First Person View Remotely Piloted Car

Andrew M, Ben Y, Leo X, Adityaa S

Advisor: Dr. Martin

Group Members

Andrew Martin
Metuchen High School

Ben Yu
East Brunswick High School

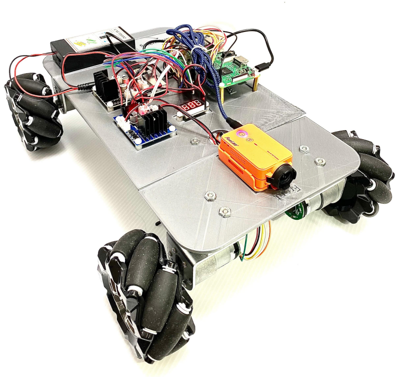
Leo Xu
Pingry High School

Adityaa Suratkal
John P. Stevens High School

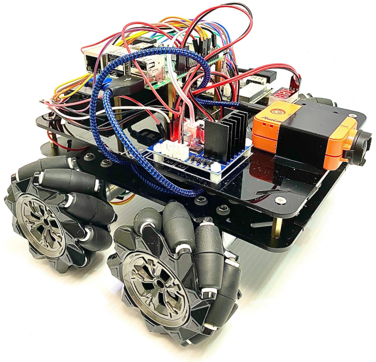
Introduction

Using different kits and resources, we created a remote controlled car that can:

- Be remotely controlled by a computer
- Stream camera footage in the first person view
- Be able to maneuver in many directions (forwards, backwards, diagonally, etc.)



About Our hardware



Initially used a kit premade by OSOYOO

- Include and arduino, drivers, motors, and mecanum wheels

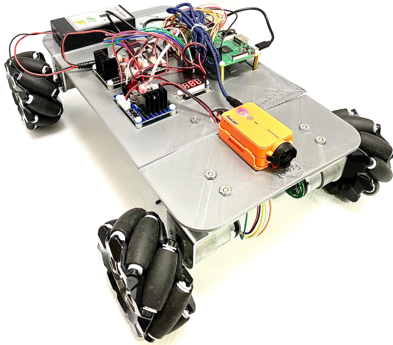
Decided it would be easier to use a raspberry Pi - replace the Arduino with a raspberry pi3

- Had to replace an original driver with a separate motor-pi driver, also made by OSOYOO
- -Soldered two male-female wires to create one female to female cable.

Attached a separate camera made by RunCam onto the robot as our FPV camera.

Decided to upgrade to a separate metal chassis for rigidity and strength.

- Moved all the electronics onto a custom 3d printed mounting board, which was tl attached to the chassis
- Final version of the robot.



What is Zerotier

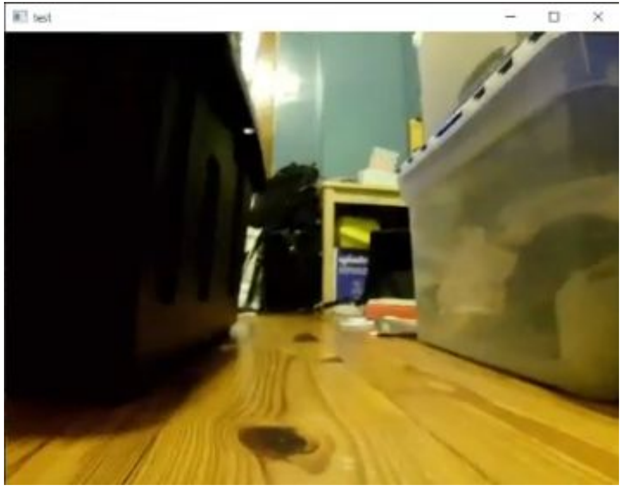
Zerotier is a VPN system that connects multiple computers over a virtual encrypted network

- Each device has its own Zerotier-specific IP that connects to a common network
- Zerotier implementation for FPV Remote Piloting:
    - Robot connects to Zerotier network
    - User connects to Zerotier network
    - User can have ‘complete’ remote control of the robot from anywhere in the world, as long as both the user and robot are connected to wifi

What is OpenCV

OpenCV is a programming library used for real-time computer vision and machine learning.

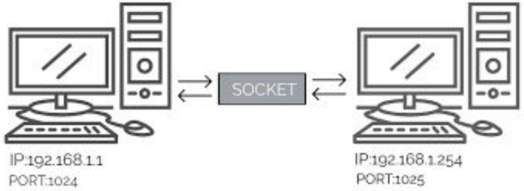
- OpenCV implementation for FPV Remote Piloting:
    - Compress camera data into JPEG’s
    - Convert JPEG’s to byte-array
    - Send bytes through socket
    - Decode bytes back to JPEG on user end
    - Display FPV video



Sockets

Network sockets are used to communicate between multiple computers over the internet

- Two ends:
  - Client sends data
  - Server receives data
- Different types of sockets; TCP & UDP
  - TCP - slower, more secure
  - UDP - faster, risk of packet loss; settled with UDP
- UDP socket implementation for FPV Remote Piloting:
  - Transmitting/interpreting camera data
    - Robot as client
    - User’s computer as server
  - Transmitting/interpreting movement controls
    - User’s computer as client
    - Robot as server



Our final Process

Controlled the robot remotely by sending UDP sockets back and forth.

