



Object Detection Drone

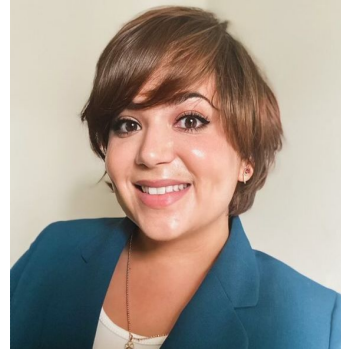
Project Showcase - Group Three

Sponsor: UCF ECE Department

UCF Senior Design
Spring 2023



Meet the Team



Derek Murdza <i>Computer Engineering</i>	Cannen Carpenter <i>Computer Engineering</i>	Jazmine Roman <i>Electrical Engineering</i>	Kevin Nilsen <i>Optics Engineering</i>
<ol style="list-style-type: none">1. Flight / Navigation2. Calibrations3. RC Tuning	<ol style="list-style-type: none">1. Machine Learning2. Embedded Systems3. Calibrations	<ol style="list-style-type: none">1. Drone Build2. Part Management3. Calibrations	<ol style="list-style-type: none">1. PCB Design2. LiDAR Design3. 3D Printing





Sponsor Information

- This project was sponsored by the **University of Central Florida Department of Electrical and Computer Engineering**
- Received funding for drone components
- Offered areas for flight testing



Cannen Carpenter (CpE)

Motivation and Purpose

- The purpose of this project was to **develop a drone that has object detection and distance detection** using multiple stages of software and hardware integration
- The drone has **full flight capability in terms of three-dimension navigation**
- The process in the development of the drone included **schematics, construction, simulation, calibration, and flight testing**
- This project allowed essential contribution from **all three disciplines** within the group



Cannan Carpenter (CpE)

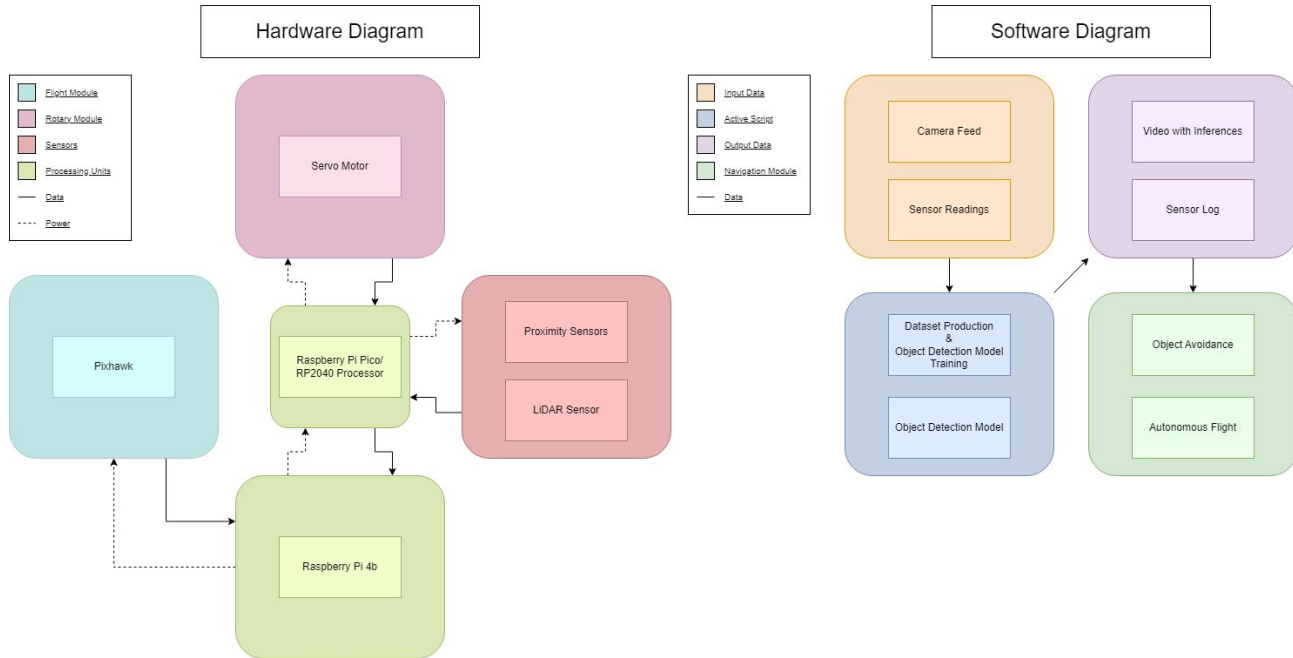
Requirement Specifications

1	The drone should be able to fly in all three axes (X/Y/Z)
2	The system should be able to hover
3	The sensors must measure distance of white objects up to at least 0.75 meter with a 0.1 m accuracy
4	The machine learning model must classify objects within 5.00m and have a confidence above 85%
5	The drone must be calibrated to pass pre-arm checks for safety purposes
6	The drone should only be flown in open indoor areas



