AeroZot: Design-Build-Vertical Flight (DBVF)

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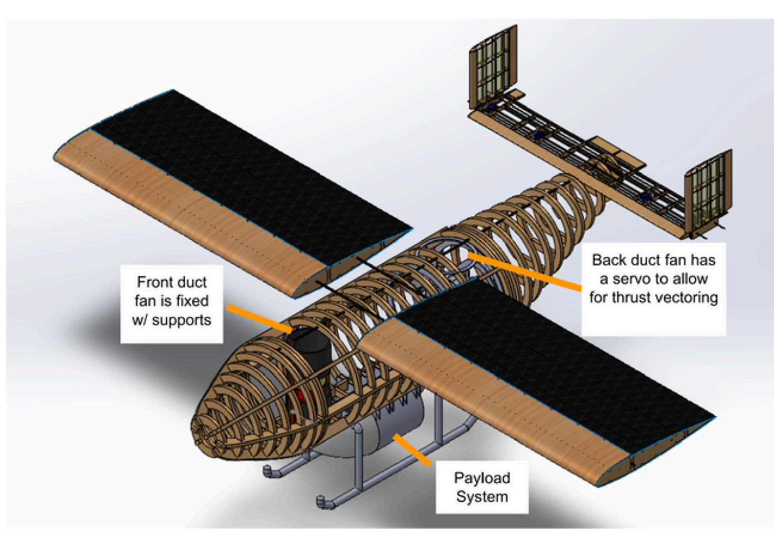
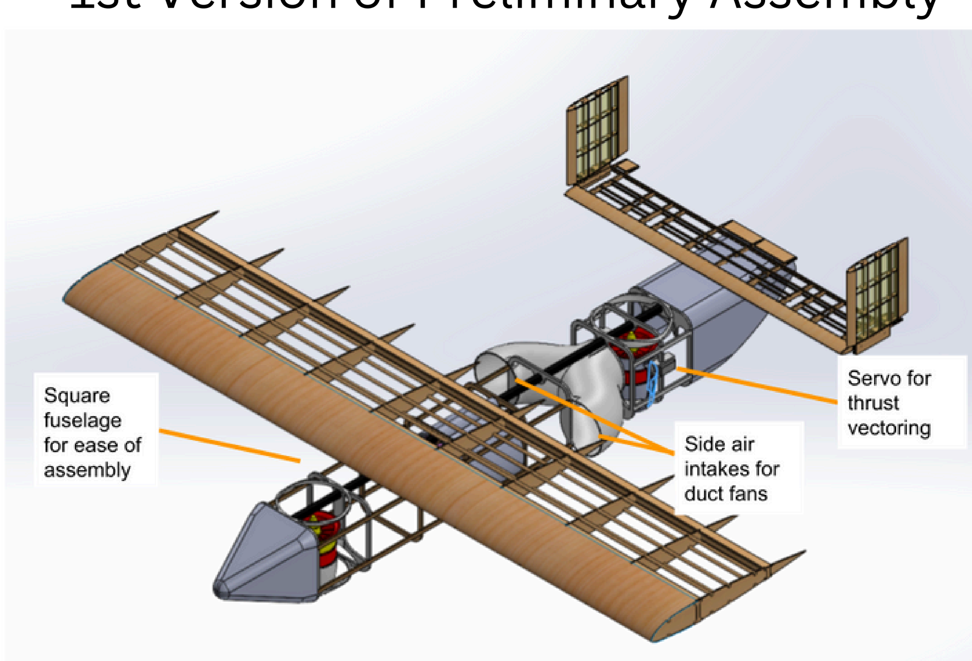
Executive Summary

- Project Objective
  - DBVF is an eVTOL (electric-powered remote-control vertical take-off and landing) vehicle competition students design, build, and test an eVTOL aircraft to meet an objective during a flyoff in Maryland.
    - This year's objective: Traverse a 1200-ft course with a payload system carrying 8-oz water bottles to be dropped inside waypoints of successively decreasing diameter.
- Design Solution
  - Our aircraft is the result of iterative design, inspired by the thrust vectoring of Harrier jump jets.
    - We integrated a ducted fan as well as the payload system within the fuselage for an efficient engineering solution.
- Overall Project Success
  - Our team achieved success in our project thus far despite the challenges of redoing our design completely from the previous year and having no elements that worked with our new design.
    - We completed a CAD model for our structure, our payload system, and our embedded duct fan propulsion system; all of which adhere to the restrictions put in place by the competition.

