Setup Foundation for the Husky

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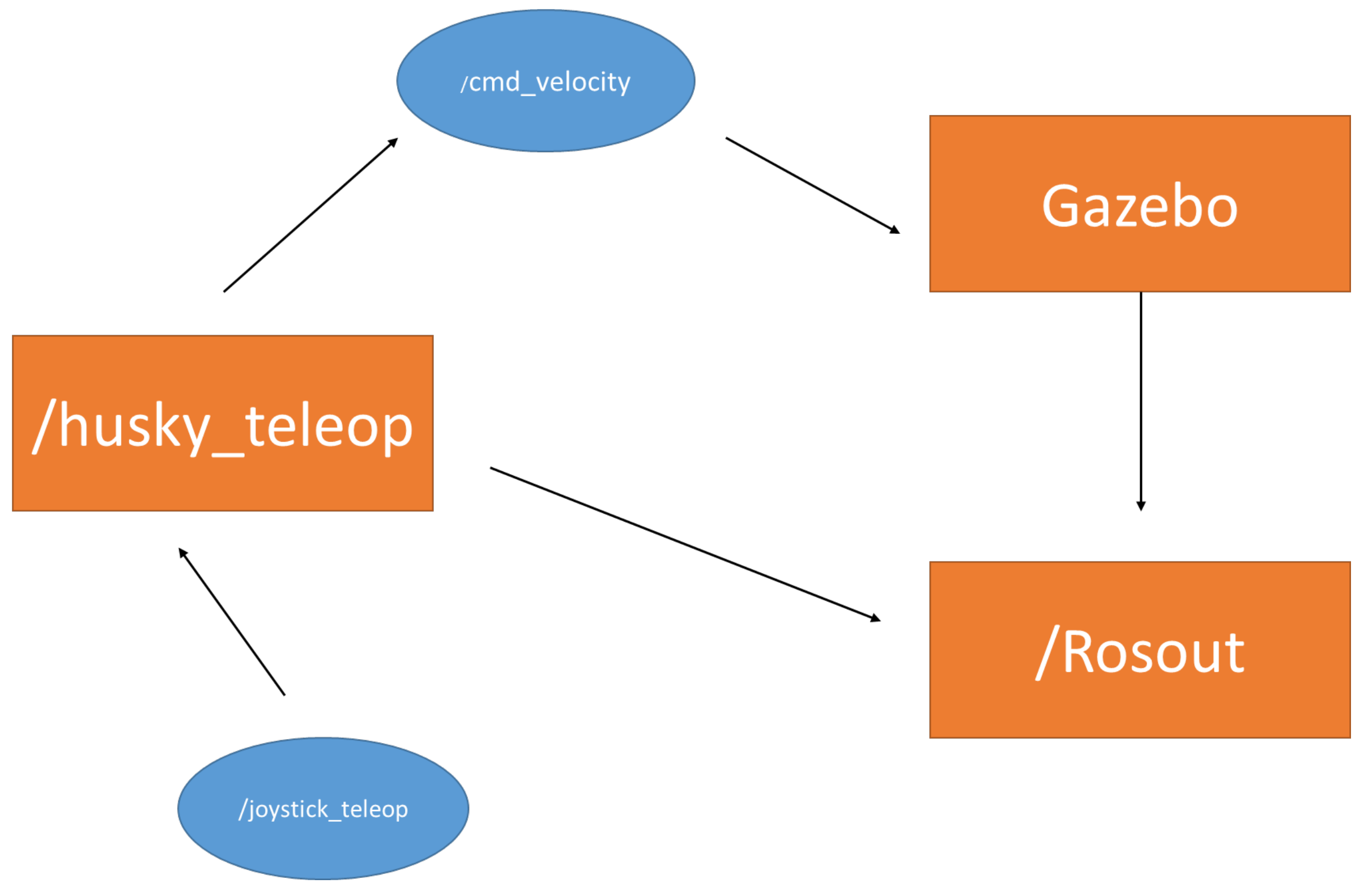
Introduction

