



EMBER EYE

Wildfire & Coastal Search and Rescue UAV · Senior Capstone Design Project

MISSION OVERVIEW

The Problem

Wildfires and coastal emergencies leave responders without affordable aerial awareness. Manned aircraft are costly; consumer drones lack range and thermal capability.

Our Approach

Ember Eye is a fixed-wing UAV: 3D-printed modular airframe, CF skeleton, dual thermal + FPV cameras, onboard AI — under \$1,500, airborne in under 10 min.

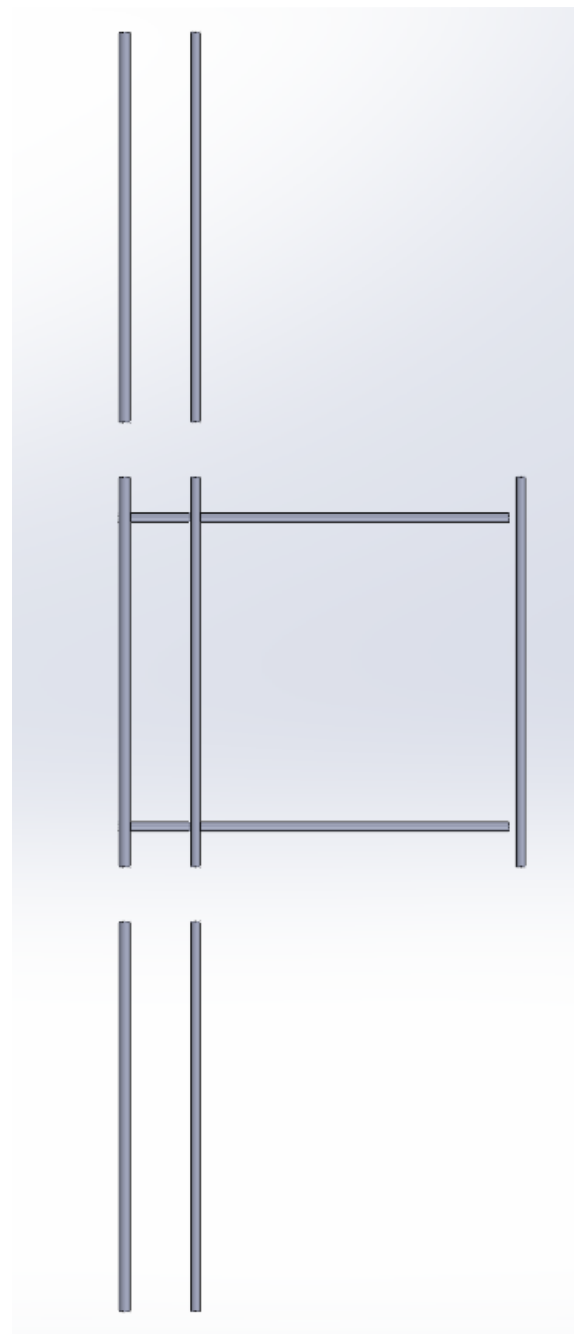
AIRFRAME DESIGN