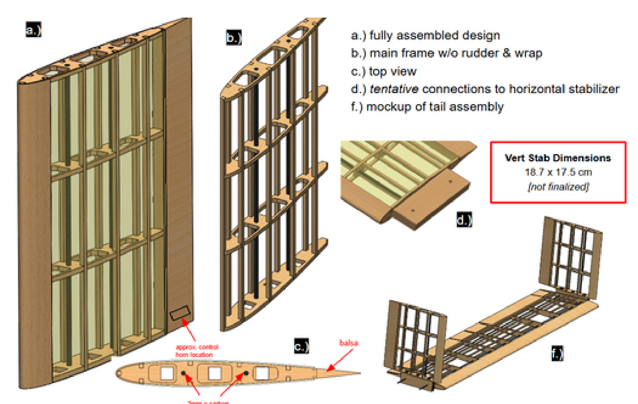


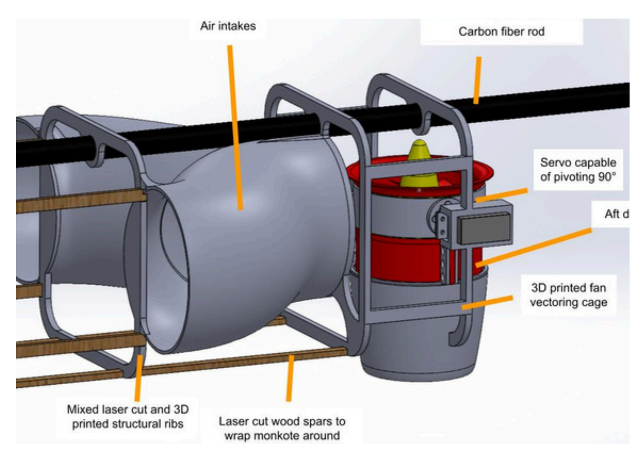
1st Version of Preliminary Assembly



2nd Version of Preliminary Assembly

Wing Design & Main Structure

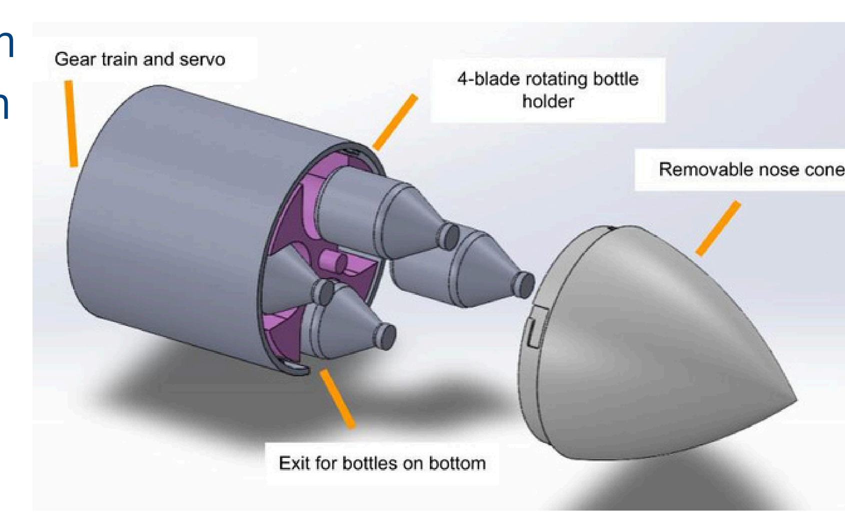




- Laser cut balsa and plywood fuselage designed to withstand our ducted fan system
- Design is reinforced with carbon fiber rods to reduce flex under heavy loads
- Monokote skin to create an aerodynamic surface
- Embedded duct fan system, designed to create static lift for VTOL and cruise
- Wings with ailerons designed to maintain and control roll and cruise flight trajectory
- Elevator and vertical rudders with associated stabilizers designed to maintain and control yaw and pitch axial control

