SPINNAKER ANALYTICS

Analyze. Predict. Execute.

Pizza Delivery Drone Team 4:

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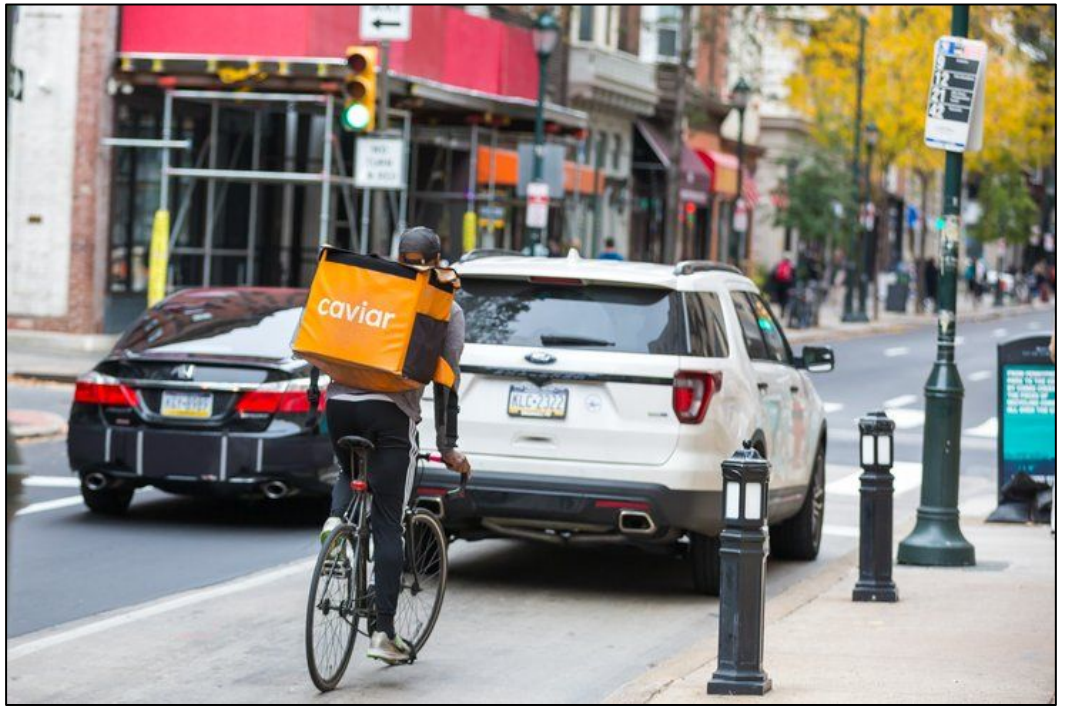
Problem Statement

- Food delivery faces delays and added costs due to reliance on human drivers
- Third party delivery services can charge up to 30% of the price of a pizza for delivery → impacting restaurant profitability
- Restaurant owners struggle with driver availability during peak demand
- Customers dissatisfied due to long wait times and cold food
- Specifically focusing on Pizza deliveries
  - Target market is 2.5 billion deliveries annually in U.S. mainland (not including PR, USVI, AS etc)



Courtesy of phillyvoice.com

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Requirement

- $3000 landed cost per drone
- Drone capable of operating in different weather conditions
- Ensure pizza is delivered in an acceptable condition
- Ensure easy customer access to pizza
- Route optimization

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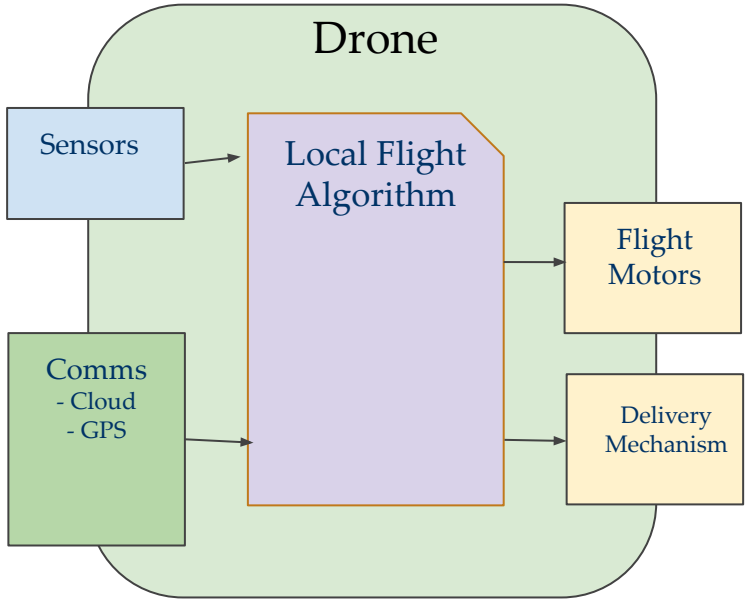
Visualization

