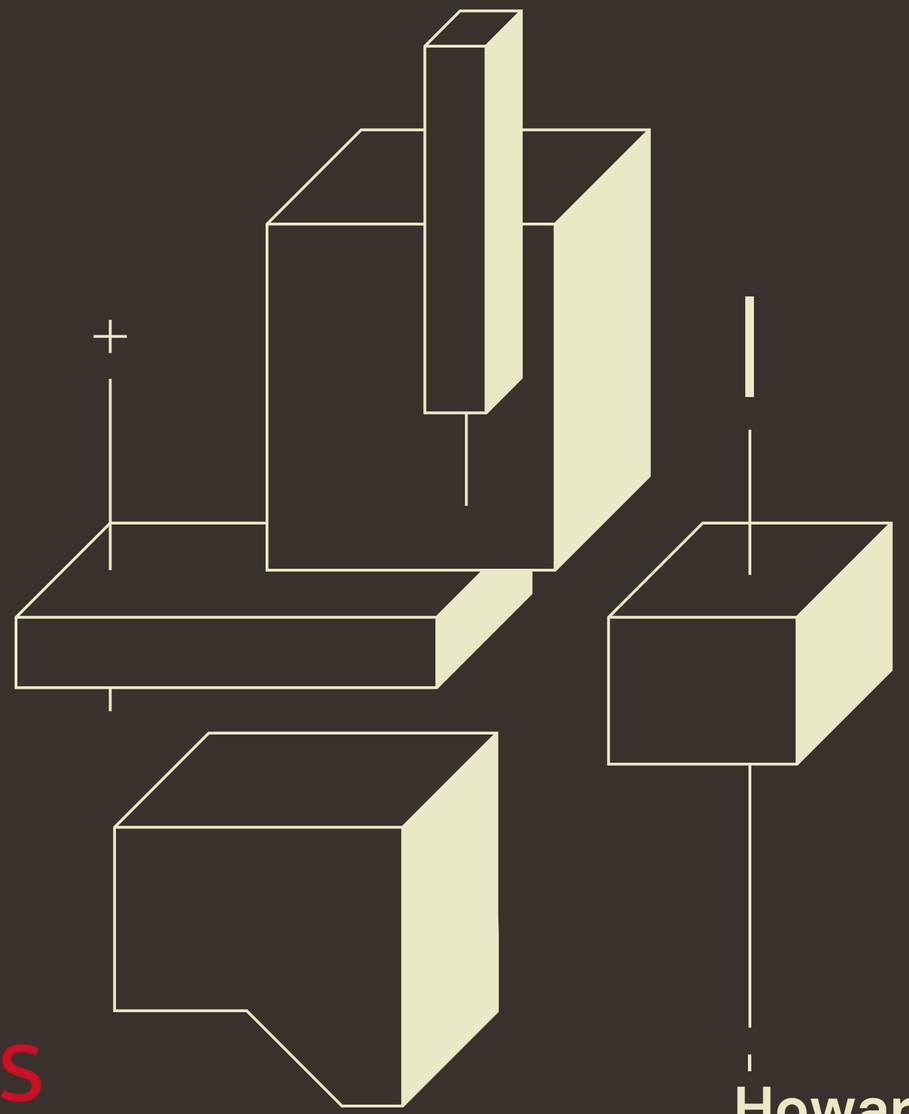
EECE 401 Senior Design I

UAV TEAM

Raytheon Technologies



Howard University

College of Engineering and Architecture | Fall 2023

INTRODUCTION

Senior Design | Fall 2023

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OVERVIEW

PROBLEM

People need to access moving ground objects using an autonomous flying drone. We have come to a few conclusive ideas that would allow the drone to make autonomous decisions in determining who is an ally or an enemy on the ground level. Customers will use drones to perform tasks in dangerous environments for military use in targeting enemies from afar. Our project will allow people to access environments that could pose threats to them, allowing them to avoid injuries/harm.

