3D PRINTED AIRCRAFT COMPETITION

GLIDE OR DIE

SDSU | San Diego State University

MEET THE TEAM

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PROJECT OVERVIEW

This project focuses on the design and manufacturing of an ultra-lightweight aircraft for the 3D Printed Aircraft Competition. The aircraft is designed to be almost entirely additively manufactured, integrating structural components, mechanisms, and avionics into a lightweight, modular airframe. Competition flights consist of an 8-second powered climb followed by an unpowered glide, where total flight time determines performance.

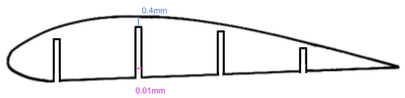
Our aircraft was developed with a focus on **extreme weight reduction**, **rapid design iteration**, and **efficient glide performance**.

MANUFACTURING

Material
ASA Aero — lightweight, tough, UV- and heat-resistant; foaming reduces weight while maintaining strength

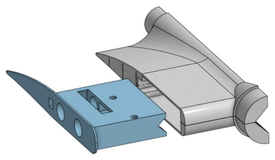
Printing Method
Vase-mode printing — single-path prints for ultra-thin, lightweight structures

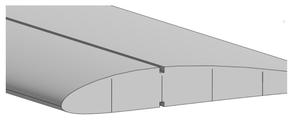
Key Structural Features
- Integrated spars — built into wings/tail for added stiffness with minimal weight
- CAD-to-print optimization — geometry directly translates into efficient print paths
- Hybrid composite parts — vase-mode shell + PLA internal reinforcement (bonded)
- Stringer spar (1 mm) — full-span spar increases rigidity and optimizes light weight



CAD Representation

Print Path Generation

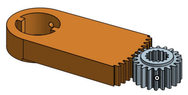




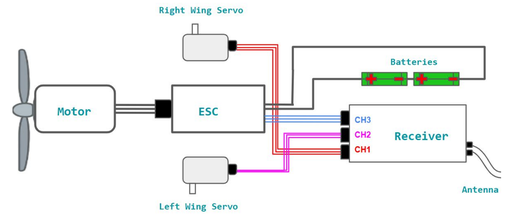
KEY MECHANISMS

Pitcheron Actuation System
- **Entire wings rotate** about the wing root to control aircraft pitch
- Servo + reduction gear drives rotation through the wing spars
- Eliminates traditional control surfaces, reducing weight and complexity

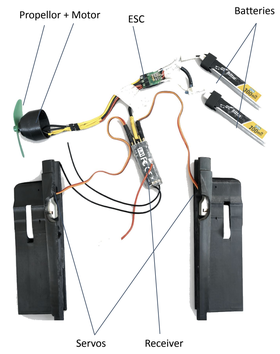
Slotted Gear/Spar Wing Rotation
- Slotted sector gear directly engages the wing spar to transmit torque
- Gear geometry allows controlled wing rotation for pitcheron actuation
- Integrated design provides compact, lightweight torque transfer within the wing root



ELECTRONICS

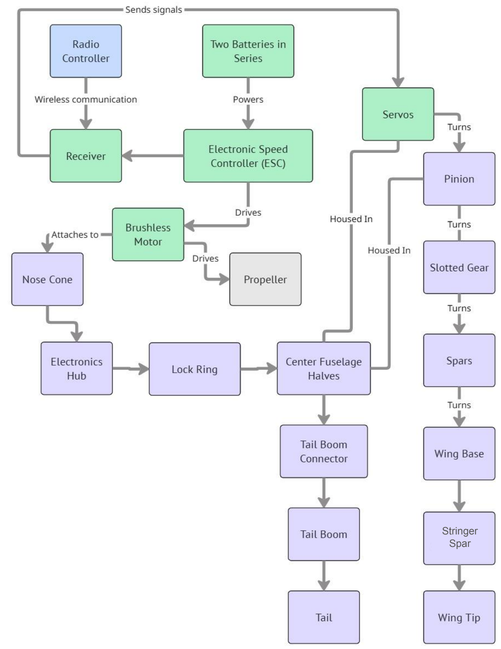


Electronics System
- Lightweight propulsion and control system including LiPo batteries, radio receiver, ESC, brushless motor, microservos, and connectors
- Receiver distributes control signals to the pitcheron servos (wing rotation) and the ESC (motor speed control)
- Enables both aircraft propulsion and flight control