Drone Capability Overview



Wheelbase: 1 m (3.28 ft)

Max Payload: 5 kg (11.02 lb)

Propeller size: 0.4572 m (1.5 ft)

Est. Flight time: 30 min

Sensors: Monocular RGB camera, GPS

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Deliverables

- Proof of Concept Prototype
  - Operates successfully in controlled test environment
  - Smaller delivery load capability
- Final Prototype
  - Carrying case capable of maintaining temperature
  - Harness mechanism allows easy access of pizza
  - Keep pizza unharmed under bad weather conditions
  - Under $3000 per drone
  - Compliant with FAA regulations
- Navigation and associated codebase
  - Self-navigate
  - Send alert to customer + pizzeria regarding delivery
  - Prioritize delivery routes if multiple orders are to be delivered in short span of time

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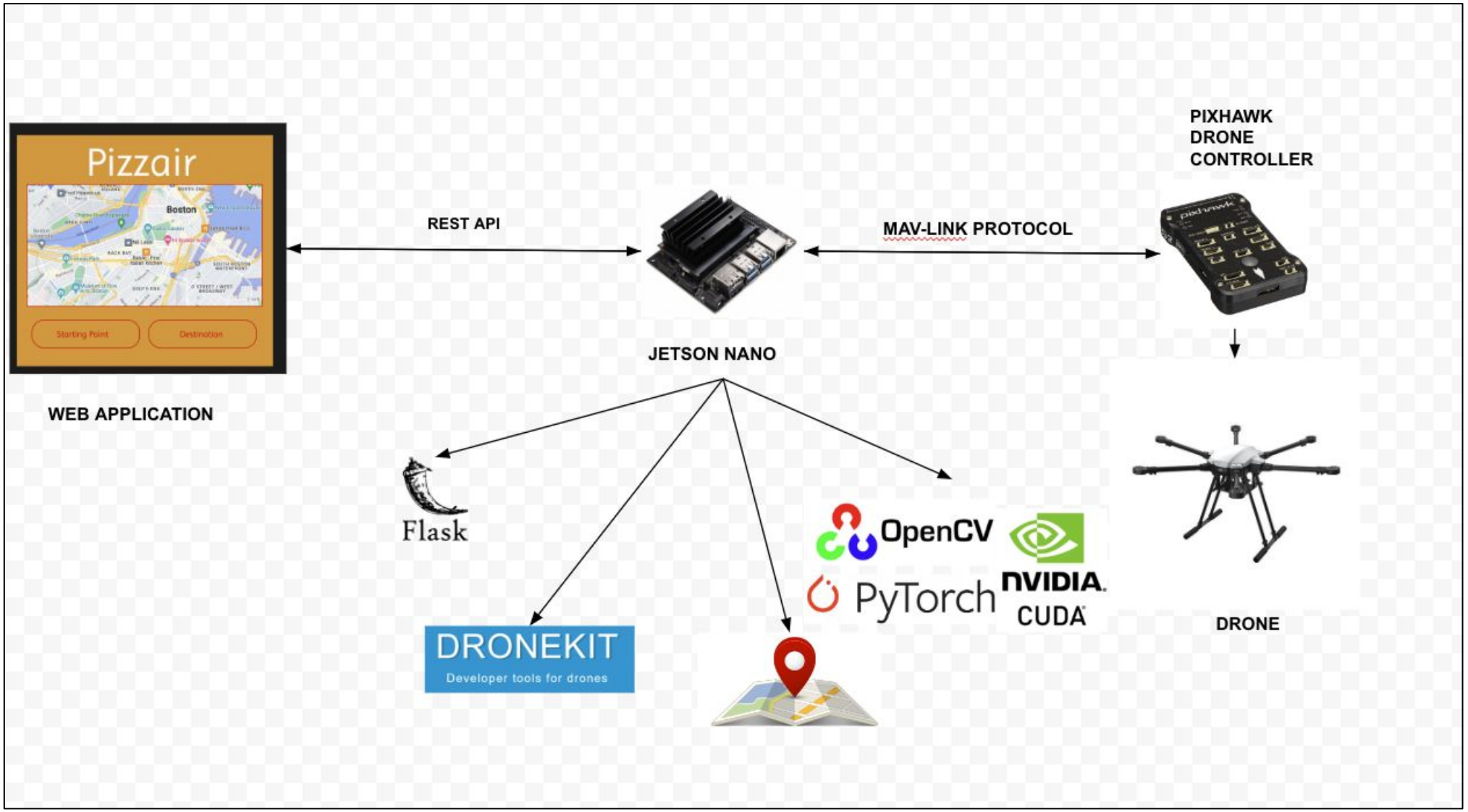
Software Architecture Diagram