DESIGN REQUIREMENTS

PRODUCT SPECIFICATIONS

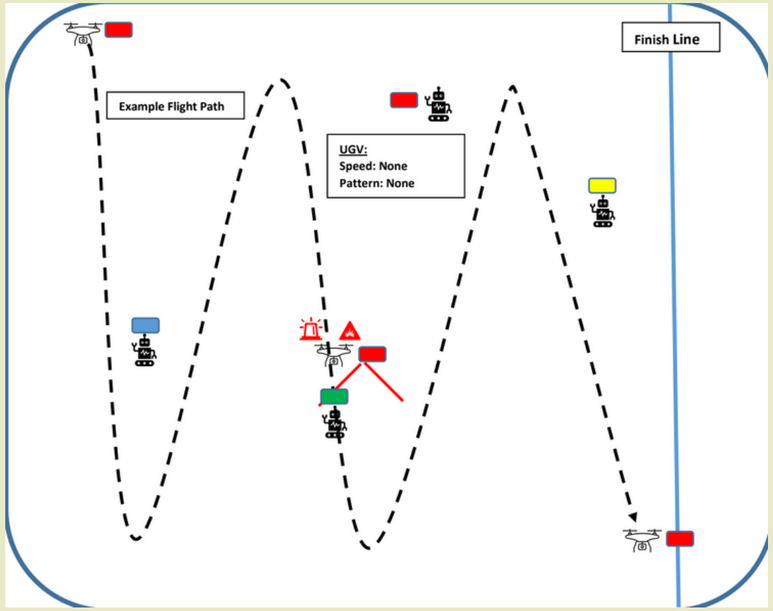
- Propellers
- Battery (with charger)
- Flight LED
- Camera
- Landing gear
- On-board Computer
- ToF sensor
- Barometric Pressure Sensor
- GPS
- Motors

DESIGN REQUIREMENTS

CONSTRAINTS

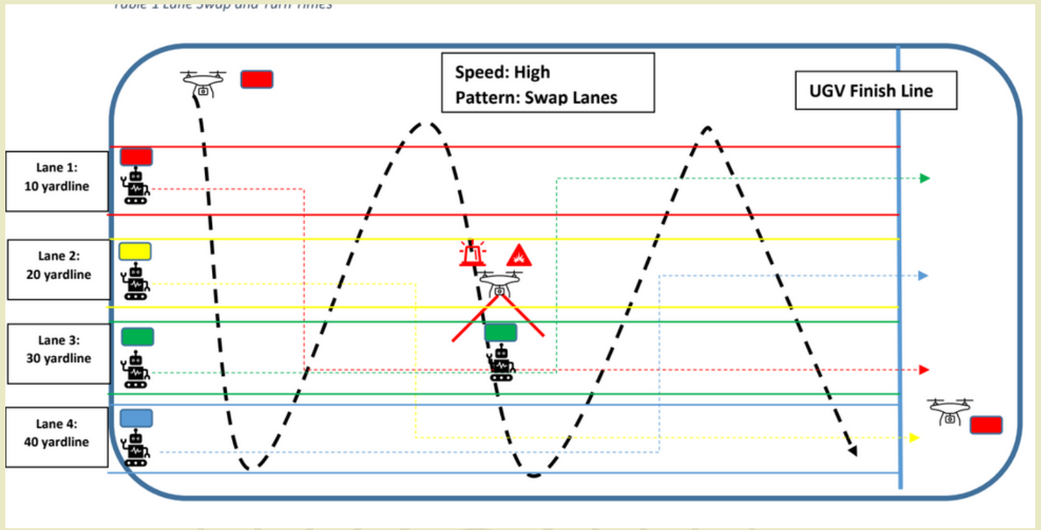
Battery Sustainability
Noise Liability
Privacy Concerns
Weight Limitations
Altitude Limitations
Region and Licensing Certifications

DRONE CHALLENGE



The UAV shall autonomously takeoff from the
designated location, search and deliver the Water Blast for the all the UGVs, except the UGV that is from the same school, then land in the designated landing zone within 10 minutes.

The UAV attempt to identify all UGVs then and deliver a Water Blast to them except the UGV that is
from the same school.



SOLUTION GENERATION: ALTERNATIVE SOLUTIONS

Alt Solution 1

The drone in the image above will have a flight LED/laser and a camera. The propellers will help our drone fly up from the landing apparatus when in motion. From the air, the camera will help detect which ground object is an ally or an enemy and will use the laser to single out the enemy target. The battery and the Ultrasonic ToF, the Barometric sensor, and GPS will hidden away underneath the drone to avoid unwanted outside elements. The Ultrasonic sensor will help the drone detect other objects/ drones in the sky, the barometric sensor will help the drone determine the altitude when in the air, and the GPS will help us track where the drone will be at all times. A remote control will be used if the drone ever goes off-course or is unable to direct itself back to the landing apparatus.

