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Team 6 - Lab 3 Report

The purpose of this lab was to implement a safety and corridor controller using the laser scan data collected from the RACECAR. A simple obstacle detector was created to detect whether or not there was an obstacle right next to, or in front of the robot. When an obstacle was detected, the safety controller would stop the car. A wall detector would detect the relative orientation and distance of the car to a wall to the right of the robot. The steering controller adjusts the steering angle in order to align the robot with the corridor down which it is traversing.

As a team we got to continue to improve our teamwork and were all consistently helping out each other on various tasks in which we had more or less familiarity. In order to streamline the work and be as efficient as possible, our technical approach was to split the lab into three sections: obstacle detection, wall detection, and control and work on each in teams of two. Based on this division we all gained increased exposure to ROS and many of us gained new knowledge in signal processing. We also now have figured out how to run custom code on our car!

We were able to successfully implement Obstacle Detection by examining the 60 degree cone of laser scan data. If we detected any obstacles less than 0.3 meters away from the car we publish the existence of the obstacle.

To detect walls we used a similar method analyzing the laser scan data in 35 degree cones on either side of the car. We then ran an algorithm over that data to determine the closest point to the wall. If that wasn't the point directly in the center of the cone we know that we are at an angle with the wall. Through simple geometric transformations we can then calculate the angle with which we are turned and then publish that angle.

Given both the existence (or lack of existence) of an obstacle and the angle we are making with the nearest wall, we then implemented a controller which subscribes to the two above mentioned data feeds and controls the car. In the case of an obstacle, the car is stopped (we also implemented a version in which the car backed up away from the obstacle as well). In the case of wall following, we implemented a simple PID controller to take in the angle deviation and steer accordingly.

While the code and related algorithms for obstacle detection and wall following was written, we were not able to test the correctness of all our code on the car. While the car was able to detect objects in front of it and back up to avoid collision, hardware gave us some some problems this week rendering our car's steering servo useless and making us unable to test wall following or tune the PID controller implemented for navigation.

While we were able to debug our hardware problem we were unable to resolve it, it seems the VESC is transmitting the correct PWM signals to control the servo's position but is not delivering enough power to drive the servos. That said, obstacle detection works when the car is just moving forwards, and will automatically move backwards when encountering an obstacle. A link to the video is here: https://www.youtube.com/watch?v=ftMEKGku-48&feature=youtu.be. Though because the physical car cannot steer currently, wall detection was unable to be tested. Therefore, we will be focusing our effort on getting our racecar operational and developing a simulated environment from which to develop code.

The biggest lesson that was learned over the course of this lab, was that we need to start labs earlier as integration of the parts took longer than originally thought. Another big lesson was that, in order to keep everyone up to speed, more documentation should occur in the form of ReadMe's in the various directories.