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Payload Harness

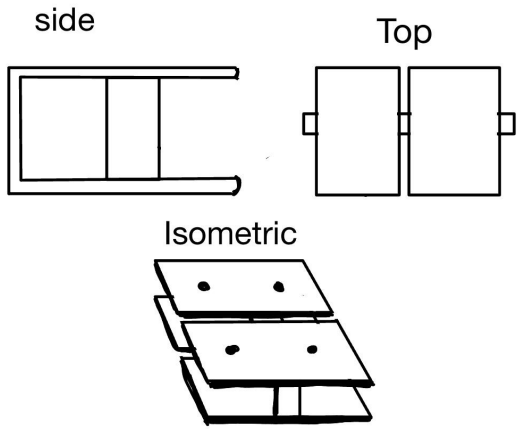
Mechanism

Possible Ideas

-string with 3 at least points of contact
-modified auto balancing camera gimbal
-modified leg basket

Current frontrunner:

Leg basket- wicker design



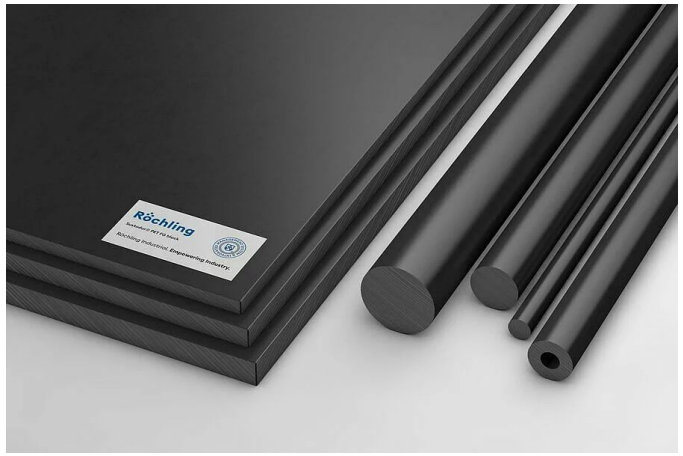
Material

Material requirements

-strong enough to withstand travel
-heat insulating material
-lightweight

Current frontrunner:

Sustadur® PET FG black



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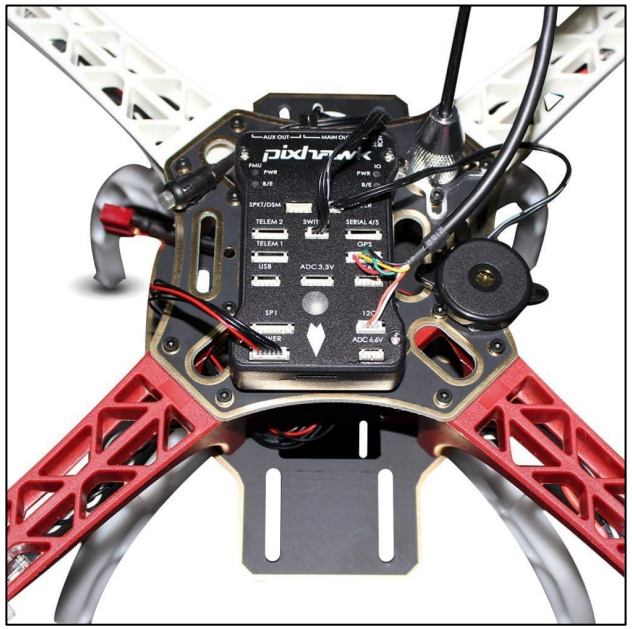
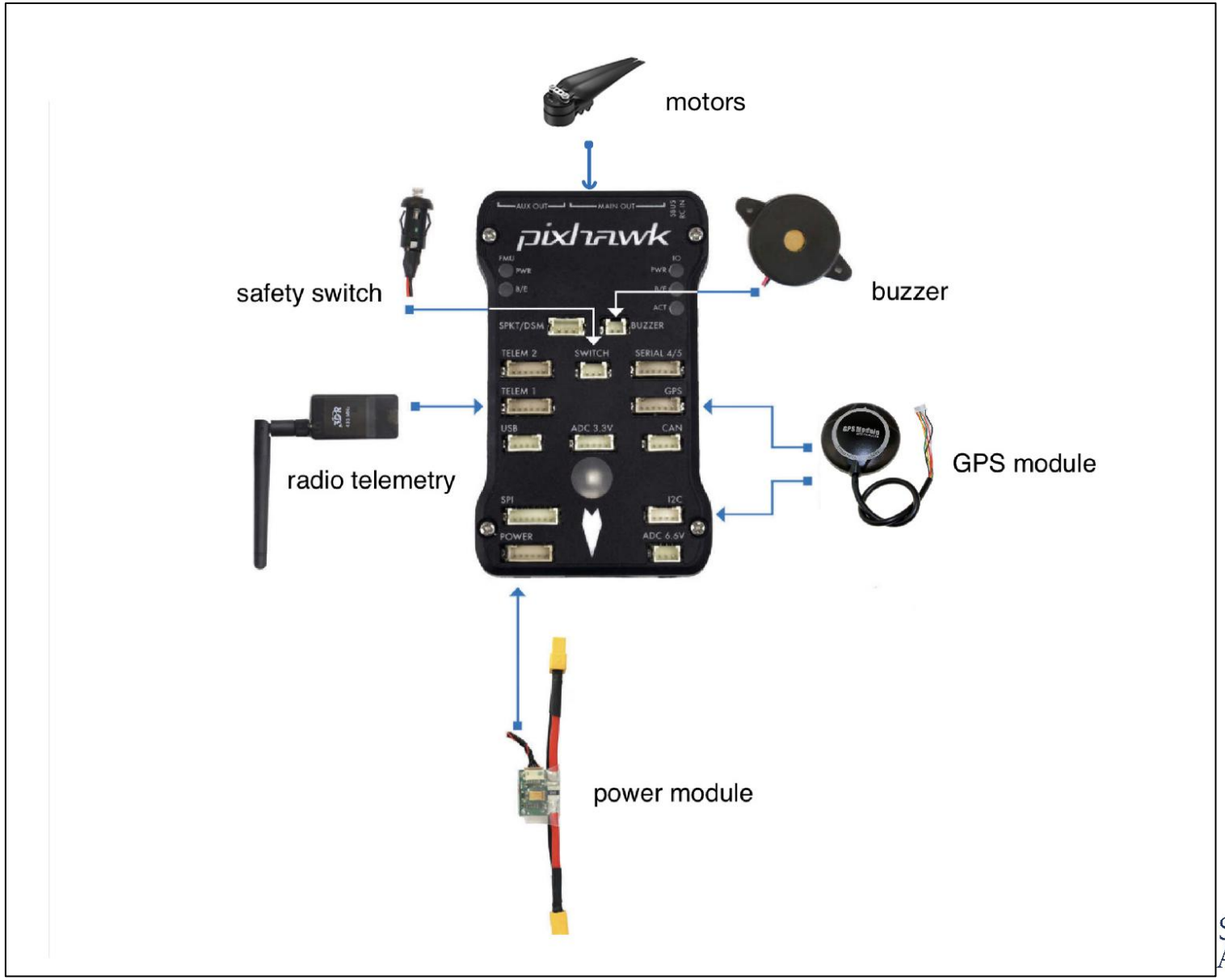
Wiring