Cannen Carpenter (CpE)

Block Diagrams





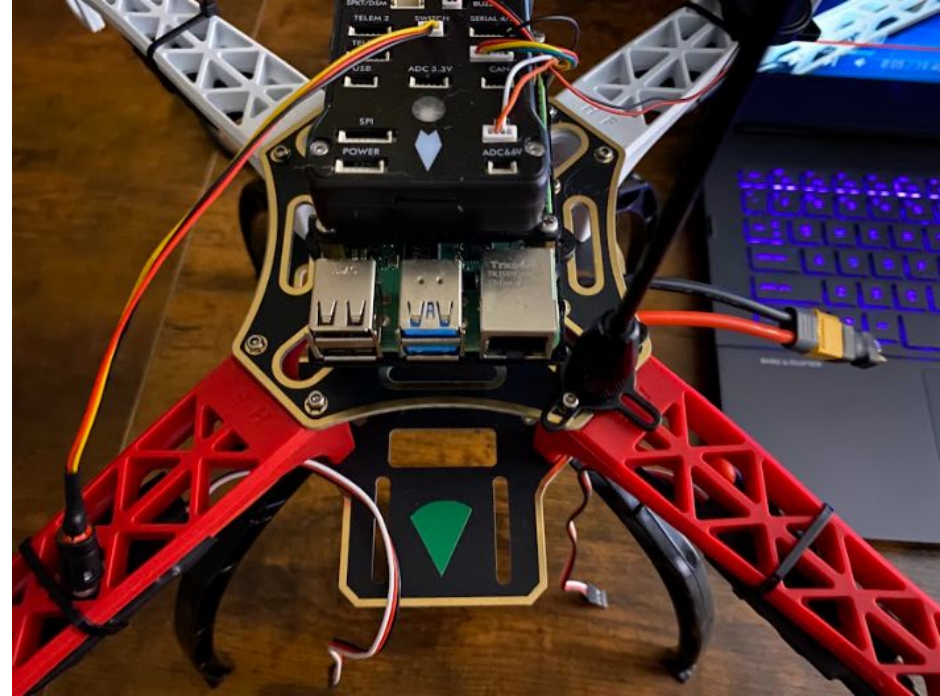
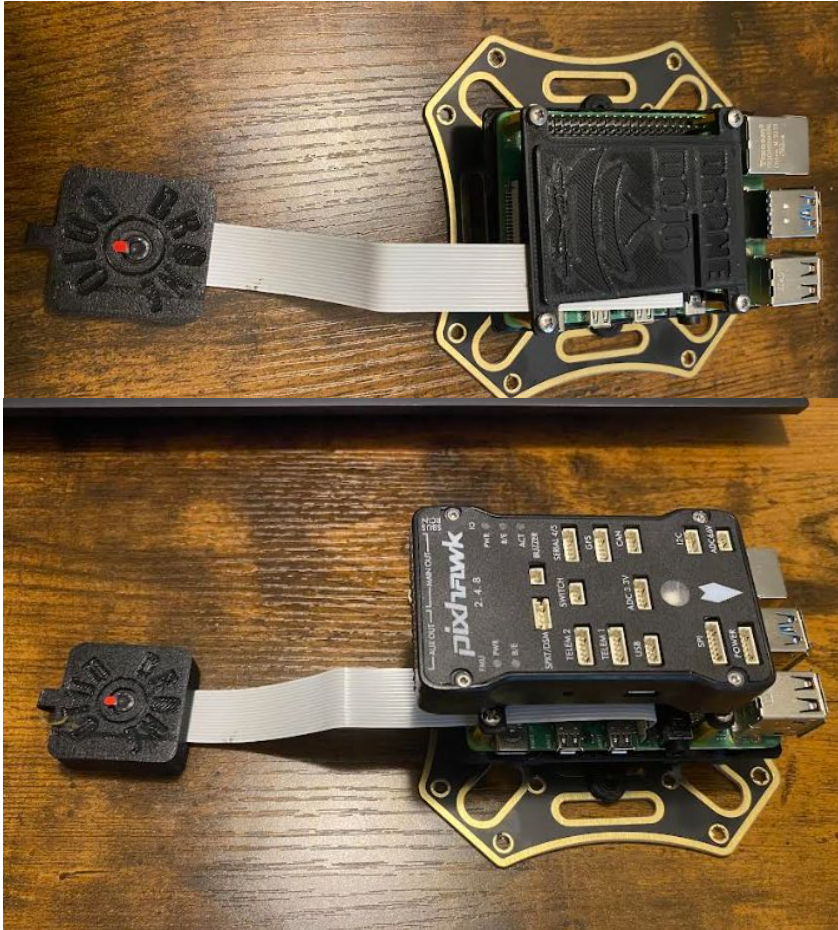
Cannen Carpenter (CpE)

