INDIVIDUAL LAB REPORT #5

AWADHUT THUBE

Team G - The Pit Crew

Team Members: Alex Withers, Justin Morris

<u>Individual Progress</u>

Since the last progress review, our team has been working towards performing a field test to gather data that can be used to build our brinkmanship algorithms. For the purposes of the field test, I had to set up our system to move around and save sensor data in a rosbag. I started by installing the drivers and packages that would allow us to use the onboard imu (FS-IMU). I also modified files on our rover computer which would create aliases for the motor controllers connected to the computer.

Once all the software packages were installed, Justin and I tested the basic movements (navigation) of the rover. Initially, this was done by connecting a keyboard to the rover computer and using keypresses as the motion commands. After this was tested, I set up the computer for remote access using the openssh-server. This allowed us to execute commands on a remote computer. The teleoperation was tested before we went out for the field test. After having all the elements working together, we executed our field test on the 3rd of April 2020.

During the test, I was responsible for controlling the rover and making sure that we captured all the relevant data into different rosbags. These bags were recorded in different situations. After recording all the data my task was to write some python scripts which could convert the data from the rosbags into something which can be accepted by our brinkmanship pipeline. The data type saved in the rosbags is *'sensor_msgs:: Image'* and the type required by our brinkmanship pipeline is a *'numpy array'*. For this conversion, I wrote a script using CVBridge in python. I subscribed to the topics recorded in our rosbags, converted them into the required format and stored them in a numpy array. After this was complete, I played back the converted data to visualize the images. I observed that some of the frames were missing because the data conversion was a slow process as compared to the data playback.

After the first attempt at conversion failed, I tried loading the bag inside the script that converted the data. This eliminated the need to subscribe to the recorded rostopics as they were read from the file inside the script. This and a few minor optimizations in the code allowed me to convert all the recorded data successfully into a usable format.

I had a first pass at visualizing the captured data. The results of the same are shown below. Figure 1 shows the visualization without a depth threshold and Figure 2 shows the visualization with a depth threshold. The left side box shows the feed of one camera from the stereo pair and the rviz screen shows the reconstructed point cloud in both Figures.
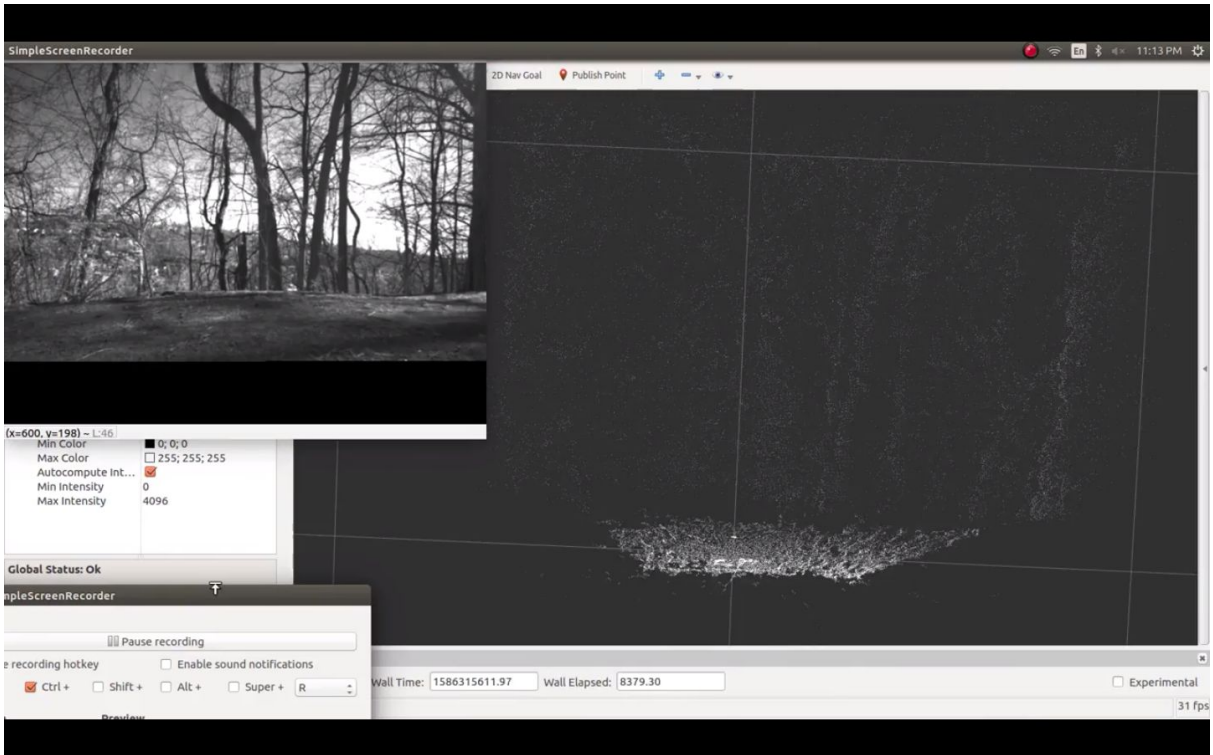
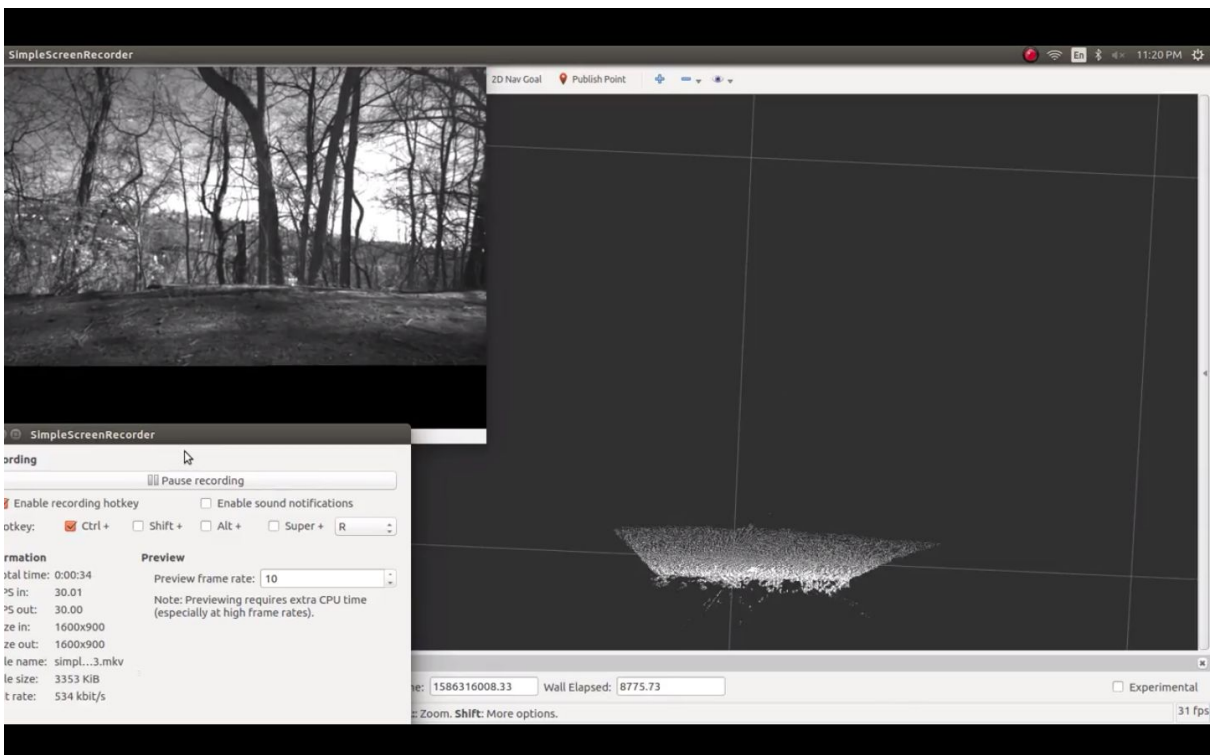Figure 1: Visualization without depth threshold