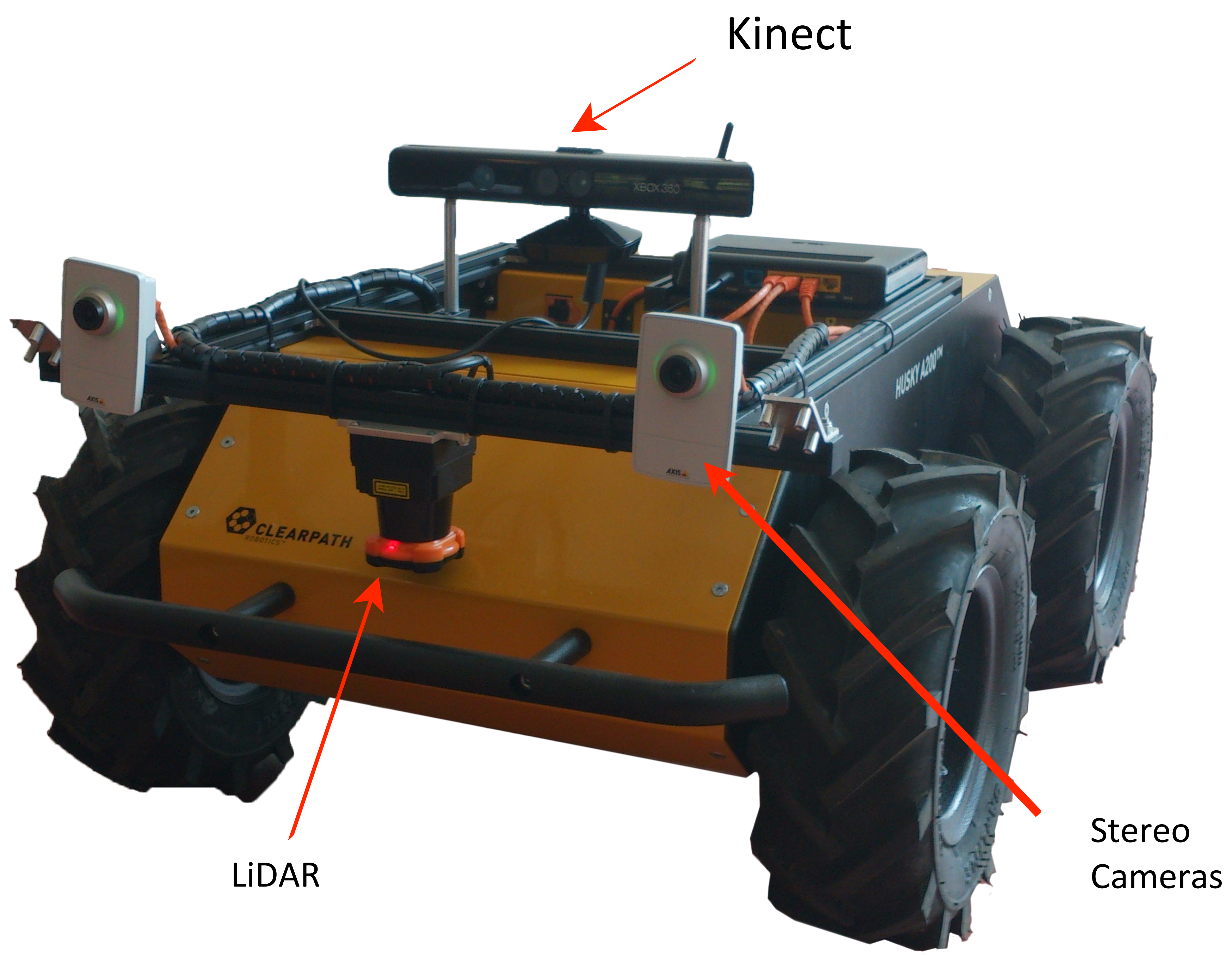
The purpose of this project was to be able to build a foundation and documentation for the recently acquired Husky A200 robotic vehicle from Clearpath Robotics. What I accomplished was figuring out how to set up the Point Cloud Library on the Kinect and being able to stream different filters and perfect each setting, set up the settings for the LiDAR in Rviz, finding the way record and play back data streaming from sensors, and setting up documentation for future projects. I also accomplished developing the code for autonomous drive both in the simulator Gazebo and on the Husky.

