

Progress Review 11

Individual lab report – 10 || March 30, 2016

Team Daedalus
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1. Individual Progress

- ❖ Simulation
- ❖ Physical Setup

Simulation

- **Rendering Script**

The rendering script required some updates based on the data structures being used in our system. It accepts ROS messages from the backend script and takes action based on the desired action, i.e. arrival or return. I also incorporated certain interpolation techniques so that the waypoints provided by the Local Planner can be joined in a realistic manner and the marker/vehicle executes continuous motion between them. I also created different namespaces for different types of markers. This will allow us to selectively show or hide different elements in the environment. More emphasis was laid on having this script visually complete so that it is ready for the first Beta testing.

- **Integration**

The integration of the simulator was carried out in multiple steps. Since our architecture is ROS based, all the communication is being carried out via ROS Services and Publishers. The current architecture, highlighting our progress and future work, can be seen in Figure 1.

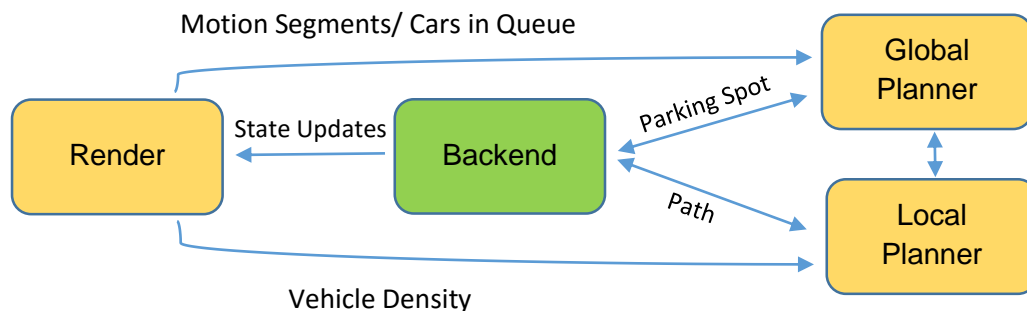


Figure 1: Architecture of the Simulation (Green: Done, Yellow: In Progress)

The most substantial bit of integration was to create the “.srv” files being used in our Server/Client setup. Mohak and Shivam had created these files in advance therefore making it relatively easier to incorporate them in my code. I also created a launch file to help us during testing. It would allow us to start all of our nodes with a single command, rather than opening multiple terminals.

- **Testing**

After successfully integrating these partially complete subsystems, I was able to create a Beta version of our Simulation. As seen in Figure 2, we can have multiple moving vehicles in our environment now. Currently I haven't implemented collision check due to which the markers can overlap with each other. My interpolation script also needs certain tweaks so that the heading of the marker stays in line with the path being followed.

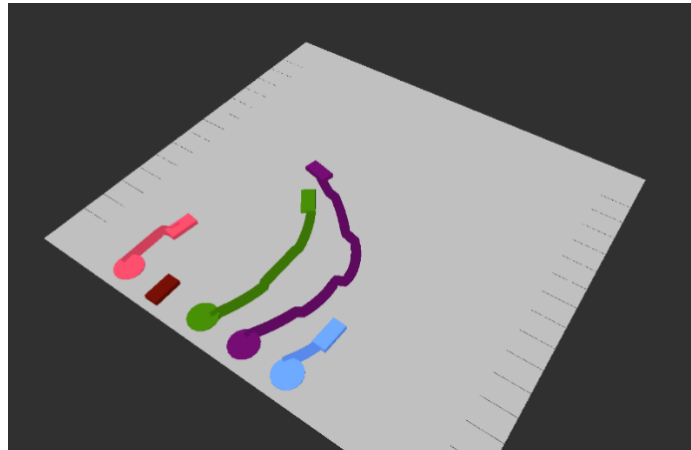


Figure 2: RViz based Simulation Environment

Physical System

- **Mapping**

After Dorothy built the parking lot, Shivam and I started the process of mapping by propping it up, as seen in Figure 3, and navigating our platform to collect measurements.



Figure 3: Final parking lot

The areas that we had mapped previously were much simpler in layout and therefore easier to map. Our current parking lot is feature rich and required substantial time and effort before we got a stable build of map from the GMapping ROS package. As can be seen in Figure 4, the map was full of noise and required cleanup. The thick lines on the map were causing the Navigation Stack to fail as they reduced the traversable area, as perceived by the platform, leading it to believe that a path can't be planned. I used GIMP Image Editor to correct the borders of our map and also gave clean lines denoting the parking spots.