Drone Build and Design

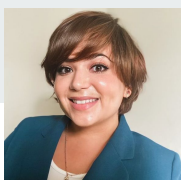
Flight Controller Placement



Jazmine Roman (EE)



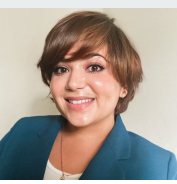
Drone Placement Planning



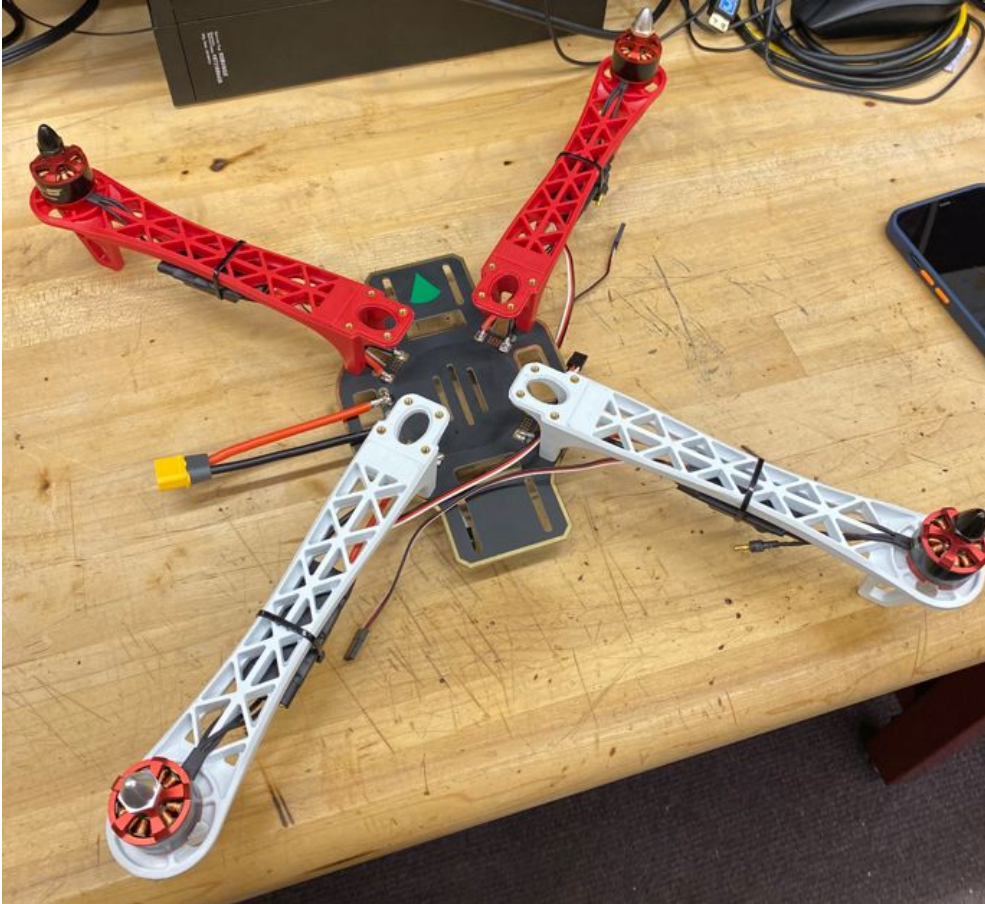
Jazmine Roman (EE)



Power Distribution Board - Bottom Plate



Jazmine Roman (EE)