ROS

Open Source Robotics Foundation



The Robot Operating System is used to control and manage sensors and actuators. It uses the idea of publishers and subscribers. For example, Node1 can publish a topic to Node2 that was subscribed to. Other than controlling and managing sensor feeds, ROS also can record the topics and store the to be played back at a later time. It also provides a visualizer, Rviz, to be able to view cameras, point clouds, laser data, mapping, and simulate model robots.



Sensors

Kinect

The Kinect is a RGB camera, depth sensor, microphone device developed by Microsoft for gaming consoles and computer stations. On the Husky, I used the RGB camera and the depth perception camera.

LiDAR

The LiDAR is a sensor that measures distance with a laser. It is a popular sensor for mapping, geography, archaeology and laser altimetry.
On the Husky, it is used for mapping out terrain and providing a laser scan of the environment.

Stereo Cameras

Stereo Camera is two or more images from cameras put together to create a 3 dimensional view.

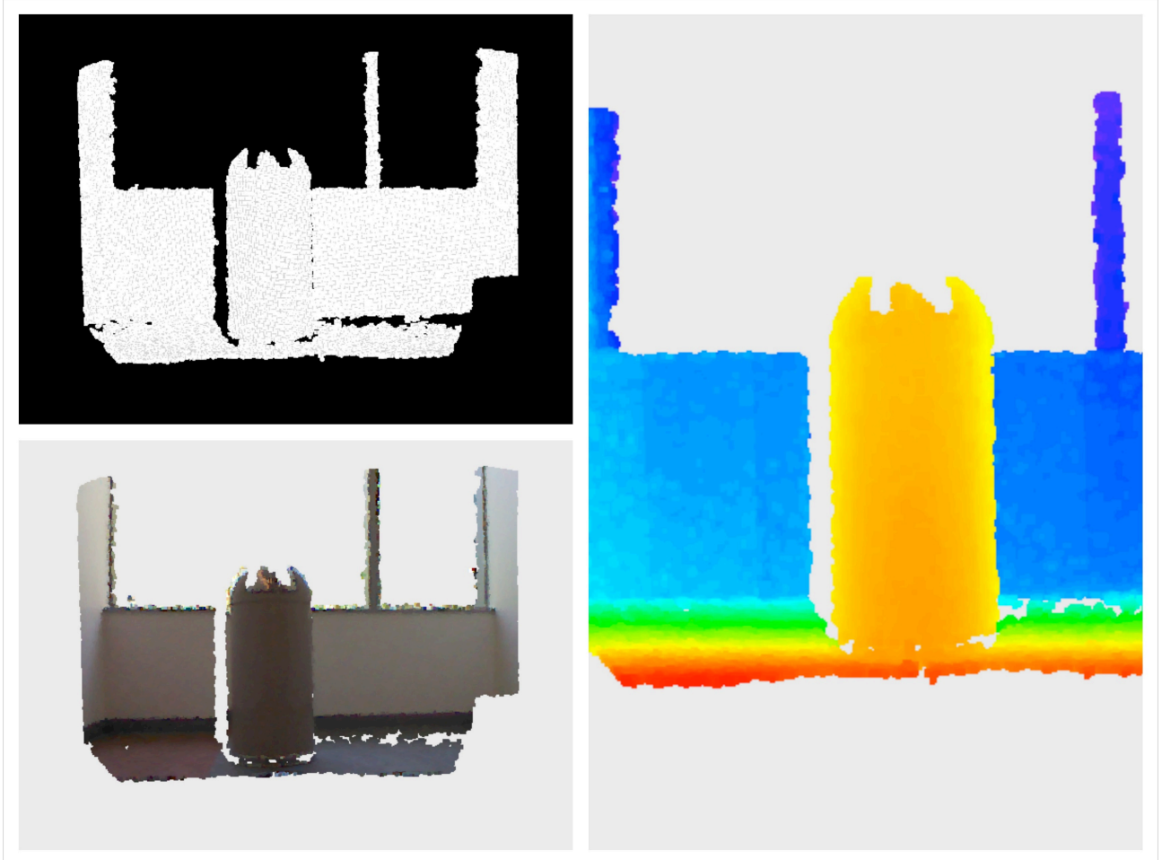
Calibration of Kinect, LiDAR and Cameras

