HAWC

Precision you can trust

Hybrid Autonomous Wayfinding Courier

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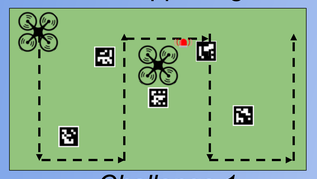
Challenge Overview

Raytheon's 2025 Autonomous Vehicle Competition

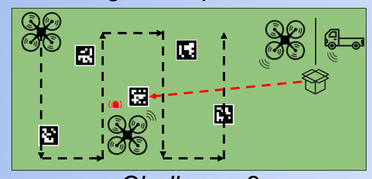
Mission Full Send - Autonomous Navigation, Target Identification, P2P C2, & Payload Delivery

Compact, low-power, high-performance microprocessors have transformed autonomous navigation in lightweight vehicles by enabling guidance through real-time video processing. This project presents a dual-vehicle delivery system that autonomously surveys a defined field, identifies a designated drop zone via onboard image recognition, and coordinates the delivery via vehicle-to-vehicle communication—eliminating the need for human intervention post-launch and supporting scalable unmanned logistics operations.



Challenge 1

- 30 x 30 yd field
- 5 possible drop-off zones
  - Identify the correct one
- Follow FAA Regulations
  - Weight < 55 lb
  - Prop Guards



Challenge 2

- Same conditions as Challenge 1
- Drop-off location to be wirelessly transmitted vehicle to vehicle
- Bonus Points:
  - Early Bird: Fastest delivery
  - Precision

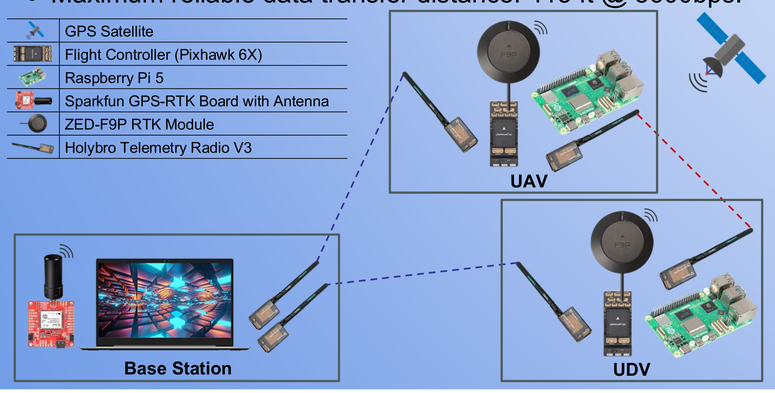
ArUco Markers:
- 10" x 10"
- Numbered 1-5

Package Information:
- 13" x 9" x 3"
- 7lb

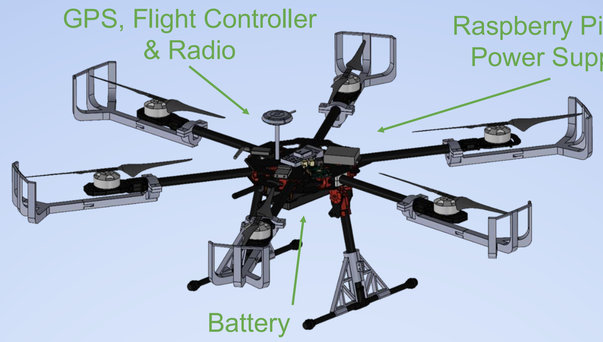
System Overview

- Raspberry Pi 5 processes the mission plan and video feed to determine the marker position
- Flight controller translates the mission plan into vehicle movement.
- UAV transmits GPS data through a 915 MHz Telemetry Radio.
  - Maximum reliable data transfer distance: 415 ft @ 5600bps.

	GPS Satellite
	Flight Controller (Pixhawk 6X)
	Raspberry Pi 5
	Sparkfun GPS-RTK Board with Antenna
	ZED-F9P RTK Module
	Holybro Telemetry Radio V3



Unmanned Air Vehicle (UAV)