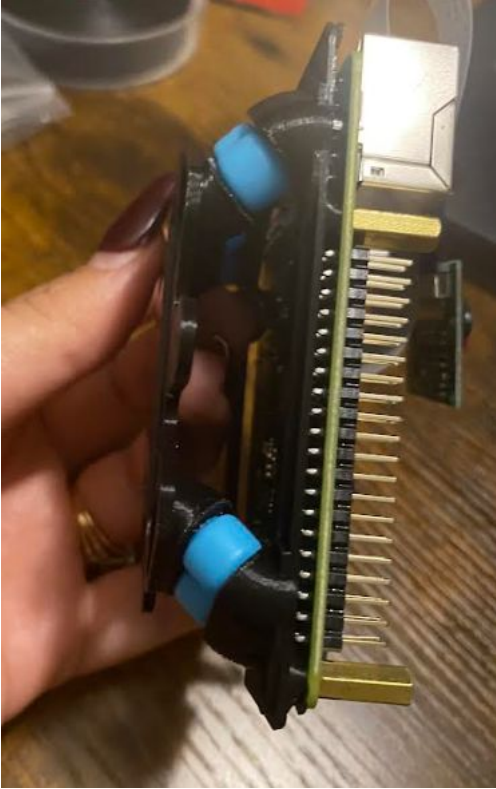
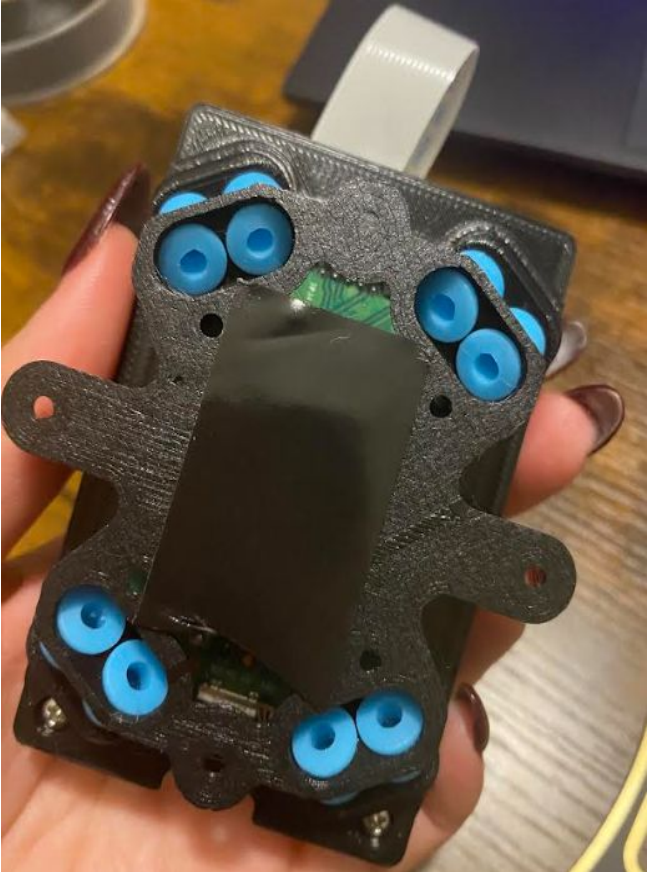


- Electric Speed Controllers (ESCs) & battery connector soldered onto PDB

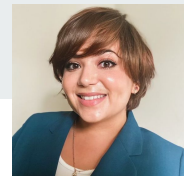
3D Printed Vibration Dampener



Jazmine Roman (EE)



Top Plate



Jazmine Roman (EE)

