Platooning Turtlebots

Concept
Self-driving cars are a rapidly emerging product in today's market. Compared to ever more distracted drivers, these cars hold the promise of safer and more efficient travel. Platooning on the highway has been proposed as a means to improve efficiency and safety on the road. In everyday life, this means reduced traffic congestion and fewer accidents. In the armed forces, platooning can help convoys avoid IEDs.

System Design
The complete system can take any number of robots with varying hardware attributes. One bot is assigned as lead while the others follow in a line, one by one. Each follower bot uses image processing and control laws to find and follow its desired target.

Simulation
We built a multi-robot simulator in MATLAB to design the control laws for the robots. This simulator made it easy to iterate through designs and understand what sensor data was needed to complete this project on actual hardware.

April Tags
The robots with raspicams use April Tags to determine relative position and orientation to a target. April Tags were developed by the University of Michigan. Variants of the April Tag project are frequently found in robotic warehouses and labs.

Depth Detection
Once color detection pinpoints the position of the target robot in the image, the Intel RealSense Stereo Depth Camera is used to extract the distance to the target robot. This detection takes in a sample of pixels near the target and computes their median depth.

Project Scope
This Platooning Robots project is a system of robots that are able to accurately follow each other without direct communication. This is done using a platooning algorithm developed such that only the lead robot takes in user commands. The remaining robots in the platoon are able to autonomously space themselves and continue on the desired path behind the lead robot.

Color Detection
The robots outfitted with depth cameras must be able to locate their target robot. Using OpenCV, we detected colored tape on a robot by masking the raw image by color and then chunking together close contours to find the largest contour.

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Repository Locations
https://gitlab.com/drogeturtlebots/turtlebots
https://gitlab.com/seboebafett/robot-matlab-sim

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