Autonomous Robots

Lab 3 : Part 2 - Localization and mapping with Turtlebot

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1 Introduction

This report deals with the practical work related to preparing the Turtlebot for having its localization and mapping ready. Here we also check the performance of these systems by performing the exercises mentioned in the lab guide.

2 ROS Dependencies and Package installation

Before continuing with this lab we had to make sure we had required dependencies installed. Therefore *sudo apt-get install ros-kinetic-turtlebot* ros-kinetic-octomap* ros-kinetic-octovis* command was run in the terminal to install dependencies such as turtlebot, octomaps, octovis etc. Further on, stated repository was pulled using git pull command, followed by **catkin_make**.

For the planning of turtle bot we have to follow few steps as mentioned below:
Now we are ready to launch turtlebot rviz for mapping of the environment.

3 Checking vehicle's Odometry in simulation

Now we launched RViz for simulation of the turtlebot by predefined command on a terminal window. By tele-operation we controlled the turtlebot in virtual environment using keyboard to move around in the environment. Keyboard tele-operation provides many functions like increasing/decreasing linear speed or angular speed etc. and corresponding change in odometry was observed in the terminal when */odom* topic was echoed.

4 Building a map using Octomap

The following next step was to build octomap of the same environment. Octomap was used to know the 3D volumetric representation of the mapping. The tutrtlebot was moved around via a keyboard to generate a map inclusive of any nearby obstacles encountered. As we move the turtlebot in gazebo the 3D map is simultaneously built in RViz. The mapping result is shown below in figure. The octomap was then saved by .bt extension file for its further analysis. Octomap can be visualized using *octovis* command in a terminal window.

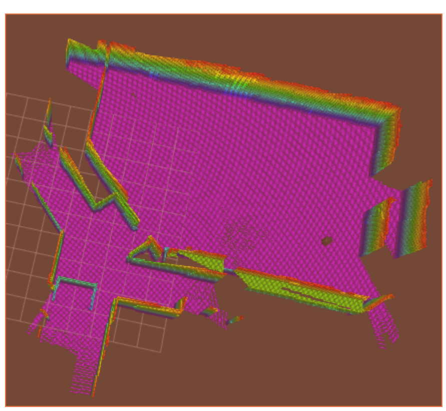

Figure 1: 3D Octomap of willow garage environment

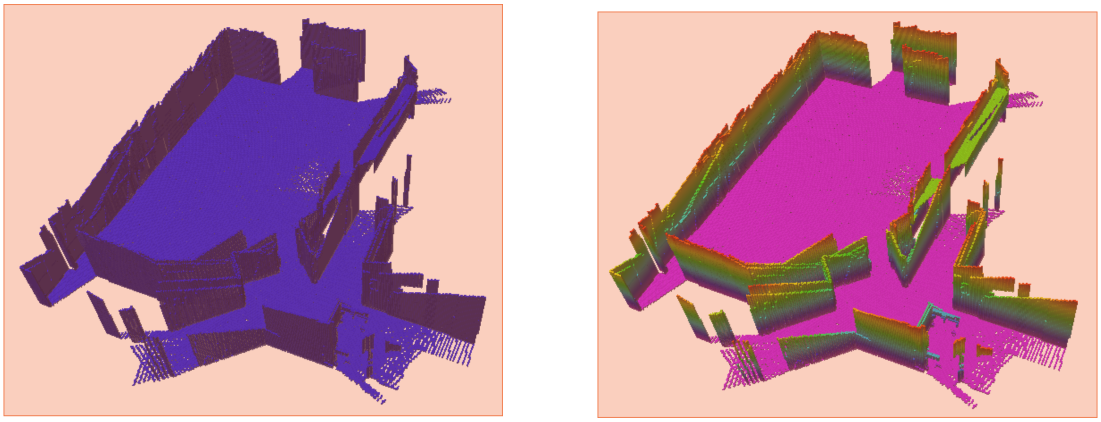

Figure 2: 3D Octomap of willow garage environment

5 Analysis

Octovis visualizer

- When 1 is pressesd in Ocotovis - It simply changes the map into height map (different z values encoded with different color).

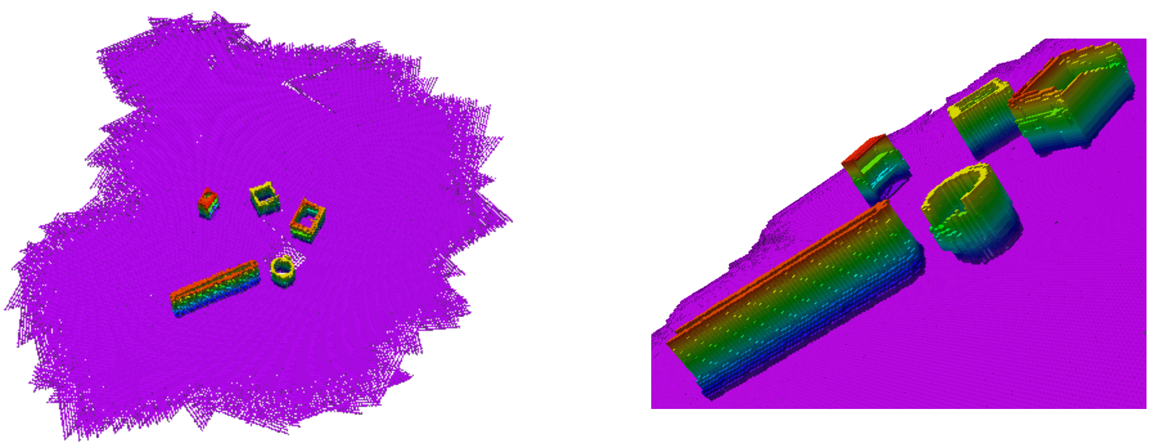

Figure 3: 3D octomap on pressing 1 in Octovis

- Basically, octomap uses special probabilistic-based approach to model the enviornment, where it models both occupied and non-occupied space. When f is presses in Octovis, the map shows both free and occupied space. Those areas without any volumetric representation correspond to unknown space.