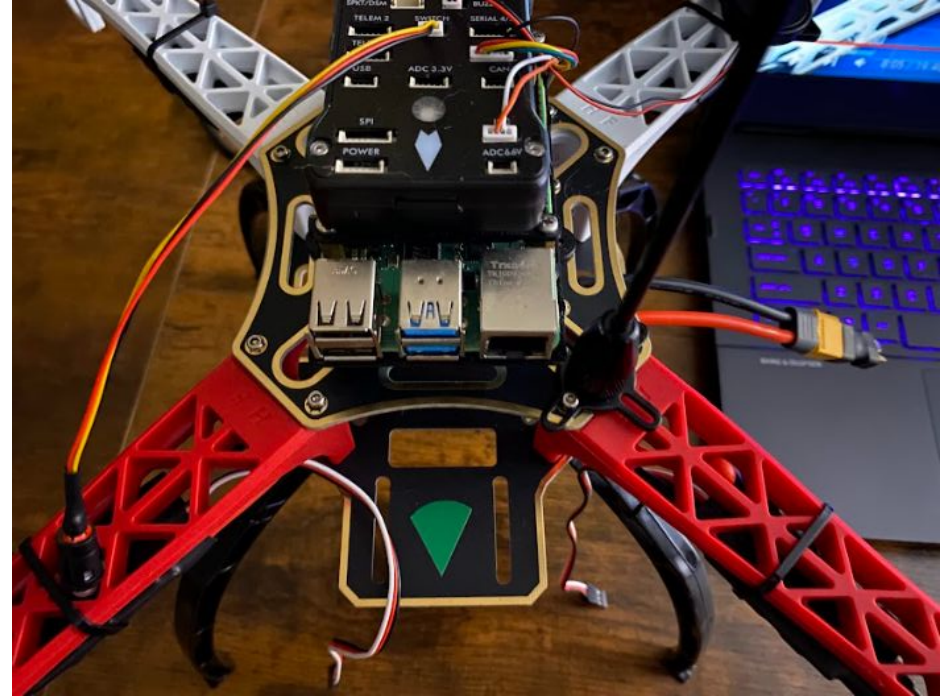
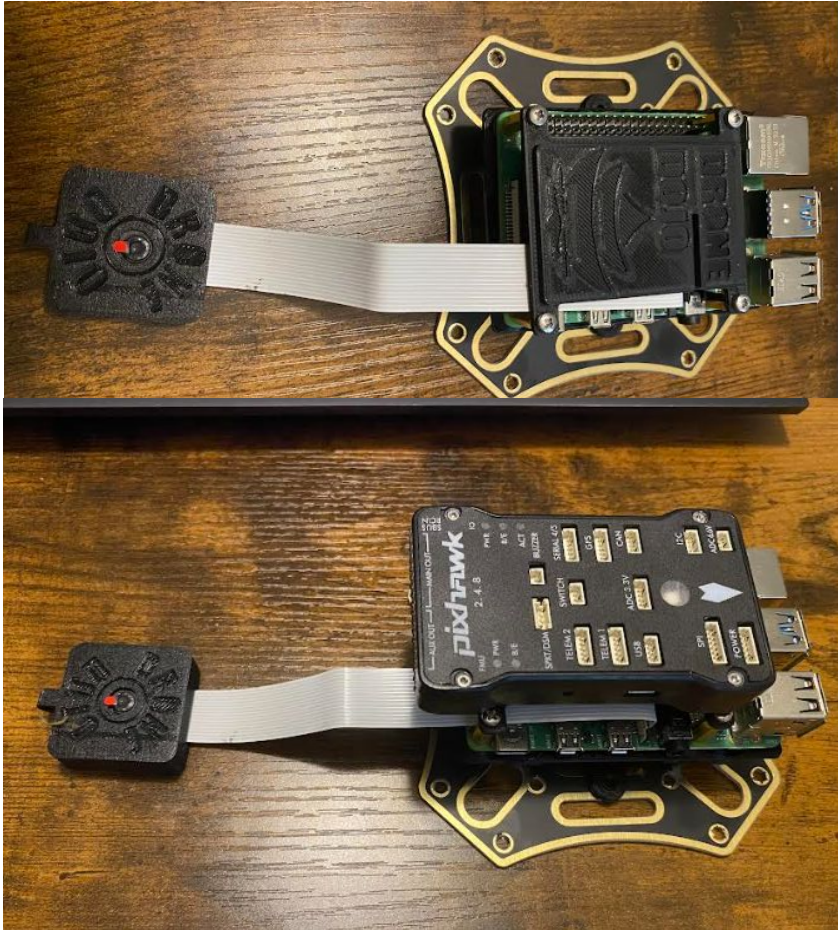


- Raspberry Pi with PiCam installed and mounted onto top plate

Flight Controller Placement



Jazmine Roman (EE)