Alt Solution 2

The modern drone is a marvel of advanced technology and combines several essential components to achieve exceptional flight capabilities. Central to its design are four propellers powered by electric motors, allowing agile flight. The battery powers the drone and charges it efficiently. The Flight LED is equipped with a laser that harmlessly targets and tracks enemy Unmanned Ground Vehicles (UGVs) as identified by the camera. The high-resolution camera captures photos and videos and is crucial for detecting and tracking UGVs. The drone is equipped with a stable landing gear for safe landing and protection. The onboard computer (PCB) processes the data and coordinates the flight. Ultrasonic ToF and barometric pressure sensors ensure precise altitude control. The GPS technology enables precise location tracking, while powerful electric motors drive the propellers to generate thrust.

TOP DESIGN: PROS & CONS

Prototype 1:

+ Pros

- Lightweight
- Easy use
- Protected camera and laser
- Protected barrier for other parts

– Cons

- Weak stability in the wind
- No ease of movement for the camera or laser

TOP DESIGN: PROS & CONS

Prototype 2:

+ Pros

- Stable flight
- Accurate navigation
- Precise targeting

– Cons

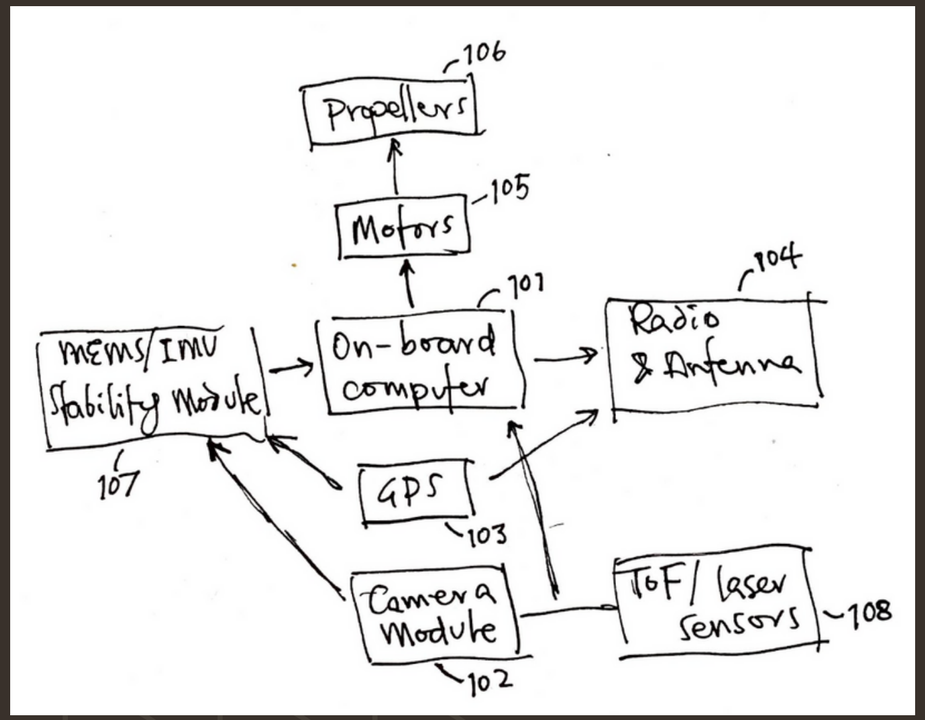
- Complexity
- Weight increase

TOP DESIGN: DECISION-MATRIX

	Wt	Design 1	Score	Agg Score	Design 2	Score	Agg Score
Functionality	5	Remote control	2	10	- GPS - ToF - Propellers Process	5	25
Connectivity	3	Bluetooth	2	6	Radio	4	12
Weight	2	Approx 4.2 lbs	5	10	Approx. 6 lbs	2	4
Power	4	Few devices to power	5	20	More Power needed	2	8
Convenience	1	- Landing apparatus - protective frame	3	3	OIS, MEMS, Landing	5	5
Total				49			54