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Power

Battery Specification:
Capacity: 16000mAh
Voltage: 22.2V
Discharge Rate: 15C
Max Burst discharge Rate: 30C
Configuration: 6S1P
Net Weight: 1932g

Frame Weight: 2.75kg
Average Pizza Weight: 1.8kg

Ideal Hovering Time: ~**27** minutes
(with 6.85kg take-off weight)

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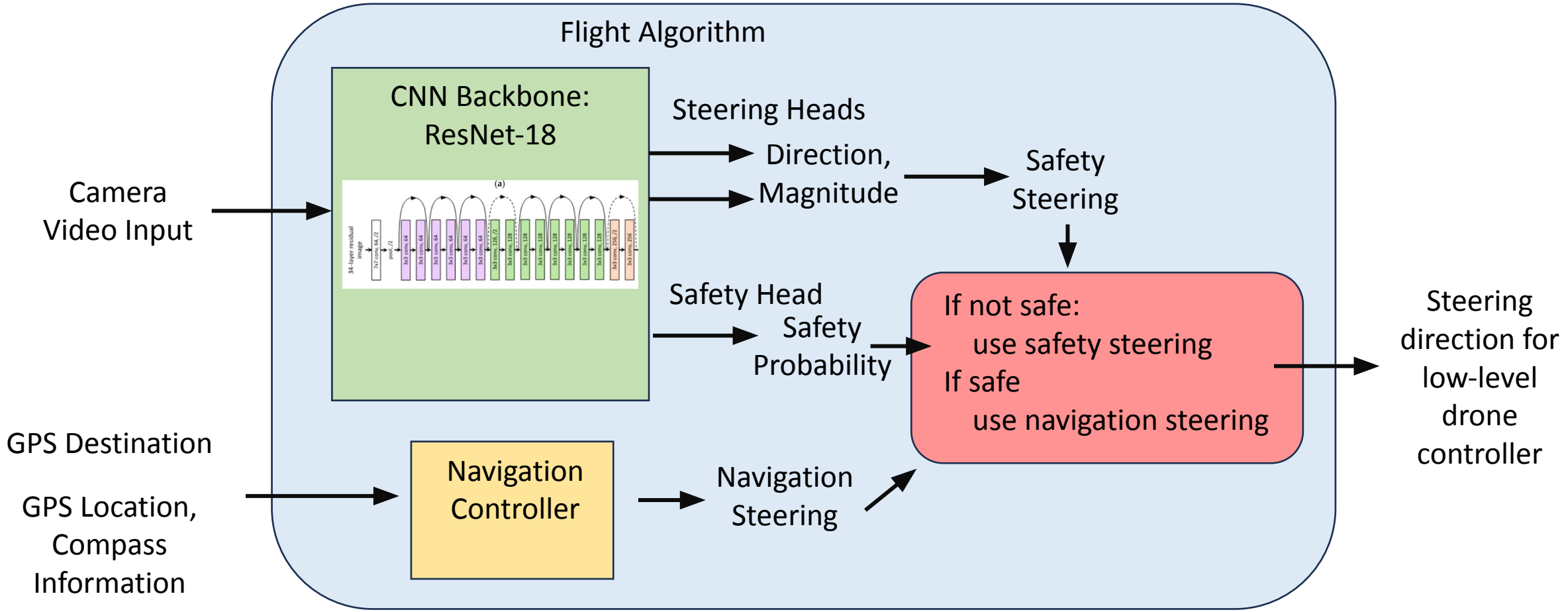
Flight Control - High Level Approach