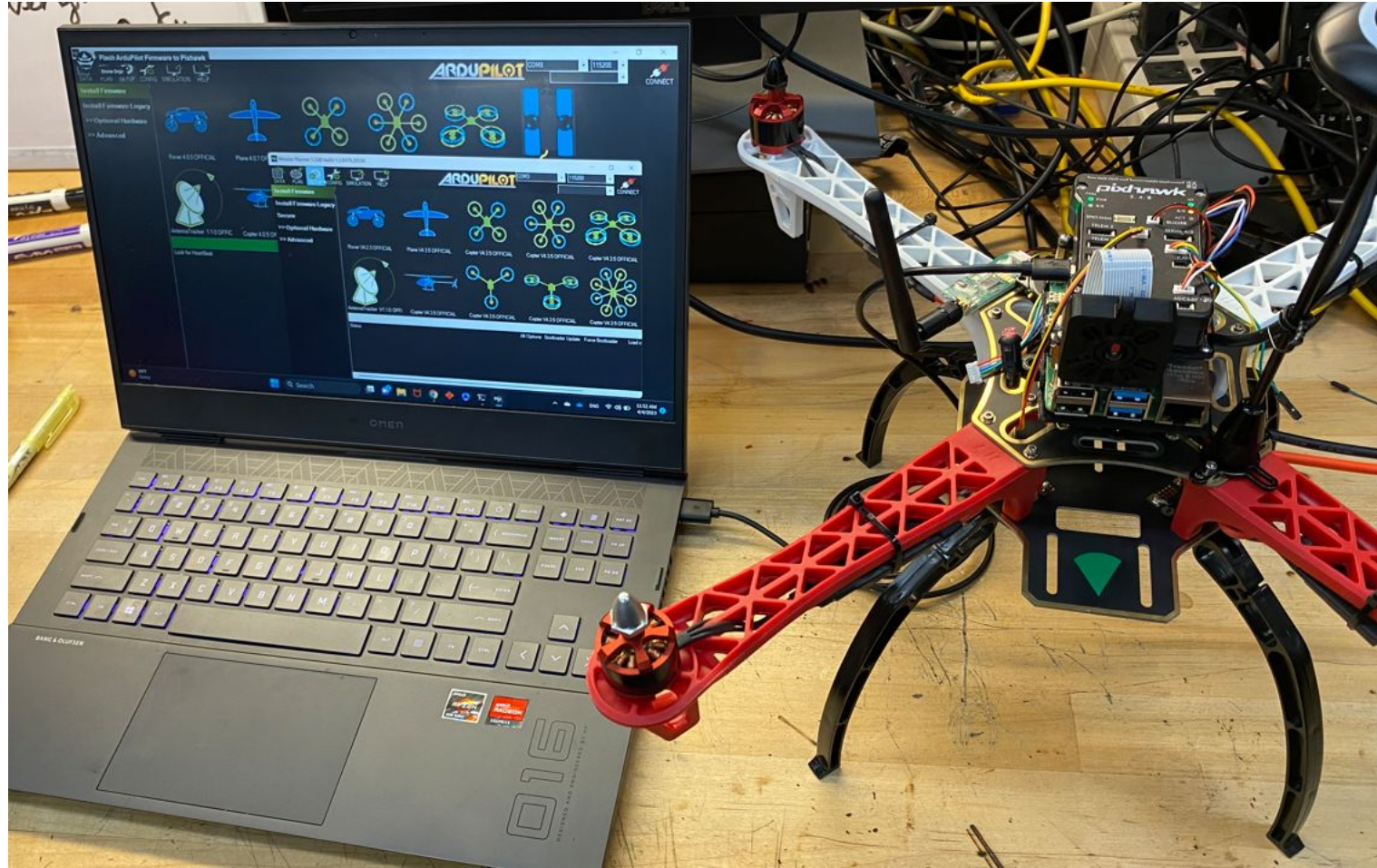
Cannen Carpenter (CpE)

Navigation and Calibration

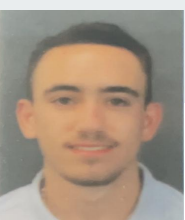
Mission Planner (User Interface)