Kinect

Rviz is an add on to ROS, give the ability to view and manipulate different video feeds.

To view through the Kinect, I had to set up the Point Cloud on Rviz and be able to select through the different filters such as optical depth and RGB to able to come up with a clear and functional image. With this set up, I was able to select the topics that will successfully be record video streams to be able to sample and play back later.

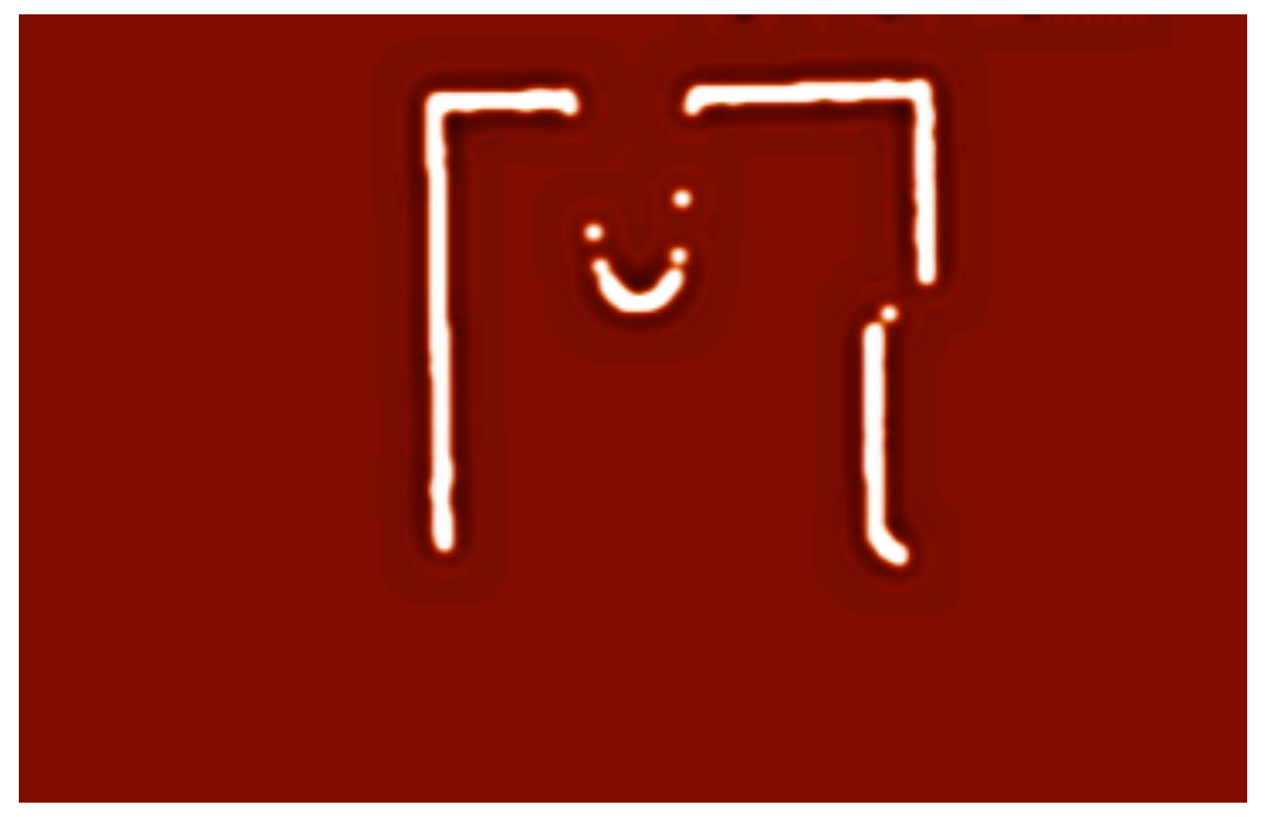
To view the Point Cloud, it had to calculate the different registered points. The points ranged from billboards (surface area covered with squares to real life points)