- Accuracy of the map generated - The map built with the help of keyboard tele-operation to move around in the environment is quite accurate. It properly detects obstacles and walls at their respective postions relative to robot. If the robot speed is increased, the map does not get stitch properly due to very fast motion of the robot. Later it was found out that it was due to mismatch in frequency between the odomentry information and the kinect sensor data.

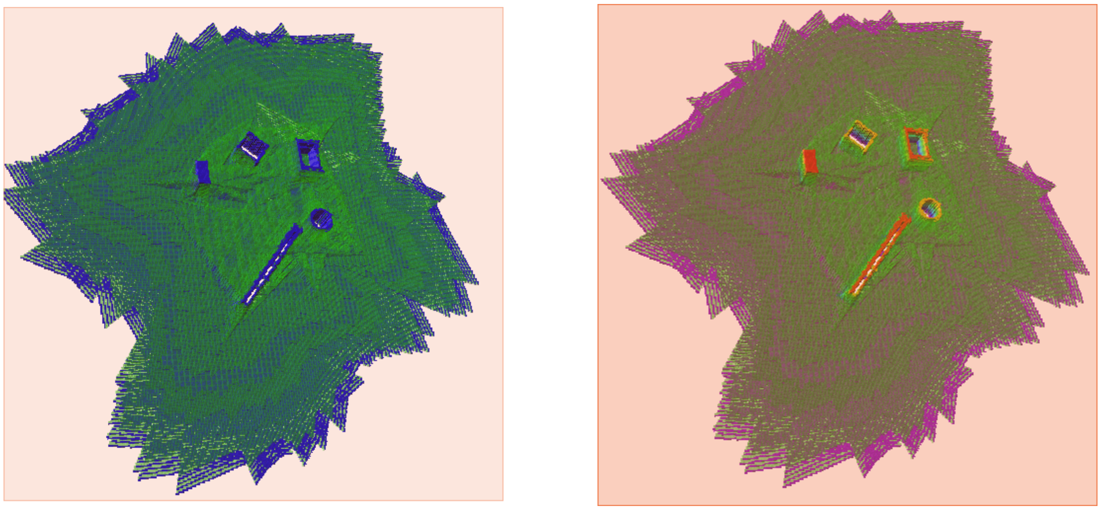

Figure 4: 3D octomap on pressing f in Octovis

Mapping with real Turtlebot

Figure 5: Robot in real action

We also checked the vehicle's odometry and built a 3D map using real turtlebot platform. We similarly performed the procedures as described above including some additional steps. We restart the vehicle nodes in one terminal window and in second termianl, we connect to the turtlebot's computer for remote controlling of the further process. Before the vehicle node is restarted, we edit some lines in the launch file so that the mapping is done with the actual turtlebot. We then tele-operate the real turtlebot and simultaneously 3D octomap is built in RViz. We performed movements in order to estimate the linear and angular errors of the odometry. Once the 3d octomap is built we then saved the map using octomap server so that it can be later viewed in Octovis for further analysis and planning path.

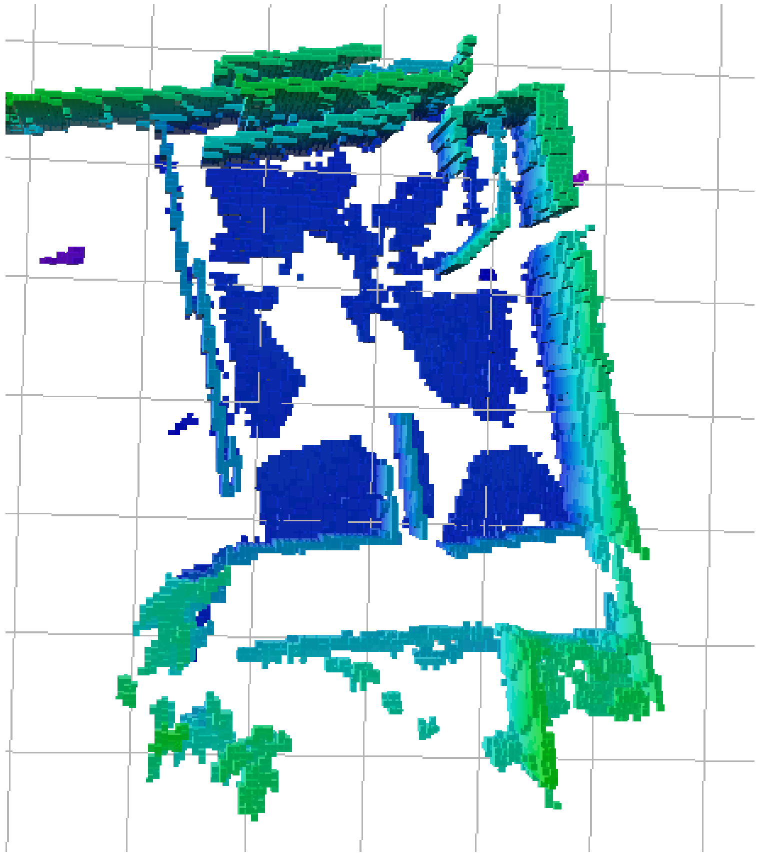

Figure 6: 3D octomap of Lab arena using real Turtlebot

6 Conclusion

This lab was overall a good exercise for proper understanding of mapping and planning both in virtual and real time environment. This lab also helped us to tackle the problems that come along while performing with the actual turtlebot.