RUTGERS
WINLAB | Wireless Information Network Laboratory

Remotely Piloted Vehicles Project

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Project Overview

Low latency networking is an emerging technology for use in remote sensing and control of vehicles and robots. Our motivation was to evaluate the usability of remote piloting over an internet connection.

Main Objectives:

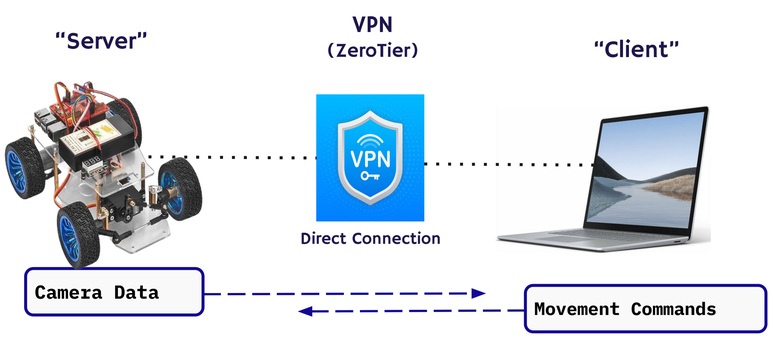
Hardware:

Build two vehicles with distinct hardware and features: one equipped with mecanum drive and the other with Ackermann steering. Integrate additional sensors, emergency stop mechanisms, and other features.

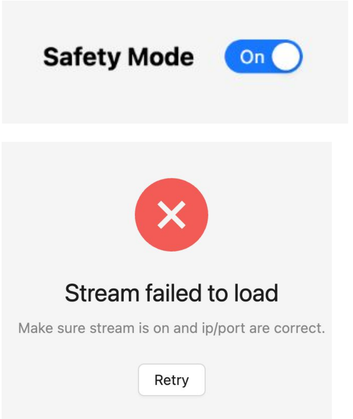
Software & Networking:

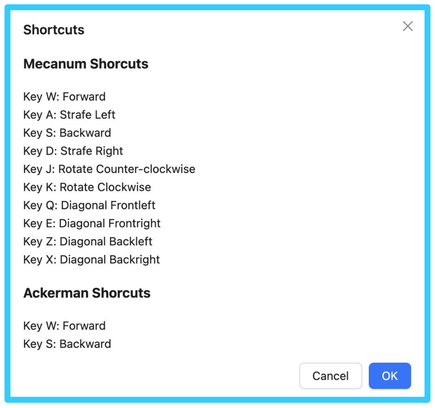
Enable wireless control of each vehicle and extend the operational range using a VPN. Develop an intuitive and user-friendly interface and establish a reliable and low-latency camera feed.

Network Architecture



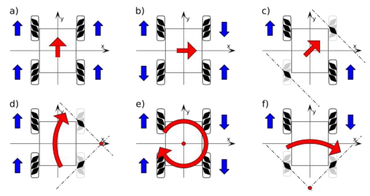
Troubleshooting



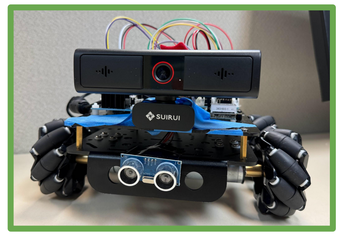


Hardware

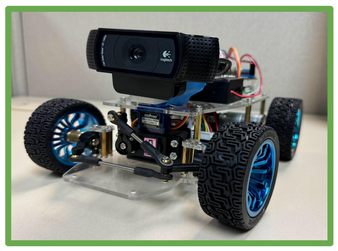
The use of mecanum wheels allow for both "tank" drive(a) as well as omnidirectional movement. We initially hypothesized that the ability to strafe left and right(b) would allow the pilot to better navigate around corners and turns. Additionally, this drive train allows for diagonal movement(c).

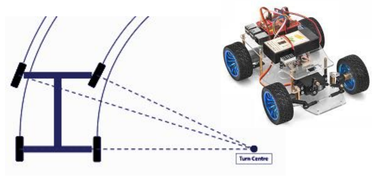


Mecanum Drive



Ackermann Steering:

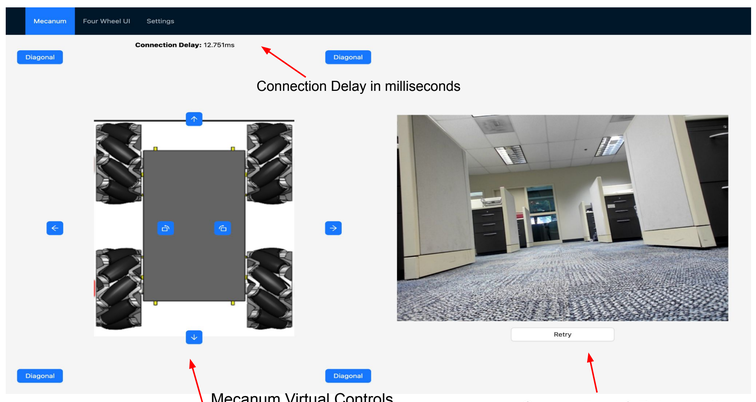




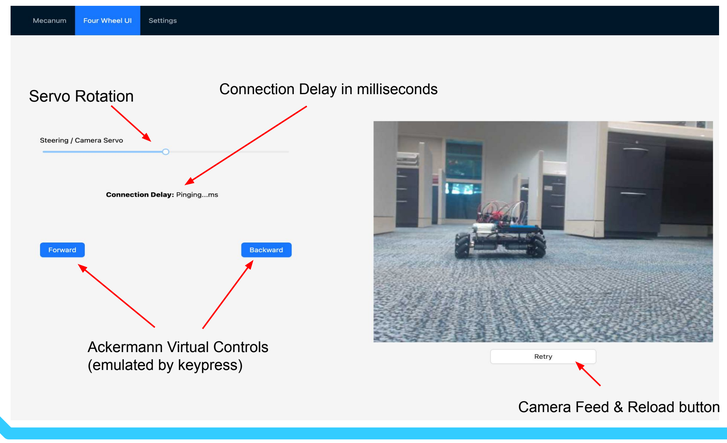
This drive train features steering similar to a traditional road vehicle. Our vehicle is modified from the OSOYOO Servo Steer Smart Car kit.

Client Software - UI

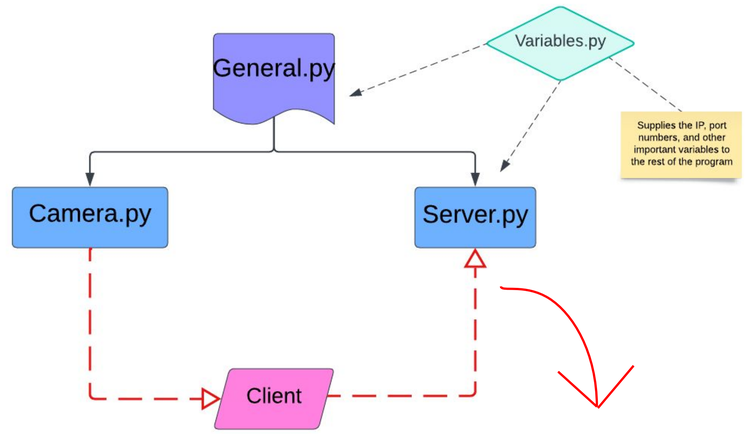
Mecanum User Interface



Ackermann User Interface



Server Software



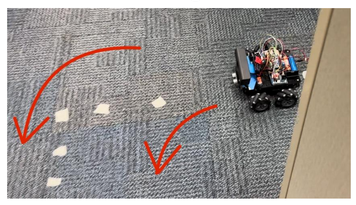
Emergency Stop

Gathers the distance data 100 times each second. If triggered it, roughly stops an inch from the obstacle. This feature can be toggled on and off.

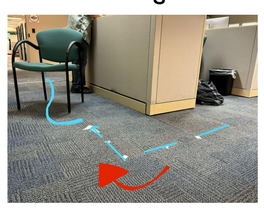
Testing and Driver Preferences

Experimental Setup

Turn #1 in testing course



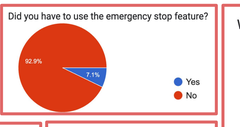
Turn #2 in testing course

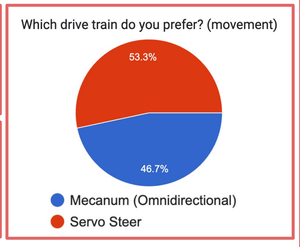


Results of the Experiment:

Average Number of Collisions while Driving:

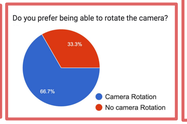
	Trial 1	Trial 2
Ackermann Vehicle	0.4	~ 0.3
Mecanum Vehicle	~ 0.5	0.4





Average Time to Complete the Course:

	Trial 1	Trial 2
Ackermann Vehicle	56.87 Seconds	42.43 Seconds
Mecanum Vehicle	55 Seconds	49.144 Seconds



Future Work:

- Experiment with different image encoding and decoding to decrease camera latency.
- Improve mecanum movement
  - Calculate the amount of energy to send to each motor according to joystick vector
  - Resolve weight and balance issues to reduce drift.
- Retrieve sound data from the webcam microphone.
- Potentially improve safety system by adding depth sensing and more sensors for emergency stops.

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