Drone kit: Tarot X6 **Max speed:** 20+ mph **Total weight:** 14 lb

Battery: LiPo 22.2 V 16000mAh, allowing for 30 min of flight

Camera: Raspberry Pi Camera Module v3

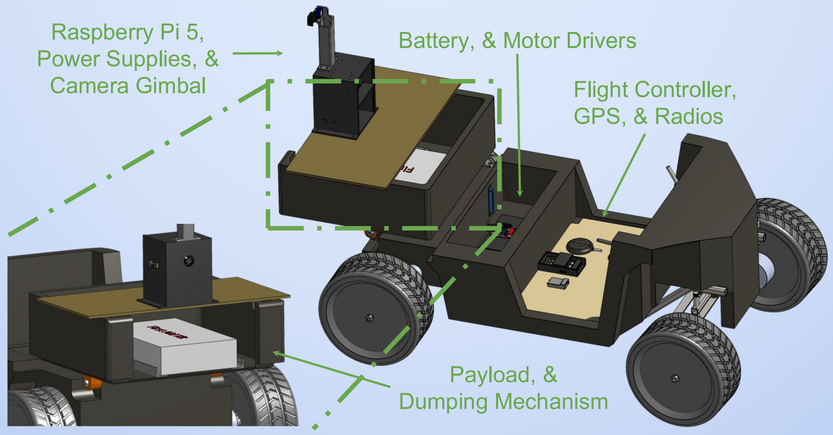
12 MP, 2304x1296p, 56 FPS, 66° FoV, Auto-Focus

Maximum flying height for marker detection: ~30ft

GPS: Holybro ZED-F9P RTK **GPS Accuracy:** ± 1"

Prop Guards: PET-G, weighing 3 lb

Unmanned Delivery Vehicle (UDV)



Car Kit: ANPABO 2 Seater Ride-On Dump Truck

Battery: 24V 7000mAh, allowing for 30+ min of driving

Movement System: 24V Brushed Motors + DC Drivers

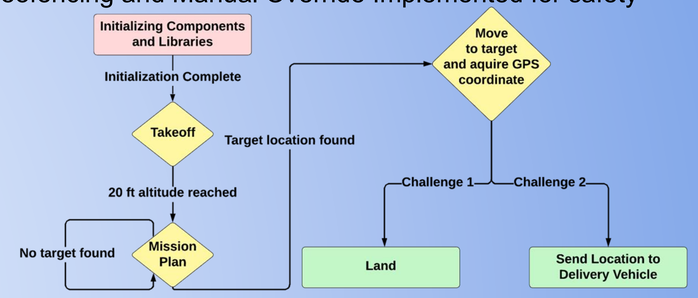
Driving Style: Originally Ackermann, converted to Differential

Max carrying capacity: 100+ lb **Max Speed:** 5 mph

Same GPS and Camera as on the UAV

Autonomous Movement

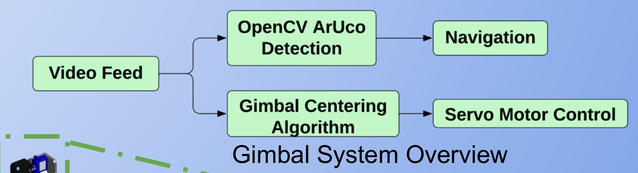
- Vehicle's movement is controlled through search algorithms developed with Python scripts
  - Open Source software MAVSDK utilized to create mission plans and guide vehicles
- Snake shaped pattern to cover entire field with redundancy
- Initial mission set using GPS coordinates.
  - Upon detecting the drop off zone marker, system uses local North/East coordinates
- Geofencing and Manual Override Implemented for safety



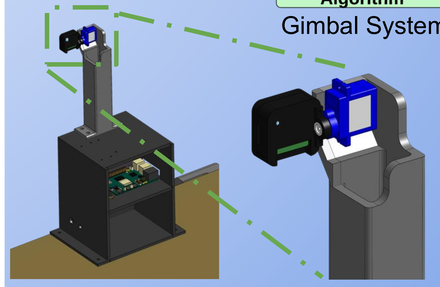
Movement Script Logic

ArUco Marker Detection

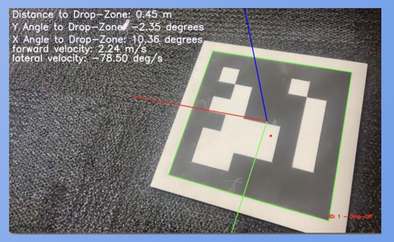
- Vehicles detect the marker by using the video feed from a Raspberry Pi Camera Module 3
  - Processes it using Python scripts including the open-source library OpenCV.
  - Marker's known size (10"x10") allows us to use pixel length to calculate distances, both vectorial and in XY from center, with a 2" accuracy.
- Gimbal system created for the delivery vehicle to track the marker



Gimbal System Overview



Gimbal System (Servo + Camera)



Marker Detection

Acknowledgements

Prof. Ilan Ben-Yaacov, Kirk Fields, Ryan Conolley, Max Youngson, Zach Reiber, Chris Cheney, Maria Raju, Jared Jonas, Trevor Marks

Raytheon
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