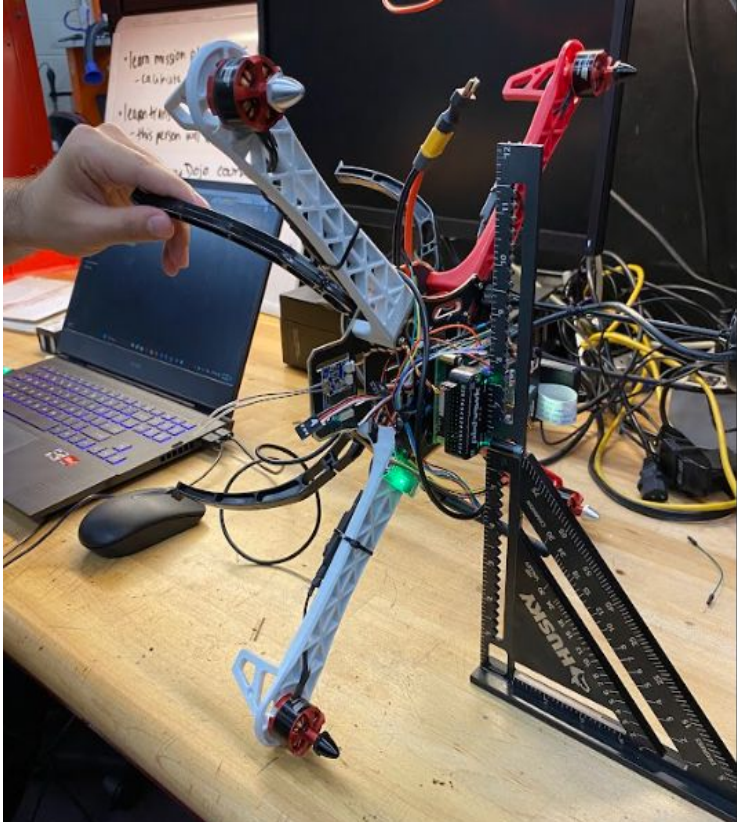
Derek Murdza (CpE)

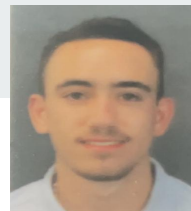


PixHawk, GPS and Motor Calibrations



Derek Murdza (CpE)





Derek Murdza (CpE)

Basic Flight Demonstration





Kevin Nilsen (PSE)

Distance Detection

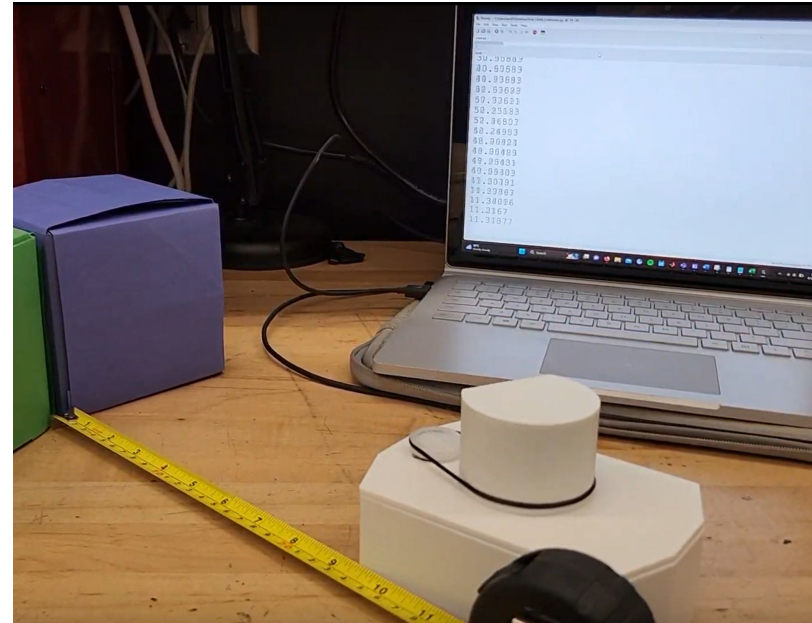
Implementing LiDAR to Detect Objects and Record Distance Mid-Flight



Kevin Nilsen (PSE)

LiDAR

- LiDAR Range is 1 meter (3 ft), with an accuracy within 8 centimeters (3 inches)
- Works best with white objects due to a stronger reflected signal
- Four sets of IR proximity sensors using LEDs are also situated around the drone





Kevin Nilsen (PSE)