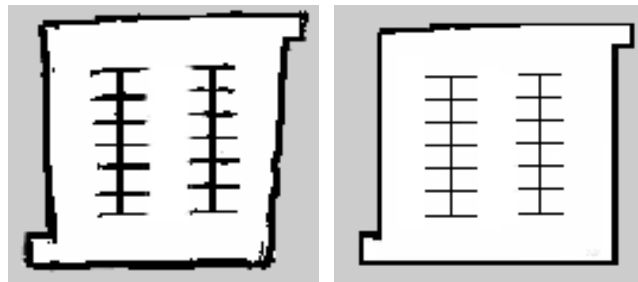


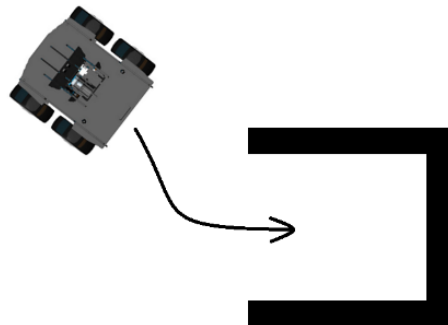
Figure 4: Map of the parking lot, before and after enhancements

- **Testing**

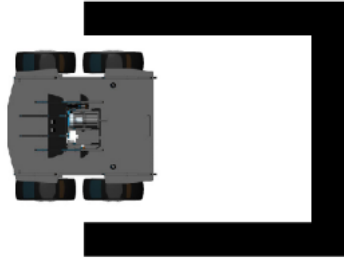
Navigation node required a fair bit of changes before it could robustly operate in our current parking lot. Unlike previous test runs, the platform wasn't always able to plan a path directly towards the goal and required a couple of transit waypoints. I had to create certain recovery routines to ensure that the platform completely enters a spot and is able to successfully go towards the exit from there.

Entrance Routine:

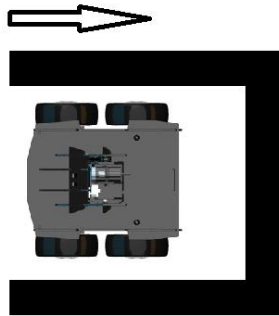
Step 1: Plan its approach towards the parking spot.



Step 2: Partially enter the parking spot.

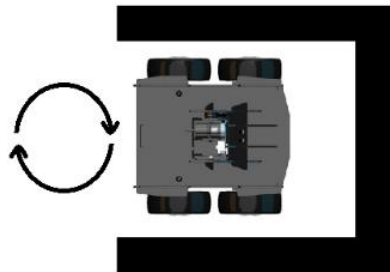


Step 3: Move forward by 8cms to fully enter the parking lot.



Exit Routine:

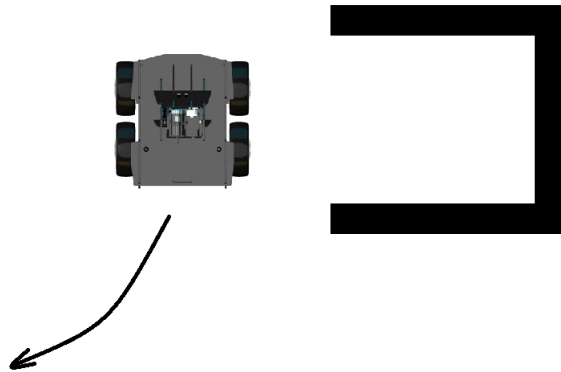
Step 1: Rotate 180° on its axis.



Step 2: Move forward by 30cms and turn 90° so that it faces the exit.



Step 3: Autonomously proceed towards the exit.



2. Challenges

Mapping and Navigation in our new parking lot turned out to be much more challenging than anticipated. The platform, on multiple occasions, collided with the walls and failed to localize itself in the map due to which I had to test and iterate multiple times over editing the map. We also faced certain issues due to USB port incompatibilities. This bug wasted a lot of our time. It stems from the way Oculus Prime starts its bash script. On startup, it locks in all the serial devices attached via USB and incorrectly recognizes the XBee adapter as the MALG PCB. This causes the platform to lose control over the actuators and sensors. It could've potentially damaged the XBee adapter. We mitigated this issue by creating a routine wherein all the peripherals are connected to the platform once it has gained control over MALG PCB and Power PCB. The work regarding simulation, even though fairly smooth and straightforward, did become challenging once the process of integration began. I discovered plenty of unforeseen issues and errors in my code which I had to debug, requiring a fair bit of time.

3. Teamwork

Shivam, Mohak and I worked on the Simulator. Mohak created a preliminary working version of the local planner with all the Services active and ready for use. Shivam created a working version of his global planner which currently uses a couple of cost factors and heuristics to calculate the optimal spots. Shivam and I also worked on Mapping of the parking lot. Dorothy designed, fabricated and assembled the parking lot. Richa delved in to some advanced topics pertaining multi agent planning and explored options to further enhance the capabilities of our physical system. Dorothy and Richa also worked on fixing the old platform and upgrading the user interface that I had designed.

4. Plans

Presently we're waiting for the arrival of our new platform. Once we acquire it, we shall start working on our SVE Demo #1. We expect to spend substantial amount of time on testing this routine and iron out any bugs which might hamper the robustness of our system. Shivam, Mohak and I shall also be wrapping up our individual packages in the simulation system and move on to integrate and test it. We expect the performance of our architecture to stay robust as we scale up the simulation. I would also be working towards creating certain metrics, such as cumulative parking and return times, which would help us in getting an idea of how well our system performs. Furthermore, I'll be spending some time to enhance the rendering environment by using 3D models of cars rather than cube markers and tweaking certain visual aspects of the simulated parking lot to make it more realistic.