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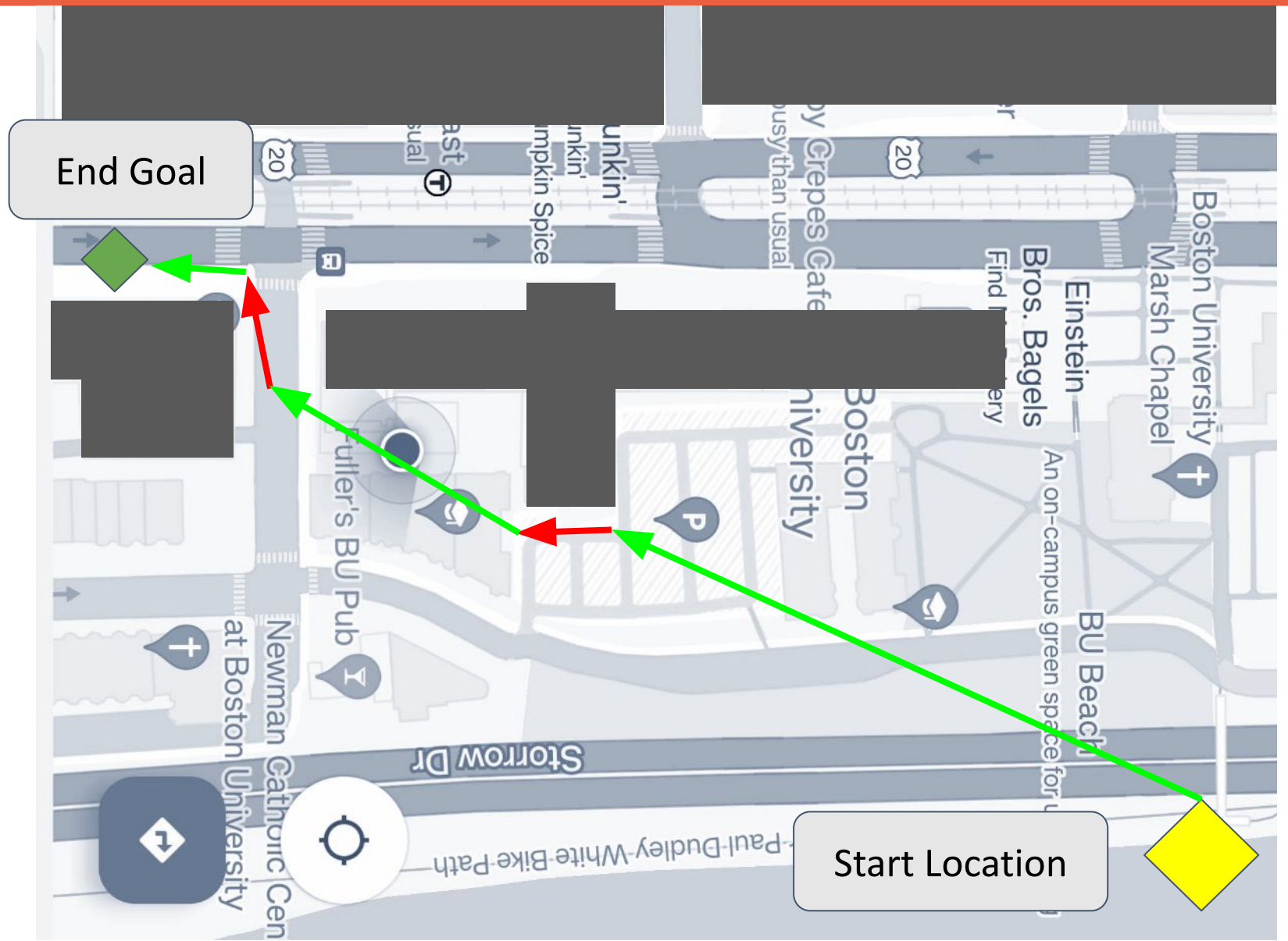
Flight Algorithm - Example



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Imitation Learning Data Collection

Data Collection

- Simulated drone trajectories in Watch Dogs 2
- Allows for environment-diverse, high-fidelity video samples
- 7 minutes of data collected at HD, then downscaled and annotated to generate labels