View of the lab through the Kinect through different filters.
Bottom left: RGB8 points
Top left: Billboards grayscale depth
Right: RGB axis color scale

LiDAR

The LiDAR measures distance with a laser.It is a mapping system that helps with navigation and creating a perimeter visual. I helped set up how to access this information within Rviz. The LiDAR can also be viewed through Rviz.



Perimeter view of the trashcan

Stereo Cameras

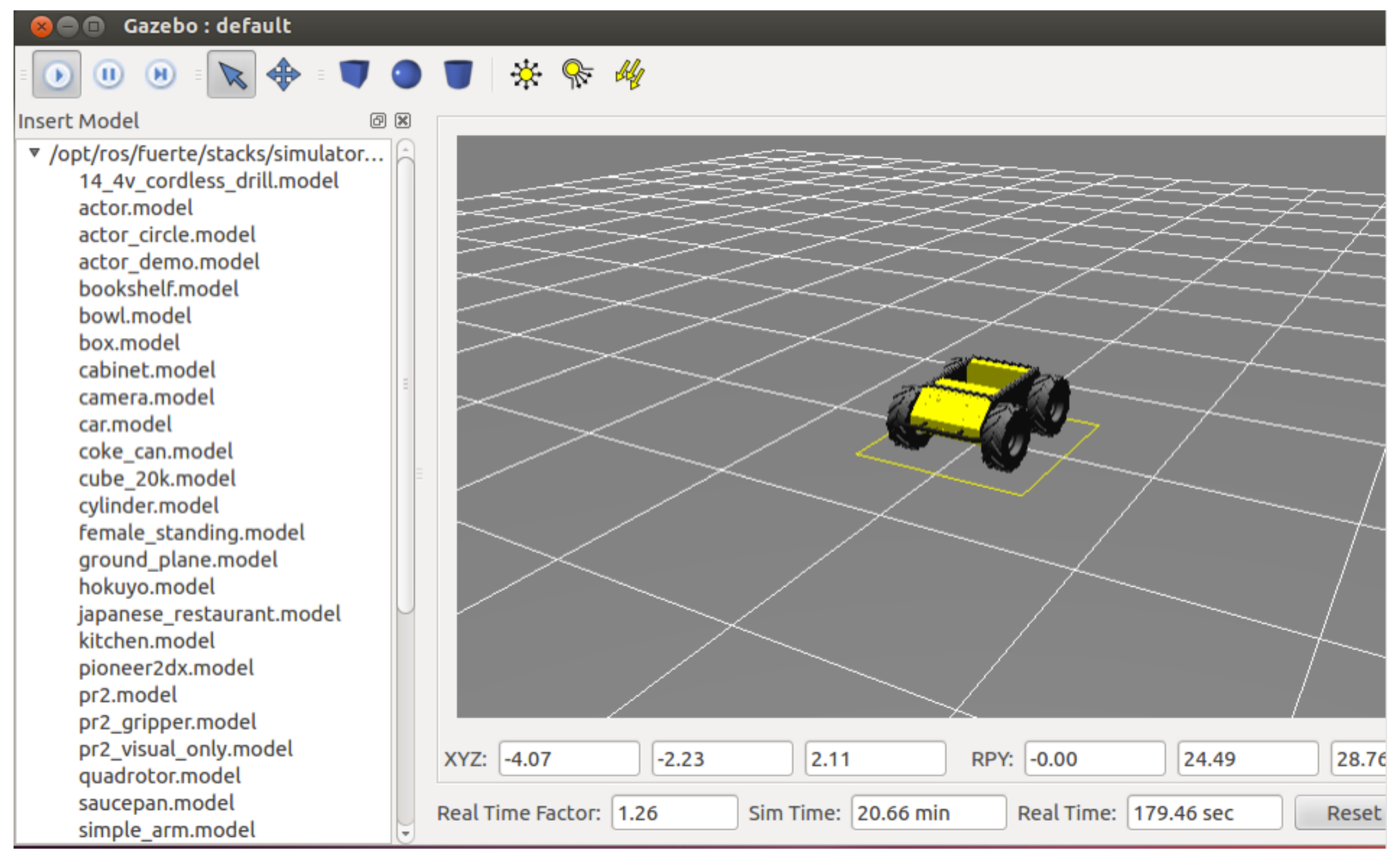
The stereo cameras provided true color images from in front of the husky. Another set of eyes allows the use of motion sensing for the Husky and a 3D vision.