Modular 3D-Printed Structure

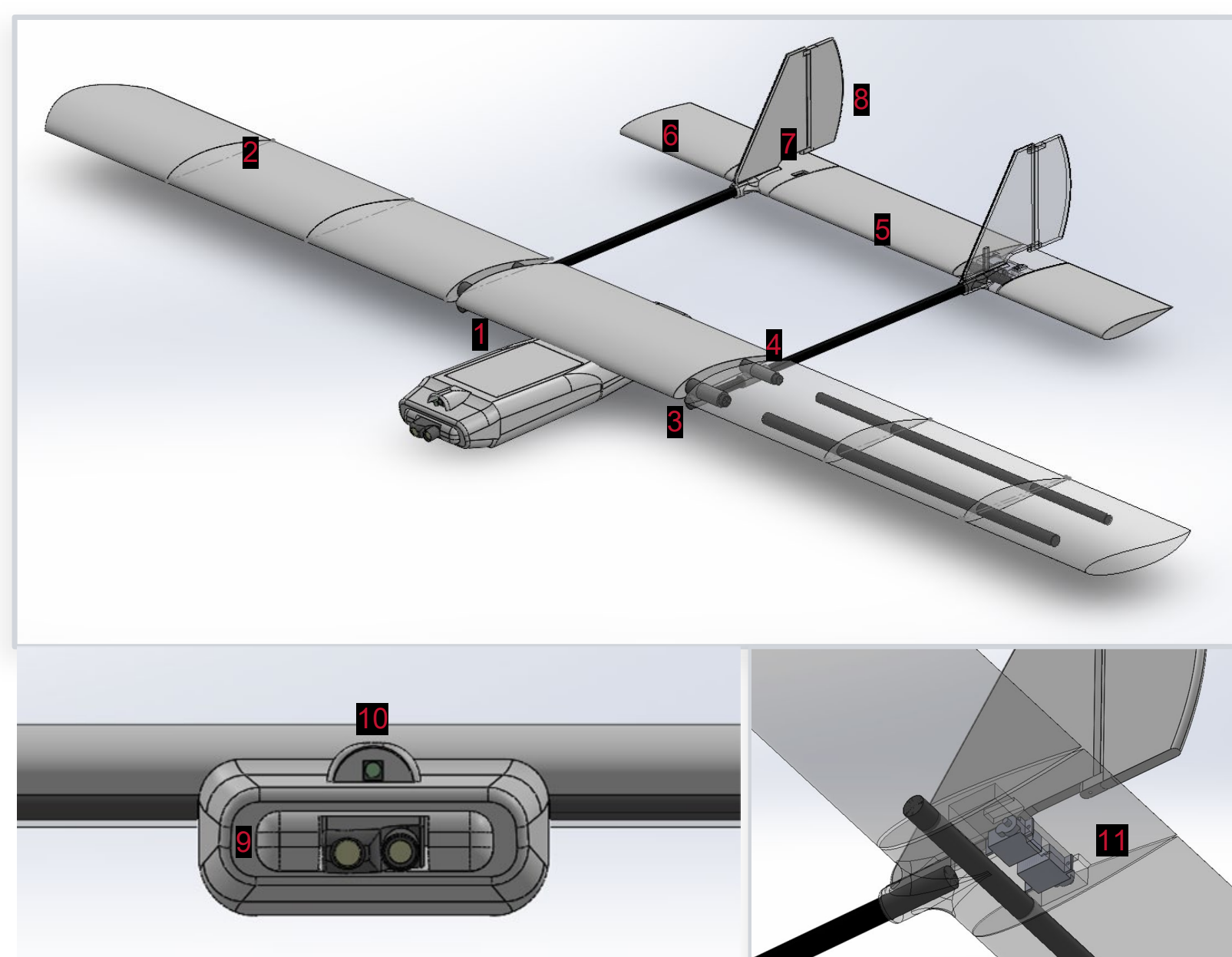
The fuselage pod, wing skins, boom mounts, and tail surfaces are segmented for standard FDM printers. This eliminates tooling costs, cuts lead time, and means any failed part can be reprinted within hours.

Carbon Fiber Load Path

Loads travel through a closed CF spar-and-boom box, bypassing the printed skins. Excellent torsional stiffness at low weight. Wing sections slide onto protruding CF rods for tool-free field disassembly.



