MRSD Project 2

Individual Lab Report #11

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PhoeniX
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Individual Progress

We had all the pieces required for doing missions on both the systems. The challenge for this last progress review was putting everything together and making necessary changes to those pieces so that everything works well together. I started working on finishing the behavior tree framework for the Husky. With the experience I had working on the behavior tree for the UAV in the last progress review, writing similar behavior tree for the Husky was efficient. Again like the last time, major work is not writing the mission logic in the behavior tree framework but updating the various nodes to be compatible with the behavior tree. The behavior tree for the simple mission on the Husky we tested can be seen in figure 1.

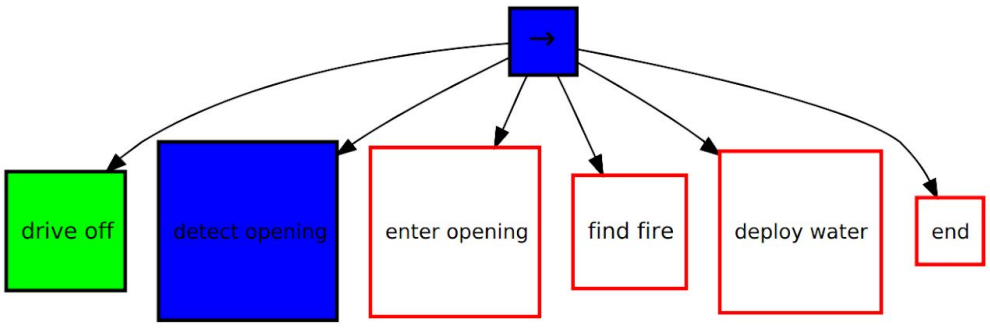

Figure 1: Behaviour tree for a simple Husky mission

I particularly updated "drive-off", "detect opening" and "enter opening" ROS nodes to be compatible with the behavior tree. I had to use an asynchronous multithreaded callback to ensure that each node was publishing its running status at a higher frame rate even when it’s processing loop of the task was running at a much lower rate.

We also needed a structure or a building to test our system. While some test sites outside CMU were available, the logistics of carrying everything multiple times a week is simply out of the scope for our project. Finally, we decided to buy a tent and set it up at the NSH B level. I was responsible for setting up the tent and designing the test scene. When the tent arrived, we realized that the tent was with a roof but no walls. I worked on setting up the tent, cutting the polystyrene sheets and creating walls for the structure. I also created the window for the drone to enter. The tent structure that was built can be seen in figure 2.

Figure 2: Tent acting as a building structure at NSH B level

The stability of the drone was greatly impacted when flown inside the tent. The enclosed space inside the tent creates air turbulence, making the flight unstable. I had to remove some of the sheets from the side walls so that the impact can be minimized. I am also considering removing the roof.

Challenges

When we started testing the mission on the Husky, we realized that the Husky's door detection which Shubham worked on was not very reliable. I helped Shubham in finding out what was wrong in the method and why it was failing. The method was failing on the edge cases because of noise in the laser scan generated from pointcloud. Shubham and I worked out the slightly updated door detection algorithm from the laser scan which Shubham implemented. The new implementation was having some problems as well. I debugged the code after which the door detection started working to our satisfaction.

While testing the full mission for the UAV, UAV crashed into the wall while attempting to land at the end of the mission. The crash resulted in hardware damage to one of the arms of the DJI drone. After the crash, I powered up the NUC on DJI drone and check the working condition of the Intel Realsense depth camera, thermal camera, microcontroller and other electronics on the drone. We also tested arming the motor to ensure if all the motors were operational. Luckily, the damage was limited to the carbon fiber tube that was broken on the impact. The motors and their controllers were fine. I

carefully disassembled the arm to separate the damaged part. DJI drones are not meant to be opened and hence the process was time-consuming and tiresome. After separation, I glued the broken part using strong epoxy glue. We are not sure if that epoxy would hold or not. We plant to further reinforce the part by wrapping carbon fiber sheet with epoxy glue. Meanwhile, we also ordered the replacement part but we are not sure if that would arrive in time for the FVD

Teamwork

Steve helped me in setting up the tent and cutting the sheets to act as walls in the tent. Akshit and I worked on performing UAV missions and fixing various small bugs in the code and fine-tuning various parameters for optimum performance. Shubham and I worked on the UGV part of the project together. I helped him with the behavior tree and the door detection using a laser scan. Performing full missions on both the system required every team member to work together. We spent perhaps the highest amount of time working together on this progress review. All the team members were there in the lab including weekends.

Future Plans

I would be working on figuring out a common transform between UAV's reference origin frame and UGV's reference origin frame. DJI drone initializes the origin in the north direction invariant of the start pose and height using barometer value whereas the Husky initializes starting pose as the origin. Because of this discrepancy, the collaborative aspect of the project requires us to figure out the transform that puts both the system in the common frame. I will also work on estimating the location of the fire in the global map that is detected by both the systems. I will collaborate with Shubham in improving the "move_base" planner for the collaborative aspect of the project. As a team, our immediate concern is fixing the drone as soon as possible. Once the drone is fixed, we will work on adding finishing functionality and testing missions to make them as robust as possible in the time available.