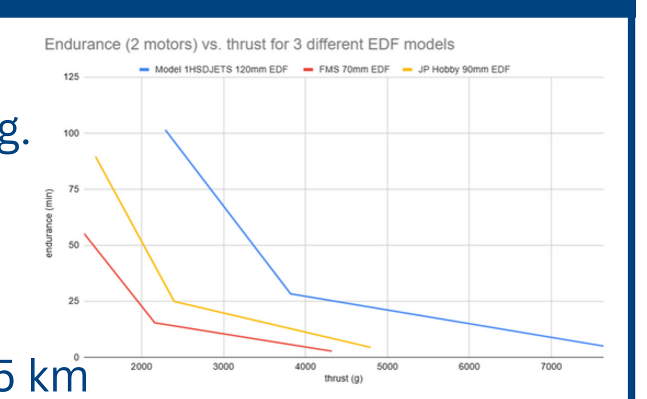
Payload

- 3D printed, lightweight, rotating barrel payload system
- Designed to maximize space, capacity, and to maintain center of mass balance after dropping bottles.
- A 5:1 GR gear train was implimented with a servo to rotate the 4-blade component on the inside of barrel with ample torque.
- Aerodynamic nose cone is removable with an interlocking cap to allow for efficient reloading.



Avionics & Electrical Hardware

- Key Features
  - Propulsion System: Dual 90 mm EDF fans with thrust vectoring.
  - Flight Control System: The Cube Orange
  - Operation: VLOS (Visual Line of Sight)
  - Endurance: 4 mins in hover mode
  - Communication Range: RC transceiver with a range of up to 1.5 km
  - Features GPS aided payload delivery for precise drop accuracy
  - Has built in fail-safe mechanism to ensure safe operation and landing in case of signal loss or system failure.
  - Has easily upgradeabe hardware components for future enhancements



Conclusion

- Proof of Concept -
  - Resources: ET Fabworks (laser cutters, 3D printers), funding to buy parts, faculty advisor, Recreational UAS Safety Test
  - Winter Quarter Timeline:
    - 1/14-2/25: Initial design phase (Sketches, complete CAD, assembly of components in full model)
    - 2/18-2/25: Brainstorm for ADR & FTR, create ADR poster,
    - 2/25-3/3: FTR writing, begin purchasing parts
    - 3/3-3/17: Prep for competition presentation, start fabrication
  - Spring Quarter Timeline

Testing & Refinements	3/18	3/31
Take Final Video	3/31	4/15
Mock Flyoff	4/15	4/22

- MAE 93:
  - Before MAE 93: Logistics (ex. organizing subteams, preliminary design sketch)
  - During MAE 93: Main design done, also fabrication, testing, and evaluation
- Future improvements -
  - Battery choice (more capacity => more endurance but less remaining weight)
  - Draw a preliminary sketch & consider requirements *before* designing
- Impact on society, safety or environmental considerations
  - The internally mounted ducted fan enhances safety, durability and protects against debris.
  - We minimized manufacturing waste with strict lb safety policies, ensured safe lithium-ion battery handling, and conducted flights with a Part 107 certified pilot.

References/Acknowledgements

- References - Multirotor Design Performance & Small Electrical Aircraft Design by Colin Sledge
- Acknowledgements
  - We sincerely thank Prof. Solmaz Kia for her invaluable guidance.
  - Special thanks to Colin Sledge for providing key resources that supported our calculations and design.
  - We also thank Gavin Fujimoto for his insights on aircraft fabrication and the resources that shaped our approach.