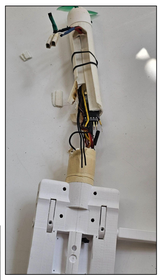
Mass & CG Considerations
- Total electronics mass: 33.26 g
- Batteries are the heaviest component (13 g total)
- Battery placement is adjusted along the fuselage to tune the center of gravity (CG)
- Moving the batteries forward or aft allows fine control of aircraft balance and flight stability

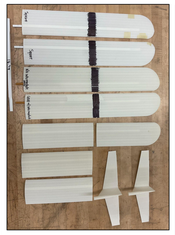
SYSTEM LEVEL DIAGRAM

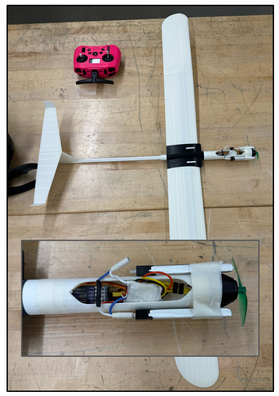


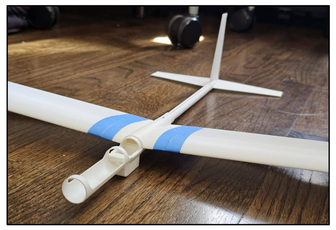
PROTOTYPES

Progression
- **Initial Concept:** Square wing design with taped assembly → transitioned to rounded wings and increased wingspan for improved aerodynamic performance
- **Electronics & Integration:** Nose cone redesigned into an integrated electronics hub with battery compartment and added finger slot for hand-launch capability
- **Control System:** Pitcheron system developed with fuselage-integrated gears; refined into a segmented gear reduction system embedded in the wing root
- **Structural Iteration:** Progressed from circular spars and wingtip reinforcements → square spars (later removed) → final 1 mm stringer reinforcement approach
- **Stability & Configuration:** T-tail implemented to improve flight stability and control authority
- **Manufacturing Evolution:** Eliminated tape through improved structural connections; introduced rubber band spar retention and modular assembly features
- **Weight Optimization:** Vase-mode printing applied to nose cone and fuselage; structural refinements reduced wing mass by 35 grams and fuselage mass by 31 grams
- **Component Refinement:** Servo spars redesigned as bonded composite-style structures for improved strength-to-weight performance

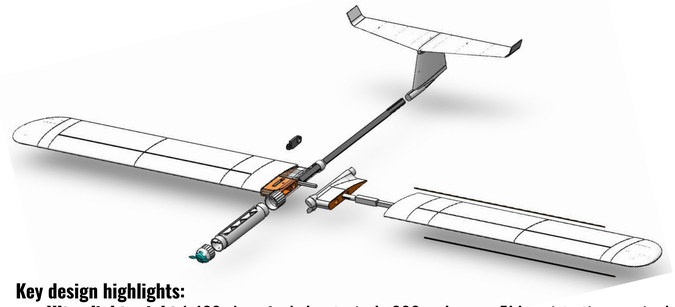




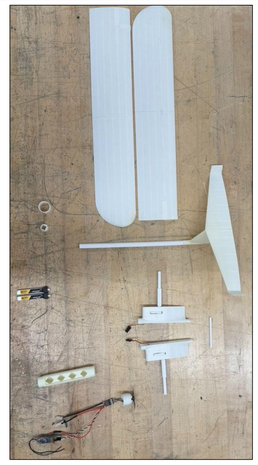




FINAL DESIGN



Key design highlights:
- **Ultra-lightweight** (~160 g) — far below typical ~800 g class; no FAA registration required
- **Modular** design — quick swap of wings and structural components
- **Micro wing spar** (1 mm) — minimal weight, optimized stiffness
- High glide efficiency — lightweight + **pitcheron** control system
- Sustained powered flight — endurance limited mainly by battery capacity
- ~90% **vase-mode** printed airframe — optimized for low mass and simplicity
- 1 meter wingspan



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