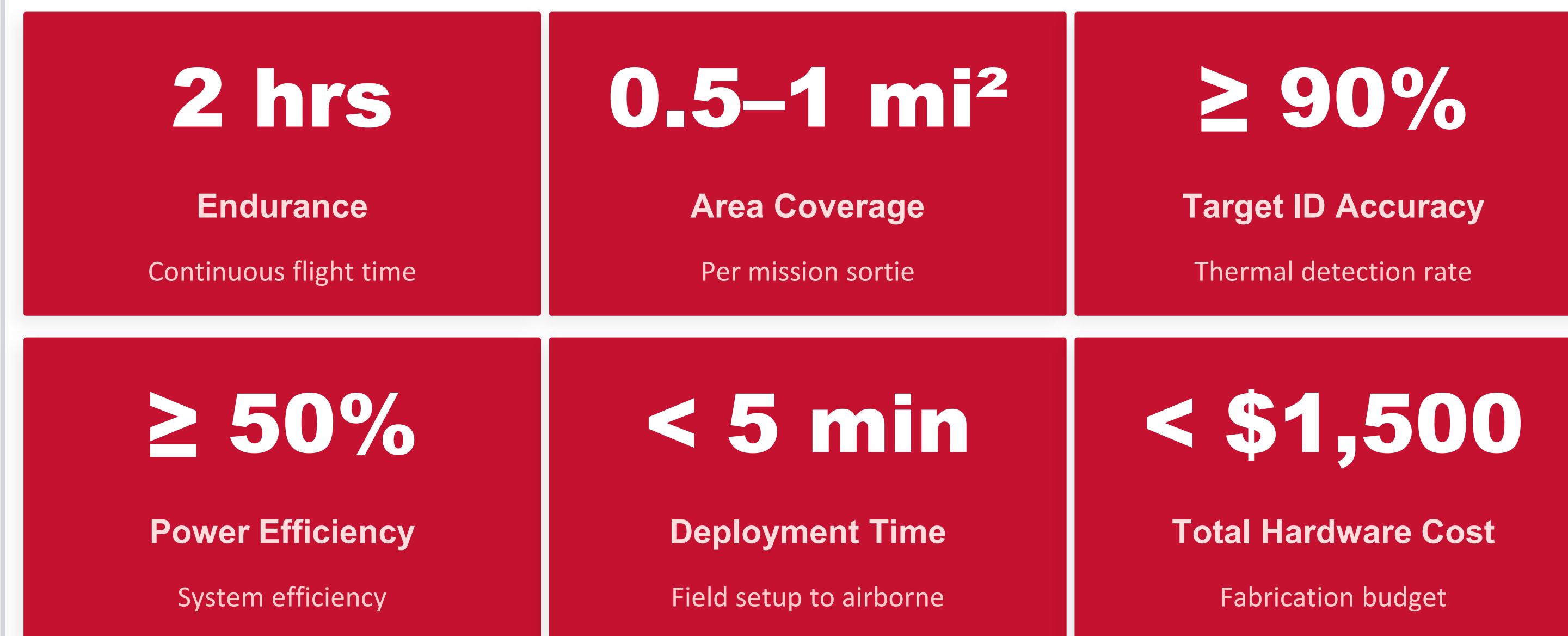
CAD MODEL — SOLIDWORKS ASSEMBLY



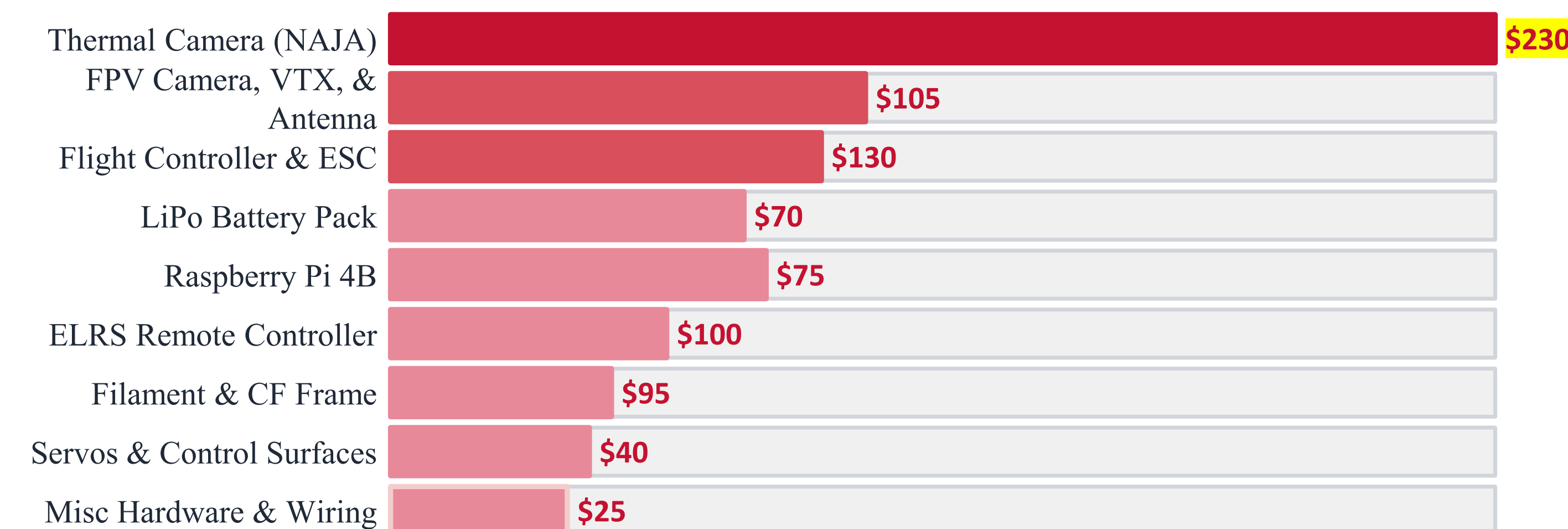
Legend

1. Fuselage
2. Main Wing; *NACA 4415*
3. Main Boom Connector
4. Small Boom Connector
5. Elevator; *NACA 0015*
6. Tail Fin; *NACA 0015*
7. Vertical Stabilizer
8. Rudder
9. NAJA Thermal Camera
10. FPV camera
11. Tail Servos

PROJECTED PERFORMANCE TARGETS



COMPONENT COST BREAKDOWN · TOTAL: \$870



Data & Analysis

Preliminary Performance Comparison

Platform	System Cost	Max Flight Time	Thermal Imaging	Deployment Time	Mission Advantage
Ember Eye	\$870	2 hrs	Thermal + FPV	< 5 mins	Low Cost, Long Range, modular, repairable
DJI Mavic 3	\$5,000	50 mins	Yes	< 30 sec	Compact, known brand, thermal capabilities
Skydio X10	\$20,000	45 mins	Yes	< 40 sec	Fast Deployment, obstacle aware, powerful camera

Prototype Iteration

Prototype Stage	Main Issues	Design Change	Expected Improvement
Initial ProtoType	Heavy wing structure and limited fuselage space	Reduced wing weight and increased fuselage volume for subsystem integration	Improved lift-to-weight ratio and internal packaging
Early Test Flights	Weak motor mount, limited control authority, unstable vertical tail response	Reinforced motor mount, updated tail servo layout, increased vertical stabilizer size	Improved structural rigidity, control response, and directional stability
Final Design	Internal Systems Layout & Battery	Reconfigured avionics layout and updated power system packaging	Faster assembly, cleaner subsystem integration, and improved test readiness