LiDAR scanner



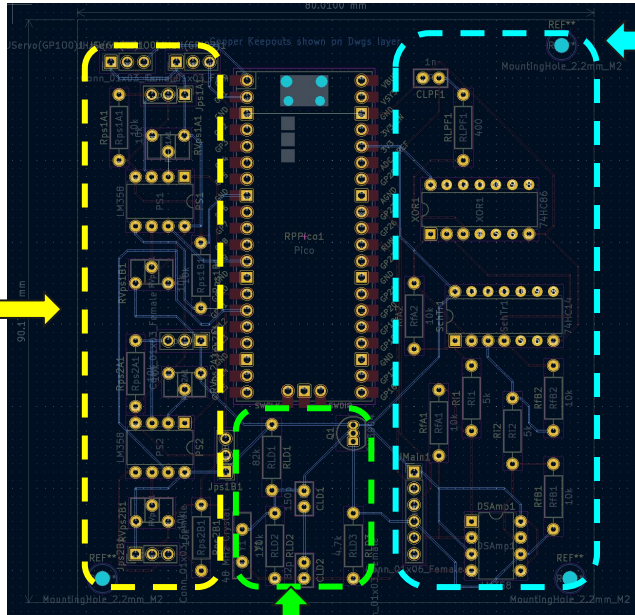
Note: the 940 nm laser can be seen by the camera but not the human eye



Kevin Nilsen (PSE)



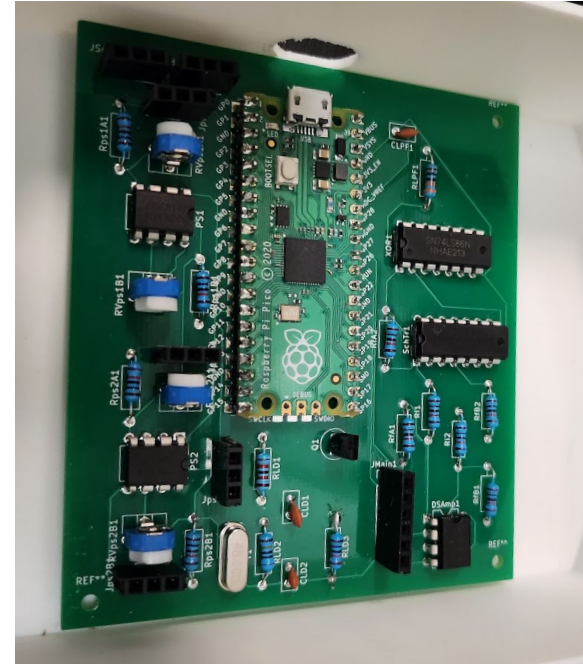
PCB - Distance Sensing



Proximity sensor control

Time of flight analysis

Modulator

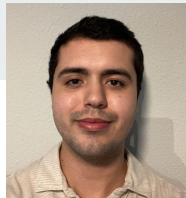




Cannen Carpenter (CpE)

Object Recognition

Implementing Machine Learning to Detect and Predict Objects Mid-Flight

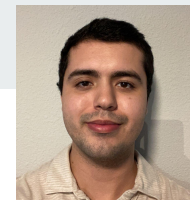


Cannen Carpenter (CpE)

Object Detection Model

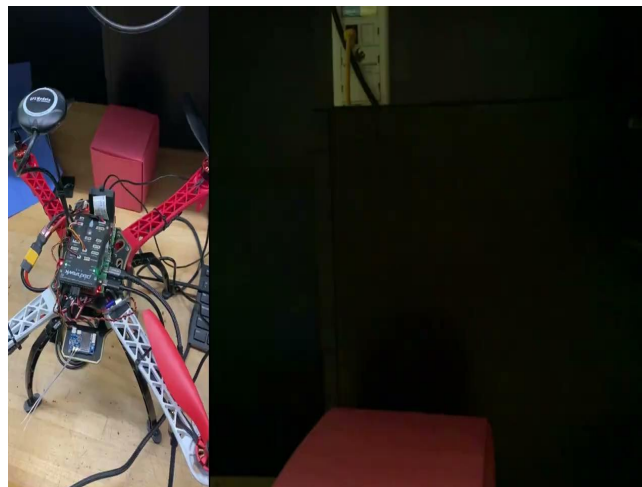
- Custom Dataset
 - Used to train our model
- YOLOv8 model
 - Implementation is done with PyTorch, rather than Darknet
- Model expectations:
 - Confidence in correct detection of at least 85%





Cannen Carpenter (CpE)

Object Detection Demo





Hardware and Software Challenges



Conclusion and Acknowledgements

- This project allowed us to intertwine skills and knowledge gained from multiple disciplines to create a fully-functional drone and has been a very rewarding experience overall
- We are proud of the work that has been put into this project even with setbacks and challenges where we were able to find solutions to solve all problems that appeared
- We would like to acknowledge the following:
 - UCF Department of Electrical and Computer Engineering
 - Dr. Lei Wei
 - Dr. Samuel Richie
 - Dr. Aravinda Kar
 - Review Committee

Thank You!