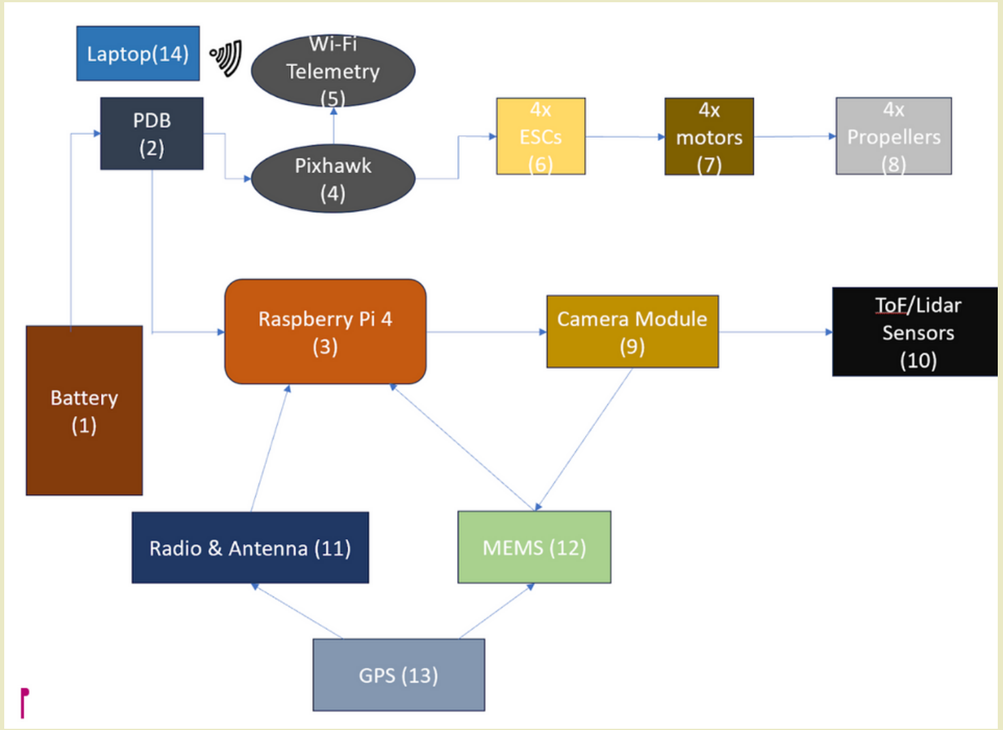
TOP DESIGN: DETAILS

The modern drone is a marvel of advanced technology and combines several essential components to achieve exceptional flight capabilities. Central to its design are four propellers (106) powered by electric motors (105), allowing agile flight. The battery powers the drone and charges it efficiently. The Flight LED is equipped with a laser (108) that harmlessly targets and tracks enemy Unmanned Ground Vehicles (UGVs) as identified by the camera (102). The high-resolution camera (102) captures photos and videos and is crucial for detecting and tracking UGVs. The drone is equipped with stable landing gear (107) for safe landing and protection. The onboard computer [PCB] (101) processes the data and coordinates the flight. Ultrasonic ToF (108) and barometric pressure sensors ensure precise altitude control. The GPS (103) technology enables precise location tracking, while powerful electric motors (105) drive the propellers (106) to generate thrust.



COMPONENT-LEVEL BLUEPRINT

Battery: The high-capacity battery is the heart of our drone, providing reliable power for extended missions.
Power Distribution Board (PDB) : This board is the hub for power management, ensuring that each electronic component receives the right amount of energy.
Raspberry Pi 4 : Serving as the onboard computer, the Raspberry Pi 4 executes complex algorithms for autonomous flight and data processing.
Pixhawk: The Pixhawk autopilot system manages the drone's flight dynamics, offering unparalleled stability and control.
Wi-Fi Telemetry: With this module, we ensure seamless data transmission and enable remote piloting capabilities.
Electronic Speed Controllers (ESCs): These controllers govern the rotational speed of each motor, providing precise adjustments to flight movements.
Motors & Propellers: Together, they generate the necessary thrust and lift, allowing the drone to soar to the skies.



COMPONENT-LEVEL BLUEPRINT

Camera Module: Our high-resolution camera offers vital visual data for navigation and detecting ground target.

ToF/Lidar Sensors: These sensors provide accurate distance measurements, facilitating obstacle avoidance and terrain mapping.

Radio & Antenna: This setup extends the drone's operational range, ensuring constant communication between the drone and the ground station.

