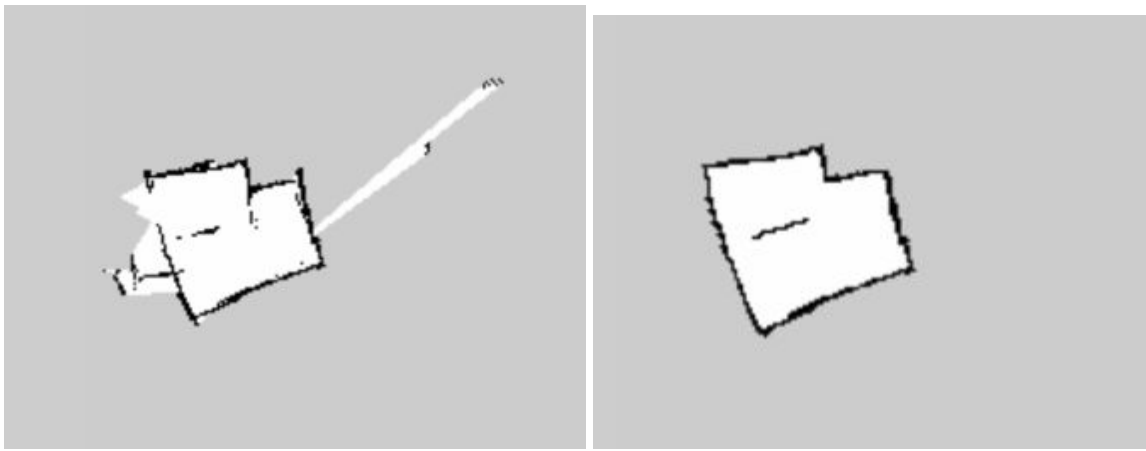

Figure 1: Map of makeshift parking lot before and after brush up

(Collaborators: Mohak, Pranav, Shivam)

WAYPOINT NAVIGATION SUBSYSTEM

Xaxxon provides a web browser based interface for specifying waypoints for navigation in a pre-mapped environment. After facing many difficulties in starting the navigation using the API, we decided to manually run all the required ROS packages for the navigation stack. After running the packages, it was now possible to use the telnet API and web browser interface for waypoint navigation. While trying to navigate the platform, it was found that the platform was not easily able to localize itself, being unable to match features properly doing a recovery rotation multiple times. Although, it was able to navigate to specified waypoint, it was found that the final parking lot will require way more feature locations. Figure 2 shows the web interface for specifying waypoints in the map.

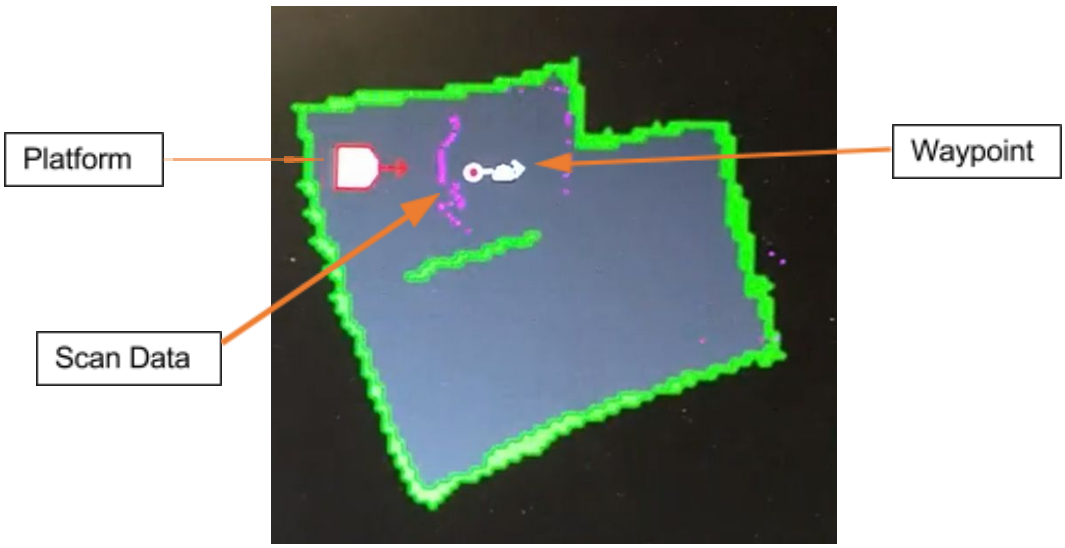

Figure 2: Waypoint navigation using web interface

(Collaborators: Mohak, Pranav and Shivam)

SIMULATION ENVIRONMENT AND PATH PLANNING

In order to show the efficiency of our parking system over the current scenario, we are going to develop a simulation environment where we intend to implement a global level optimal spot policy, a path planning algorithm and a dynamic visualisation using RVIZ. Both the optimal spot policy and path planning will involve multiple heuristics to ensure effective scheduling of cars inside the parking lot. The complete details of the simulation environment can be seen in Figure 3 which shows a detailed architecture and heuristics used in different planners. I will personally be taking lead on the path planning algorithm where I will implement A* using multiple heuristics for keeping the path away from already occupied or claimed spots and obstacles using a potential field approach. Also, depending

upon the dynamic state of the parking lot, the lot will be divided into four different segments to ensure that the the chosen path is one of least activity.