30,000 High-Fidelity Images

Fly around environment, collect video →

Annotate frame by frame →

Steer: 0
Safe: 0

Steer: 0.5
Safe: 1

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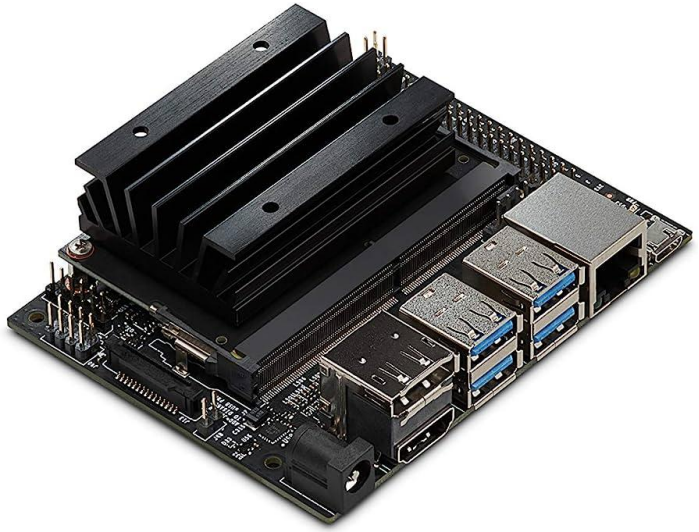
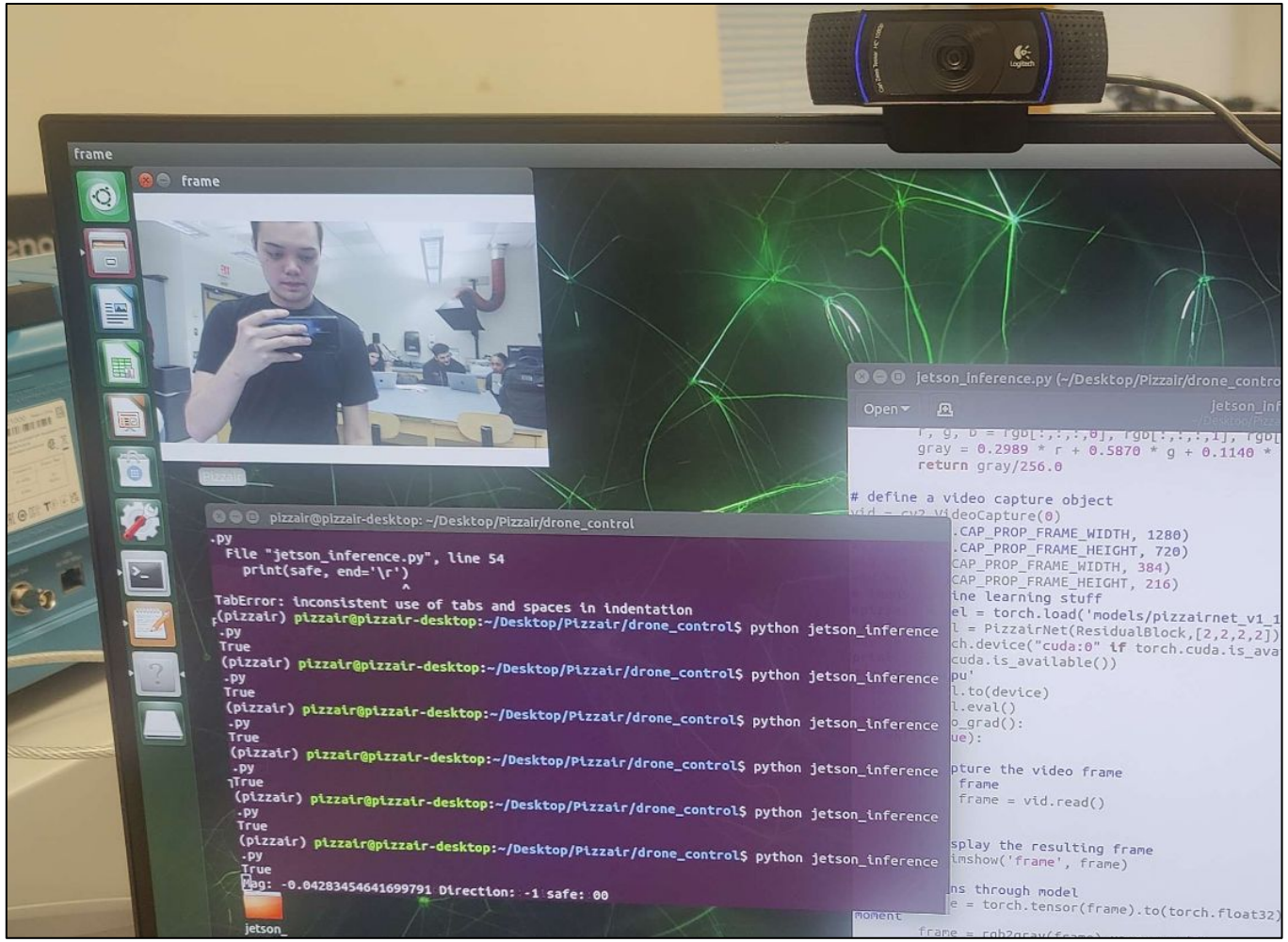
Control Algorithms on Hardware