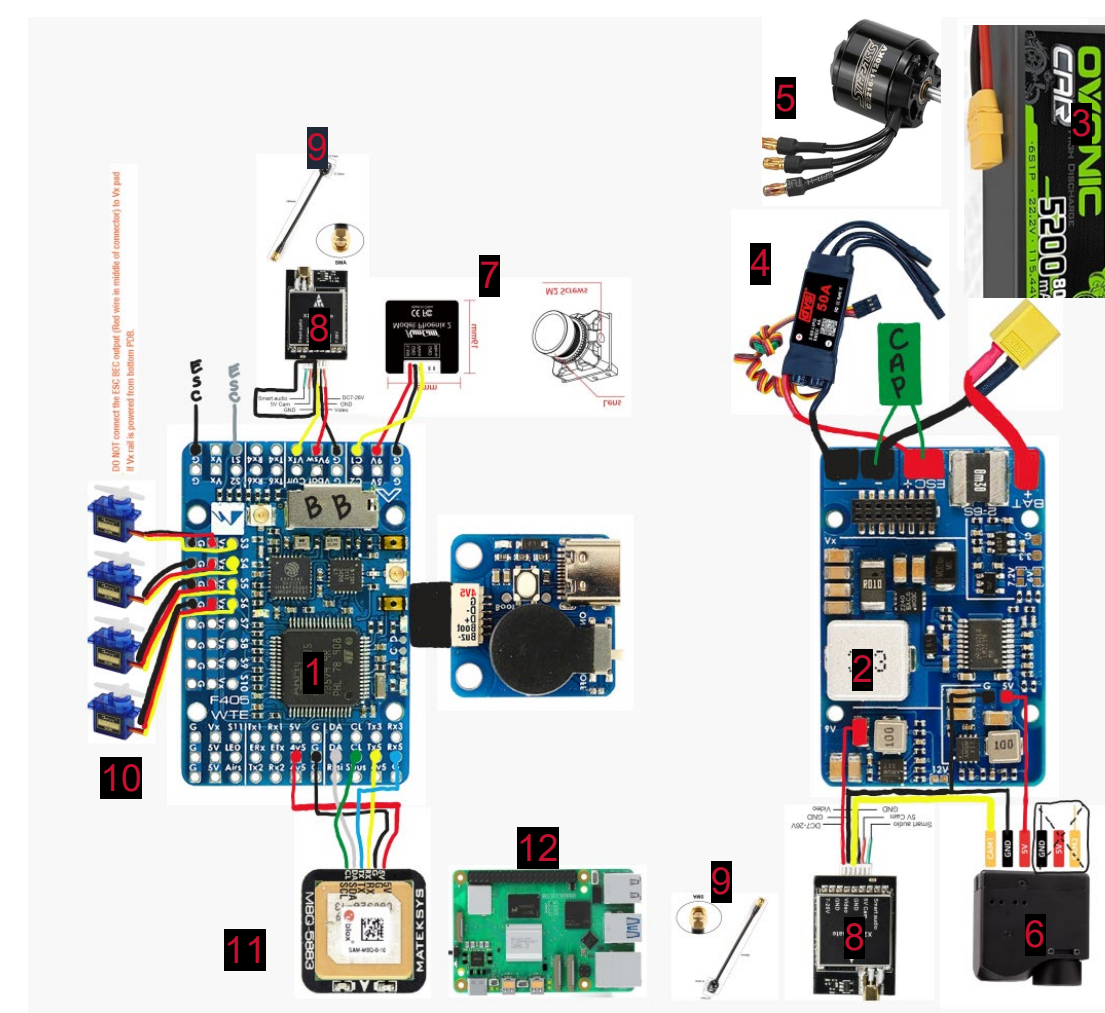
ELECTRONICS & AVIONICS

● Flight Controller	Matek F405 Wing V2
● ESC	DYS 50A 2-6s Brushless
● Motors	SunnySky X2212 1200 kV brushless
● FPV Camera	Phoenix RunCam 2
● Thermal Camera	NAJA Dual thermal Camera
● Compute Module	Raspberry Pi 4B (2 GB)
● Radio Link	ExpressLRS 2.4 GHz (ELRS)
● Power System	2× LiPo 4S 4Ah in parallel

Internal System Diagram

Legend

1. Mateksys Flight Controller
2. Mateksys Power Distribution Board
3. 5200 mAh, 6s Battery
4. 50A Electronic Speed Controller
5. 2112 1200kV Brushless Motor
6. Naja Dual Thermal Camera
7. Phoenix RunCam 2
8. AKK X2-Ultimate VTX
9. HGLRC Antenna
10. SG90 Servos
11. Mateksys Compass
12. Raspberry Pi 4



NAJA Dual Thermal Camera



The NAJA Dual Camera combines a high resolution optical lens with a thermal imaging sensor, enabling simultaneous day and night visual capture in a single compact unit. With our UAV integration, it provides real time thermal detection critical for wildfire monitoring, search and rescue, and target identification missions.



DESIGN TEAM



Brendan Scharmann



Hayden Schmehl



David Maturin



Andrew McGlynn

Aerodynamics, airfoil/ tail sizing & manufacturing

Structures, airframe, & tail boom sizing

Propulsion, power, & control surfaces

Team lead, Mission systems, payload, & fuselage

Aerospace Engineering · San Diego State University