OpenCV is a program that will be used to calibrate the cameras taking both pictures and meshing the together to create wider and in depth picture.

GAZEBO

Gazebo is a simulator that allows the user to test and control objects in a simulated world. One of the primary uses of Gazebo is to be able to test code on the simulated Husky before using it in realtime. It helps debug code without even having the Husky.

Another great thing about Gazebo is how it is integrated with Rviz. You can have the Husky move in the environment while interacting with the other sensors such as the Kinect and LiDAR.



Gazebo : default

Insert Model

/opt/ros/fuerte/stacks/simulator...
14_4v_cordless_drill.model
actor.model
actor_circle.model
actor_demo.model
bookshelf.model
bowl.model
box.model
cabinet.model
camera.model
car.model
coke_can.model
cube_20k.model
cylinder.model
female_standing.model
ground_plane.model
hokuyo.model
japanese_restaurant.model
kitchen.model
pioneer2dx.model
pr2.model
pr2_gripper.model
pr2_visual_only.model
quadrotor.model
saucepan.model
simple_arm.model

XYZ: -4.07 -2.23 2.11 RPY: -0.00 24.49 28.76

Real Time Factor: 1.26 Sim Time: 20.66 min Real Time: 179.46 sec Reset

There are two ways to be able to test the code. The first way is to create a ROS Bag. A ROS Bag is a file that records the selected topics. Then replay the Bag while in Gazebo. To make sure the Bag plays, sometimes you will need to kill the node the you are trying to emulate. It can be seen with recorded video streams.

Another way to test the code is to write a node. In this project I learned how to code in python to write executable nodes. A node is a file that can either publish topics or subscribe to topics. To make a Node move the Husky, I wrote a node that publishes the topic /cmd_vel to Gazebo in either a loop or in a set of commands.

From this node that simulates the Husky in Gazebo, it is easy to transfer it onto the Husky replacing the topics with /husky/cmd_vel.

Future Work

There are several more steps to completely the setup for the Husky. After the full calibration of the stereo cameras, the MIDG and the GPS will be installed with further documentation. Also, Gmapping would provide an excellent future for future projects along with a full 3D image of the LiDAR scans in Rviz. Lastly, full documentation including pictures and a sample code bank for future base projects for the Autonomous Systems Lab.

Acknowledgements

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