Figure 1: Visualizing the recorded data with depth threshold

<u>Challenges</u>

Performing the field test was the most challenging part yet in this project. We had to make sure every sensor was not only working individually but the system was functional as a whole. I had to solder wires coming in from the dynamixel controller together with those coming in from the rover computer barrel jack to distribute power among the two. The power distribution board that we designed would have helped us in this case. Setting up the rover for the field test included some peripheral tasks like setting aliases for the motor controllers, enabling ssh on the rover computer, etc. These tasks were challenging as they required us to make changes in the filesystem of the rover computer.

Another challenging aspect of the field test was verifying that the data has been captured correctly and that we were not dropping any frames from the realsense camera. For this, we had to connect a display and other peripherals like a mouse and a keyboard to access the files and visualize the data. This ended up taking a substantial amount of time between successive tests.

After capturing the data, I tried to convert it to a usable format. However, the size of the bag files and the relevant data itself was very large. This caused issues with an initial method that I tried to use for the conversion of data. I had to write separate scripts for reading and converting the data from the rosbags.

<u>Teamwork</u>
Alex Withers
Alex surveyed the test site beforehand and identified a few locations where we could gather relevant data. Alex did an excellent job of formulating the test plan for our field test. He had formulated a plan with specific tests at specific sites. These tests covered a range of scenarios that the rover could potentially see on the surface of the moon. He spearheaded our work during the field test. He also contributed towards getting the rover ready for the test. He designed and 3D printed a case for holding the rover computer in place.

Justin Morris
Justin worked towards getting the pan-tilt mount to move with the Arbotix-M controller. This allowed us to move the camera to a predefined angle to capture data at different camera tilts. Justin and Alex made sure that the rover was mechanically and electronically ready to go out in the field.

Future Plan

Next up, we will work towards achieving our SVD goals. We have divided the tasks among ourselves fairly well. Personally, I have to work towards achieving the stopping behavior near the pit edge. I will be using the captured data and look for metrics that can be used to trigger rover actions. This would lead up to controlling the rovers motors based on the perceived environment. We also have the Image capture test which requires us to control the camera position and move it it desired angles. Justin will be working towards achieving the same. Alex will be working towards achieving basic navigation and planning in the Webots simulator.