- Send UDP packets to the robot for control
- Received UDP packets for the camera feed

Accessed robot using both computers Zerotier ip address

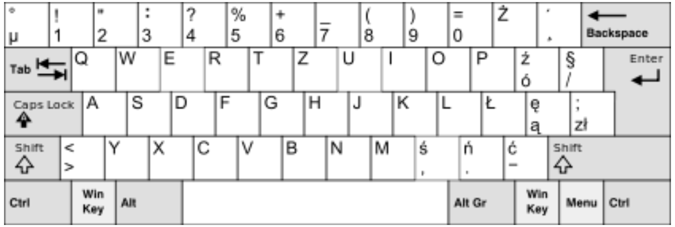
Controlled the robot using the W,A,S,D,Q,E,R,T,F,G keys.

Video is streamed to the control device using a UDP socket and is decoded and displayed on the device.

Only two programs need to be run

- One program on the Pi & one program on the control device

Able to pilot the vehicle through an obstacle course and from a remote location.



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F	Diagonal Down Left ↙
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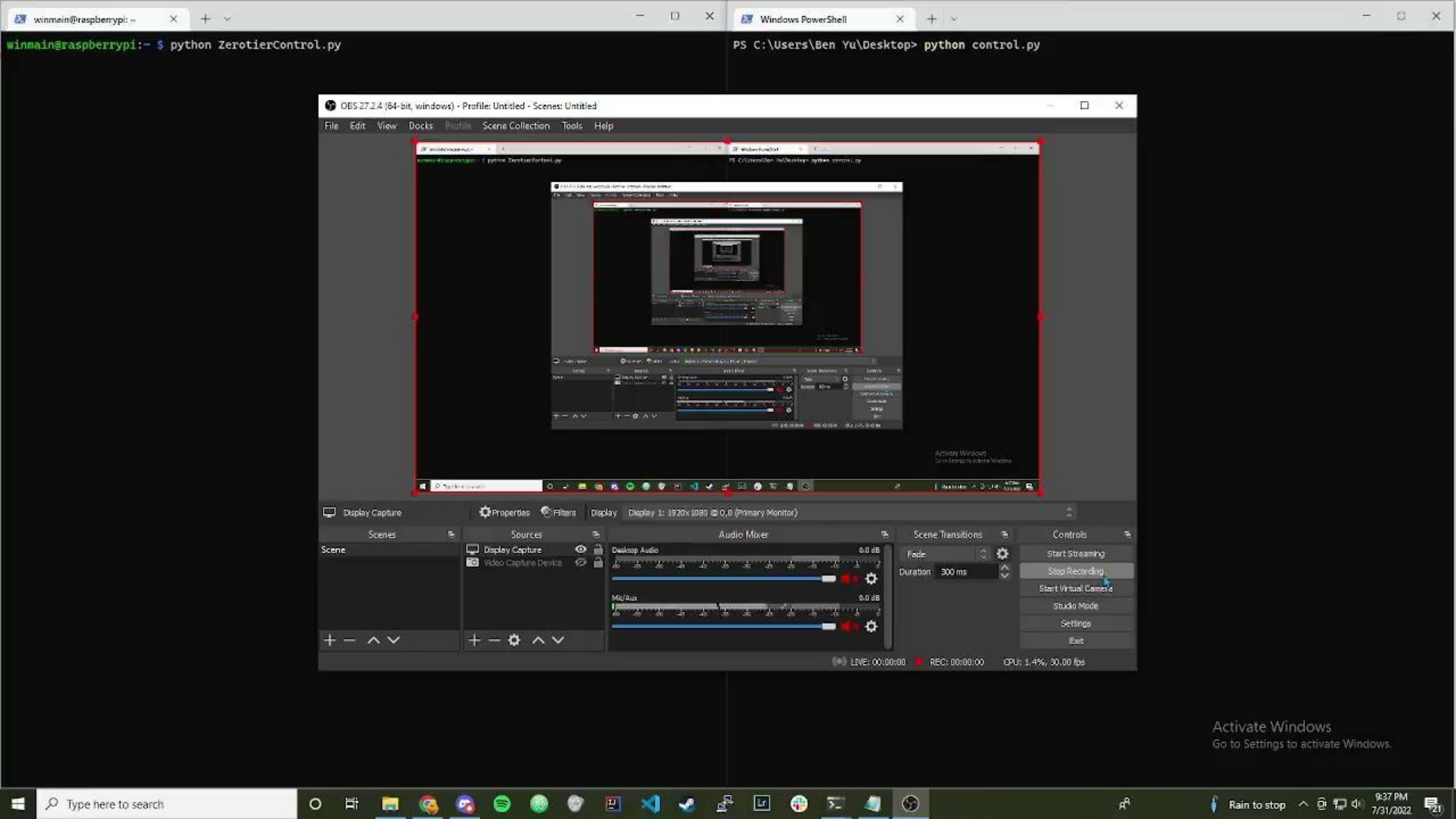