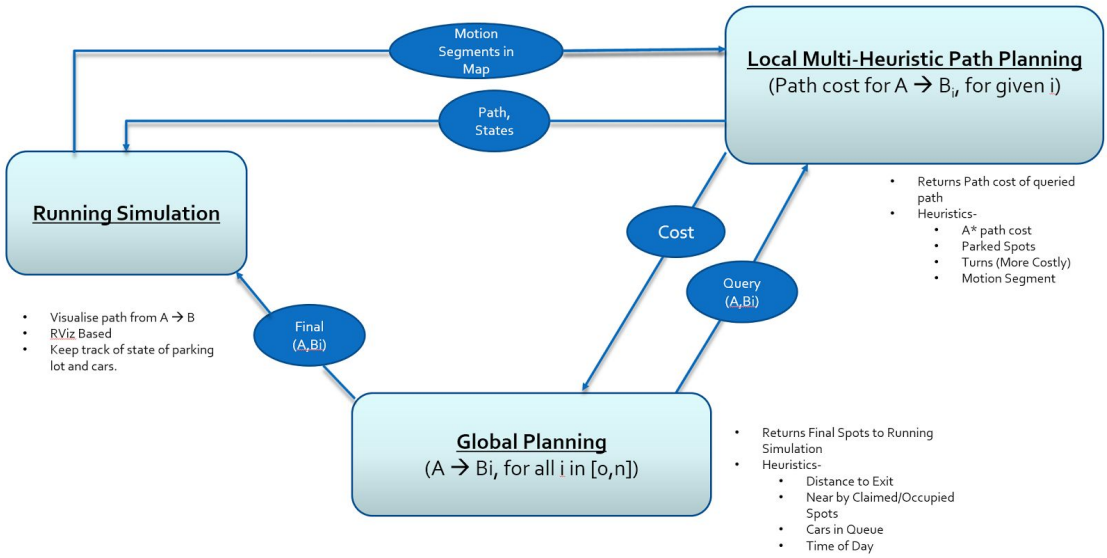

Figure 3: Architecture of Simulation Subsystem

(Collaborators: Mohak, Shivam and Pranav)

INTEGRATION OF MULTI-AGENT PLANNER AND COMMUNICATION SUBSYSTEM

The optimal spot algorithm running in the multi-agent planner was integrated with the communication subsystem. It was setup to receive the status of the parking lot from a ROS topic published on by the communication subsystem upon receiving the park command and then publishes the most optimal spot coordinates to the locomotion subsystem and the index back to the communication subsystem. Multiple iterations were done to test that the system works completely and the most optimal spot is specified always using the closest to exit metric.

2. Challenges

1. The Oculus Prime API was not working out of the box as we had expected. There were hardware problems that had to be dealt and the mapping and navigation system were not starting up as expected. In order to overcome this problem, we decided to allocate more of the team resources on the platform. Shivam, Pranav and I had to go back and forth with an engineer at Xaxxon and go around the API to

create the map. Different methods for mapping using Hokuyo and hector_slam ROS package were also considered.
2. The scope of the project has been changed significantly and work has to be planned and redistributed significantly.

3. Teamwork

The other members of my team were working on the following subsystems:

1. Shivam: He worked with me and Pranav on the mapping and navigation subsystem and developing an architecture for the simulation environment and planning.
2. Pranav: He worked with Shivam and me on the mapping and navigation subsystem, developing an architecture for the simulation environment and planning and with Dorothy and Richa on integrating the visualization tool with the communication subsystem.
3. Dorothy: She worked on building a mock parking lot, with me on integrating the communication subsystem with the planner and with Pranav and Richa on integrating the communication subsystem with the visualization tool.
4. Richa: She worked with Dorothy and Pranav on integrating the visualization tool with the communication subsystem and on setting up the old platform so that it can be used in the future.

4. Plans

We will now be working on integrating all the different subsystems along with the two platforms. Richa and Dorothy will be working on making the parking lot and setting up both the mobile platforms. I along with Pranav and Shivam will work on the simulation environment and planning. Pranav will be taking the lead on the visualization using RVIZ and Shivam will be working on the global optimal spot policy. I will be taking lead on the path planning using A* with multiple heuristics.