On-Drone Hardware: NVIDIA Jetson Nano

Hardware-accelerated

Runs our algorithm at ~10 FPS





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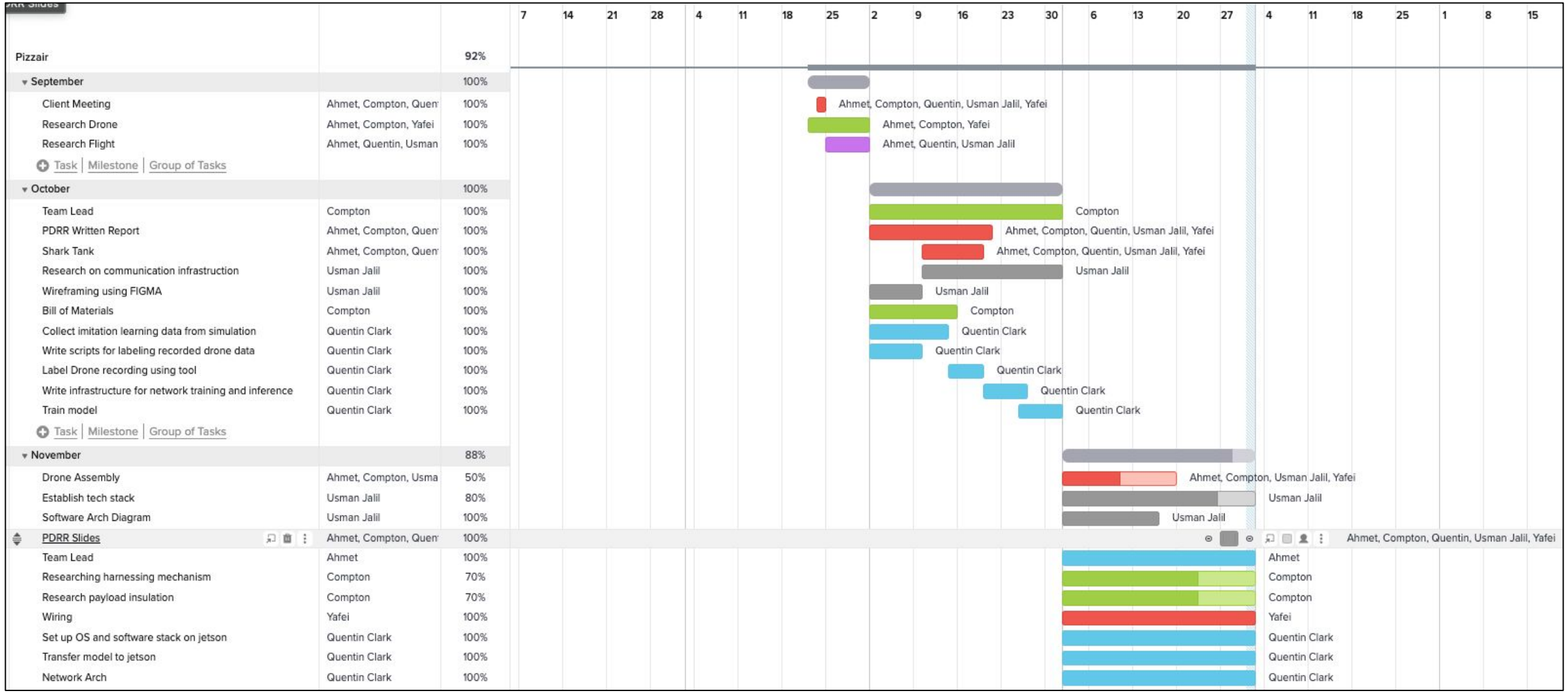
Gantt Chart



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Schedule

Client Meeting – Dec 8, 2023
Application Development (client and server side) – Winter Break
In-person Testing – Early Next Semester
Functional Testing – Week of March 27, 2024
Customer Installation – April, 2024
ECE Day – May 5, 2024

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