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winmain@raspberrypi:~ $ python ZerotierControl.py
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PS C:\Users\Ben Yu\Desktop> python control.py
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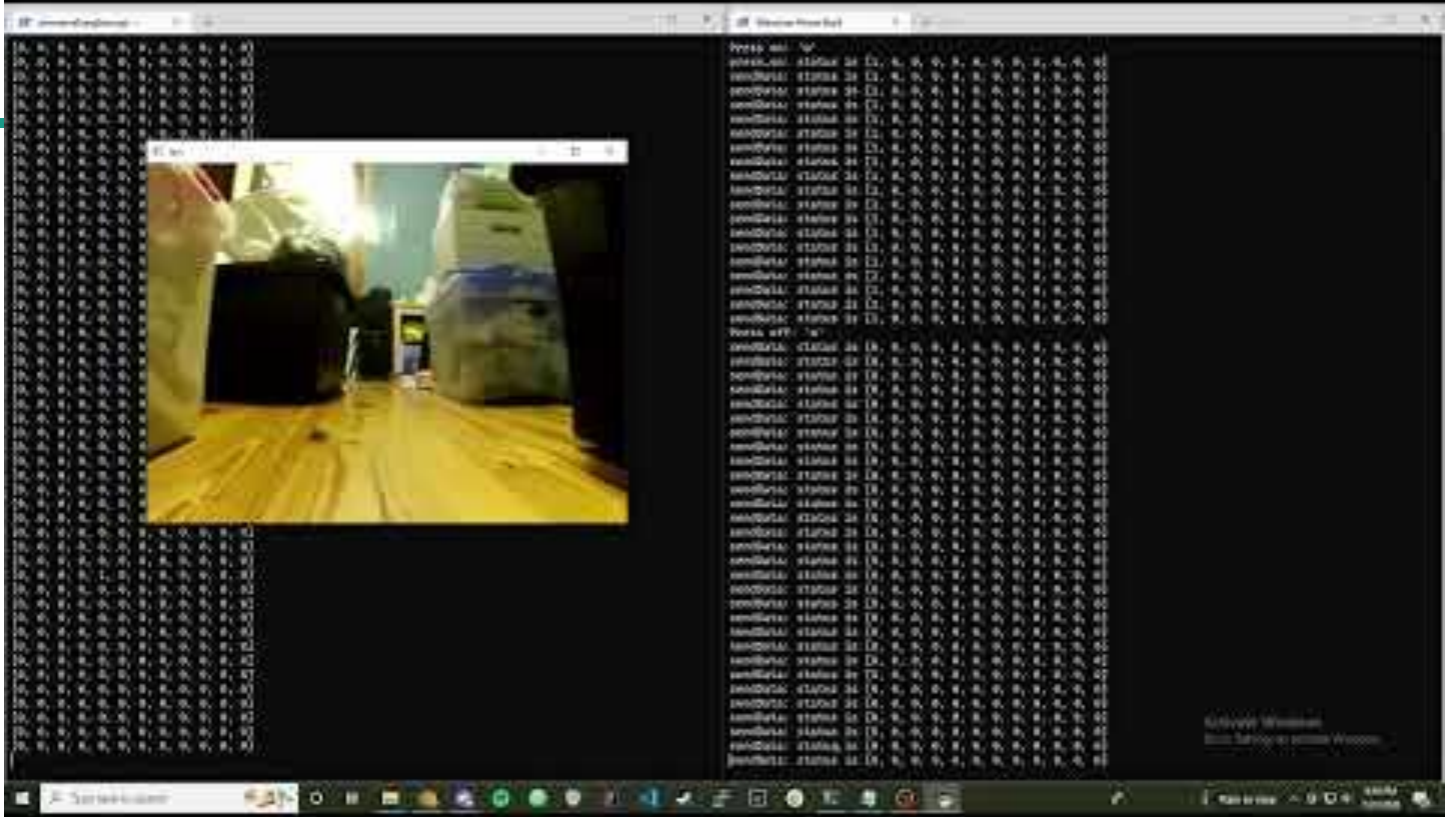

Conclusion + Future Direction

- We were able to successfully run the robot remotely.
- The robot was placed in one team member's house, and was controlled by a different team member in a different location.
- There were no hitches with this setup, except when the internet connection weakened then control of the robot worsened.
  - Latency was visibly increased, in both video and control.

Future Direction:

- Get the Intel RealSense camera to work, which outputs a pointcloud, which can be programmed to give the car self-driving capabilities

Questions?