Individual Lab Report – 7

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Team D: CuBi

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Individual Progress

The major task for this progress review is to implement an obstacle-free mapping of an environment. Obstacle-free meaning that obstacles in the environment are large and not easily movable, like sofa set. As discussed in the earlier documents, RTAB-Map ROS wrapper was implemented for our case. This task was jointly carried out by Laavanye and I. We set out to implement the package on our own systems before putting it on the robot. This task took considerable amount of time for me as I faced issues while installing the Intel RealSense ROS wrapper package. Once this and RTAB-Map installations were complete, mapping of a room was done using a handheld RealSense camera. RTAB-Map has various combination of sensors that can be deployed to map a room, and I used the stereo camera configuration. We had already completed mapping of a room using Hokuyo LiDAR and this stereo mapping was done to compare the two and to explore the possibility of fusing data from both the sensors.

Once the handheld stereo mapping was successful, I then set out to install and implement this package on the robot. After successful installation, I wanted to first collect a ROS bag file and map it to test the performance on Jetson TX2. We've been using the robot in autonomous mode for testing since the end of previous semester. When I started up the robot to use in joystick mode, to run it around the room to collect a bag file it failed to start. After debugging this problem together with the teammates, the bag file was collected and tested.

The figure is not included in this report as Laavanye has it in his document. The comparison between the mapping of the stereo (RealSense) and LiDAR (Hokuyo) gave valuable differdiffer. Since the LiDAR we use only projects a 2D beam, it misses objects/obstacles that are smaller in height to its own position. But the stereo was able to capture this critical information as it was pointed downwards toward the ground. LiDAR had better results when it came to detect the edge features of objects. LiDAR map was better defined with lesser uncertainty at edges compared to that of RealSense. The fusing of LiDAR data and stereo output would work the best for our problem.

Other than mapping task, there were discussions and task delineation for the upcoming goals, including obstacle detection. The system does not have any Deep Learning implementation and does only classical computer vision. I studied on the various architectures that can be deployed for this task on Jetson TX2. This would take a considerable amount of work since the entire pipeline has to be implemented from scratch.

Challenges

Installation of the camera and mapping packages were a challenge just as usual. Even after doing everything as per the instructions, the camera's input was not being recognized on rviz. This is critical because RTAB-Map subscribes to the camera output ROS topic. The Intel RealSense SDK did work fine. After a lot of fixes, I got it to work.

The next challenge was getting the joystick to work. Since a large part of the development were done towards the end of the previous semester, we as a team, did not do a good job at documentation. I had to go through the code base on why this problem popped up. The publisher that publishes velocity with input from the joystick was null. This helped in getting to the root of the problem. After going through the code, it was found that a variable was set to False. In addition to this, the joystick had to be kept in a specific setting in order to work.

Another challenge would be compute power on JetsonTX2. Once mapping, obstacle avoidance is integrated to the system, it is going to take a huge hit on the processor. Using Deep Learning techniques for any computer vision task is going to be expensive. I have been looking at quantized models for implementation which will make less expensive. This challenge is still being tackled on and solution can be found by iteratively.

Teamwork

The mapping task was handled by both Laavanye and I. We discussed about other potential packages and helped each other if anyone got stuck. Laavanye also helped me debug the installations. As for debugging the joystick bug, Bobby, Jorge, and I worked together as we were involved in a large part of the codebase. Bobby had implemented the joystick controls, Jorge and I had implemented the controls and planning for the base and manipulator. We reviewed the code together and tested in order to debug. Jorge and I had discussions on critical design decisions for odometry reset, for example when should CuBi reset the odometry, the steps that needs to be taken to achieve odometry reset.

Plans

I would be working on integrating mapping implementation into our state machine. Also, data fusion of stereo camera and LiDAR in real-time is my focus for the next progress review. Depending on other advancements, I will try to fuse data for localization, for example IMU, LiDAR, odometry. I will be grouping with Bobby and Jorge for that task. Laavanye plans to work on detecting if the grasp has failed using

computer vision. Bobby and Jorge will plan out exploration strategies for the robot and perform an initial implementation. Paulo will work on reducing slip of the castor wheel, implementing recovery of robot during failure.