

Aerial Backup Enabler

Aerospace Engineering Capstone Senior Design 2023-2024

Team Penny Pinchers

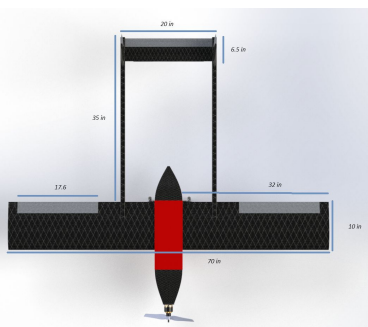
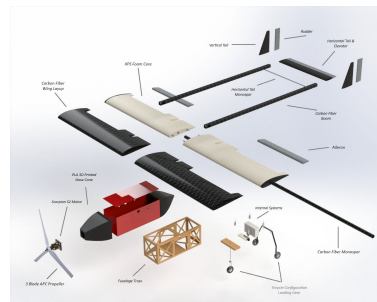
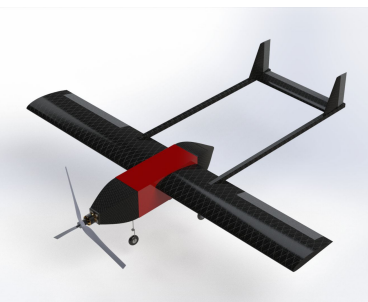
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 Section Instructor: Joseph Deneke
 Customers: Kevin Gitushi, Auston Gray, Michael Hughes, Tom Freeman
 Sponsor: Engineering Trust Fund

Design Solution

The goal when designing A.B.E. was to create a durable, easy-to-manufacture, and stable aircraft. The final iteration features a twin-boom, U-tail, tractor design. The structural rigidity of the vehicle is highlighted through the wings, booms, and tail. These components connect to become one rigid-body. A.B.E. comprises of a tricycle landing gear layout and open concept fuselage lined with Velcro, allowing the avionics to be modular for different mission capabilities. Assembling the UAS is a quick, easy process. From start to finish, it takes a two-person team less than five minutes with only four bolts to secure.

Specification	Value
AUR Weight	13 lbs
Wingspan	70.4 in
Aspect Ratio	7.2
Static Margin	7-8%
Thrust to Weight Ratio	0.86
Endurance	30 min
Range	20 mi
Cruise Speed	40 mph
Stall Speed	28 mph

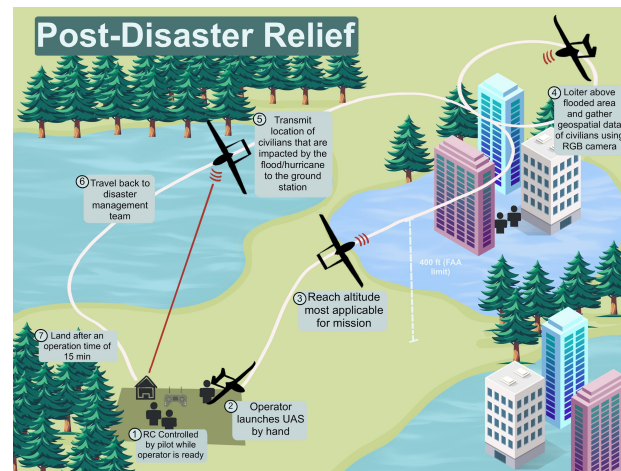


Project Overview

Our task was to design and manufacture a fixed-wing UAS that meets the following requirements:

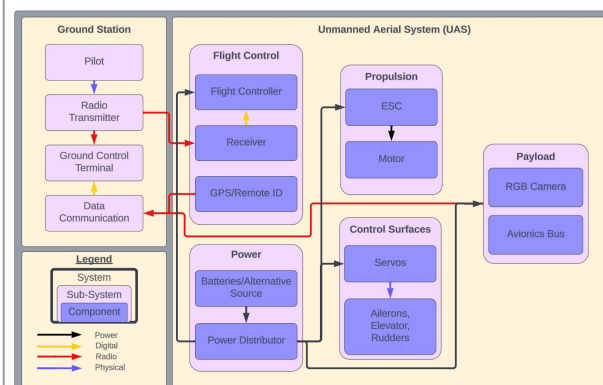
- 20 lbs or less
- Hand-launchable
- Fits within a 5'x3'x2' sedan trunk
- Controlled flight

CONOPS



Using the live video camera, operators can locate victims without putting search teams in harm's way. Hand-launching capability means A.B.E. can takeoff from anywhere.

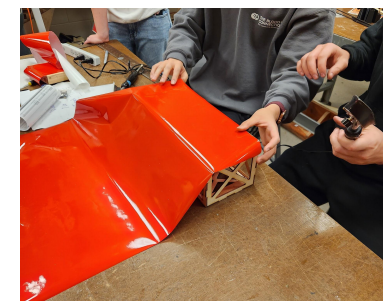
Functional Block Diagram



Flight Controller: Pixhawk PX4
ESC: 80A Brushless
Motor: 420 KV BLDC
Propeller: 14x7x3 (old)
Receiver: Spektrum AR410
Main Battery: 6000 mAh, 22.2 V, 6S2P
VTX Battery: 2200mAh 11.1V LiPo
Camera Suite: GoPro 8 (oblique) Runcam Mini (nadir)

Manufacturing

Manufacturing of A.B.E. began in December 2023 and was completed in February. The wings and horizontal tail are composed of an XPS foam core, cut with a hotwire CNC, with a carbon fiber layup skin. The fins are 3D printed PLA with a carbon fiber layup. Birch ply was laser cut and assembled in a truss structure to form the fuselage. The fuselage is wrapped and designed with Ultracote. The nose and tail cones are 3D printed with PLA and painted.



Flight Testing

We have conducted three flight tests, each with their own learning experiences:

- 22 March: Stall on takeoff, throttle not at 100%
- 26 March: Ground takeoff, tail strike lead to crash
- 29 March: Failed hand-launch, rough knock-it-off

Our next flight is 13 April where we expect to fly. Our new, bigger propeller combined with experienced piloting will ensure we can successfully take-off and complete our mission.