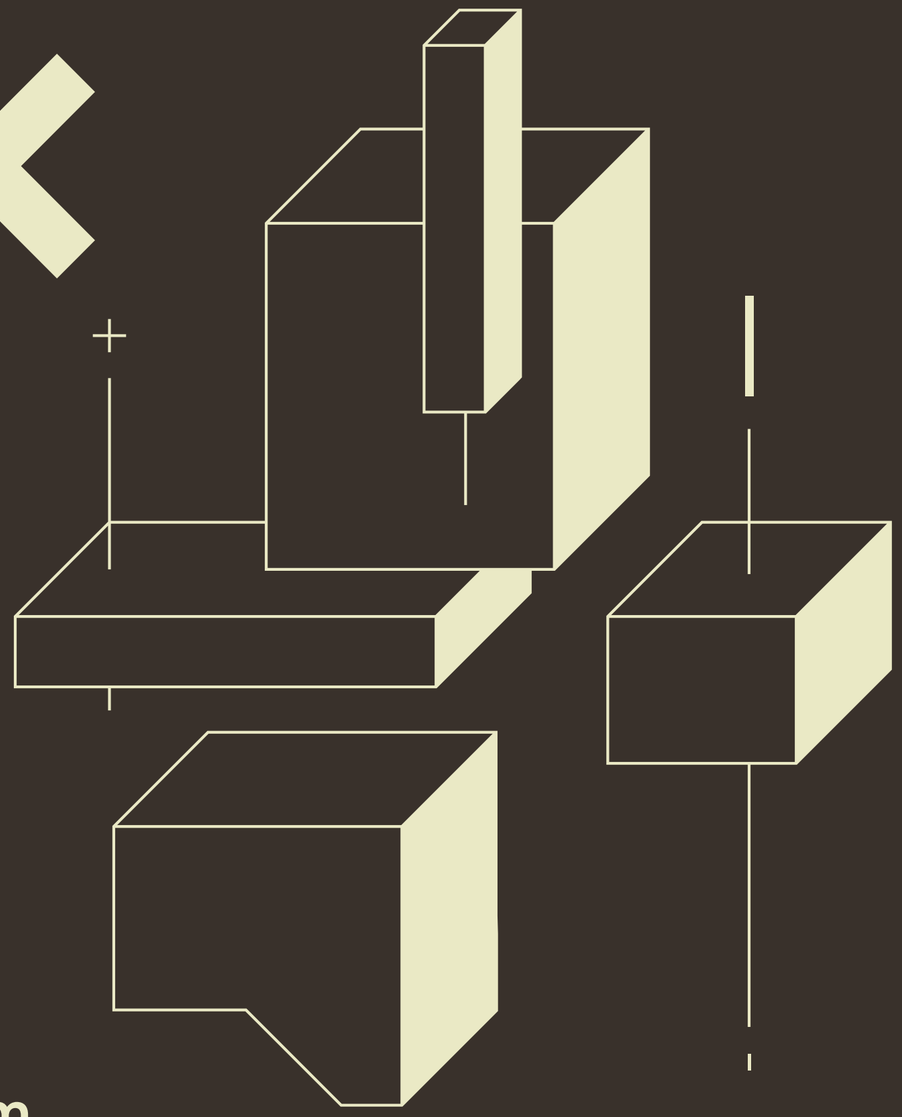
MEMS: These sensors are crucial for real-time orientation, aiding the Pixhawk in maintaining a steady flight.

GPS: Our GPS system is essential for precise geolocation, route planning, and coordinating targeted actions with the water jet mechanism.

Water Jet Mechanism: This mechanism is designed to engage and neutralize ground-based threats detected by our sensory network. Controlled by the Raspberry Pi 4, it can deploy a powerful stream of water to mark targets as needed.

IMPLEMENTATION

Dates	Agenda
11/27/23-12/4/23	Going over the Bill of Materials with Dr. Kim on ordering the required parts
12/4/23-12/18/23	Researching other UAV designs on determining how to deliver the water load.
12/18/23-1/15/2024	Downloading needed IDE. Researching software needed in the UAV(Python, Pihawk, or Raspberry Pi) Gathering information on obtaining the FAA drone license Working on gaining the drone license
1/15/24-2/5/24	Receiving needed components Building a functioning UAV Integrating need sensors and other parts Testing components for efficiency
2/5/24-2/19/24	Programming requires software Implementing required communications UGV Developing autonomy control Receiving drone licence(It take 6-8 weeks to receive the license)
2/19/24-3/4/24	Testing UAV flying capabilities Testing UAV camera capabilities Testing UAV delivery capabilities Resolving possible hardware or software issues.
3/4/24-3/11/24	Gathering feedback from Dr Kim and/or Dr Rawat Gathering feedback from the Raytheon Team
3/11/24-4/1/24	Making adjustments according to feedback received Ensuring no other issues occur before the competition



THANK YOU

UAV Team

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