Summary Report

Team 9, FLY-WU

Objective

The objective of this report is to summarize the work done throughout the project and to provide a good overview of the design.

Mission Description

This year's Bronze propeller competition was to design "A Storable Semi-Autonomous Emergency Supply Aircraft." The goal is to build an aircraft which can accurately and autonomously deliver significant amount of supplies to the designated drop zone and complete 5 laps with the fastest time.

Team strategy

According the scoring rubric, mission time add up to more points in determining the final score rather than number of balls. Therefore, the team's strategy is to carry a smaller number of balls (4 balls) and fly fast. The estimated flight time is 72 sec flying at a speed of 60 ft/s.

Aerodynamics

The wing of the aircraft is constructed with NACA 4412 airfoil. The wing has a chord length of 8-inch, and a total span of 36-inch. This design generates a max lift coefficient of 1.11 and the maximum lift to drag ratio of 18.3. To reduce the structural damage while landing, the aircraft has a high wing configuration. The wing has a simple rectangular shape with no dihedral or sweep angle.

Structures

One of the major objective of this mission was to maintain the aircraft's weight. The aircraft needed to be light as well as strong enough to withstand the loads. As the material choices and options were limited; Balsa, Bass wood, lite plywood and coverlite were selected. The wing structure is designed with 2 spars, 1 is the primary spar which will carry 75% of the load, and the rear spar which is connected to ailerons. 15 ribs are used along the wingspan to make the wing stronger. The aircraft is designed to be a semi-monocoque structure. The final weight of the aircraft was estimated to be 2lbs with payload. The wing tip deflection was calculated to be 0.13 inches. The shear force on the primary spar was 5.7lbs and bending moment was 51.75lbs-inch. All joints are done using puzzle joints, which will interlock the structures together strongly, hence the use of epoxy can be minimized and can limit the weight from increasing. All parts are designed to fit in the carrier box and to have a fully connected load path up on assembling, with minimum number of parts to get the vehicle assembly done in 5 minutes.

Propulsions

According to the mission requirement the aircraft must fly at least two laps before dropping the payload and complete a total of five laps or more. An adequate propulsion system, which is an even balance between power and weight was required to meet the design and mission goals. To provide the necessary thrust to keep the aircraft airborne it is equipped with Great planes' Rimfire .15 35-36-1200 Outrunner Brushless engine. The design incorporates a pull propeller system and thus the propeller is placed at the front of the plane. The propeller used in the aircraft is EAPC 11x7 thin electric propeller. To maintain the power and control the propulsion system Castle Creations Talon 60 6S 60A HeavyDuty BEC speed controlled is used in the design. The competition has strict restrictions on battery selection, so in compliance with the requirements Venom Fly LiPo 3S 1500mah 35C UNI 2.0 Plug battery was selected to power the aircraft. Total propulsion system weighs about 0.7lbs and provides maximum power of 105W with 40A maximum current draw.

Stability and Control

To fly at a cruise speed of 60ft/s with the payload, high stability and control of the aircraft is required. To control the controlling surfaces, Futaba S3102 Aircraft Micro Metal Gear servo was used. Stability depends on the location of CG and the Static margin, which for the designed aircraft was found to be 7.2inch from datum (nose of the aircraft) and 12.89%. The stability of the aircraft at turns depends on Maneuver margin which for the designed aircraft was 8.65 inch. The control surfaces are made by laminating thin sheets of balsa and it is kept being simple rectangular plates for construction simplifications. The horizontal and vertical stabilizers are joined with tails by using a hinge and connected to the servos using connection links.

Dropping Mechanism

The aircraft is equipped with an Arduino chip mounted with a GPS module. The team decided to use the GPS module as it can read coordinates of any pre-defined plain. Arduino is programmed to sense the input signals given by the GPS module and trigger the servo. The servo is soldered to a plate which is connected to four legs with pins were the balls hang. When the servo gets triggered it will push the plate and move the four legs in forward direction. The pins will release the ball corresponding to the trigger and drop all four balls at once.

Conclusion

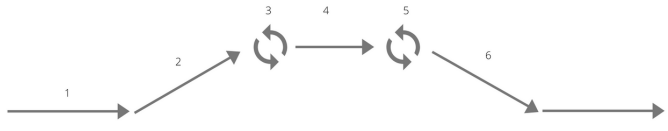
The aircraft has been designed to fulfill all the mission requirements with an effort to keep the weight as less as possible. The final weight of the aircraft was calculated to be 2lbs, including around 0.5lbs of payload weight. The vehicle was designed to carry 4 tennis balls as payload and was equipped with a dropping mechanism to drop all balls at once.

Mission

A storable semi-autonomous emergency supply aircraft.

Mission Profile

- Deliver,extract, assemble, install payload, pass structural check and hand launch within 5 minutes.
- Autonomous payload drop after 2nd lap in the target zone.
- Fly at least 5-laps
- Land successfully



1.Assembly **2.**Hand launch **3.** First 2 Laps **4.**Payload drop **5.** completing 3-5 Laps **6.**Landing

Team Members

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FLY-WU

Bronze Propeller Competition

Department of Aerospace Engineering

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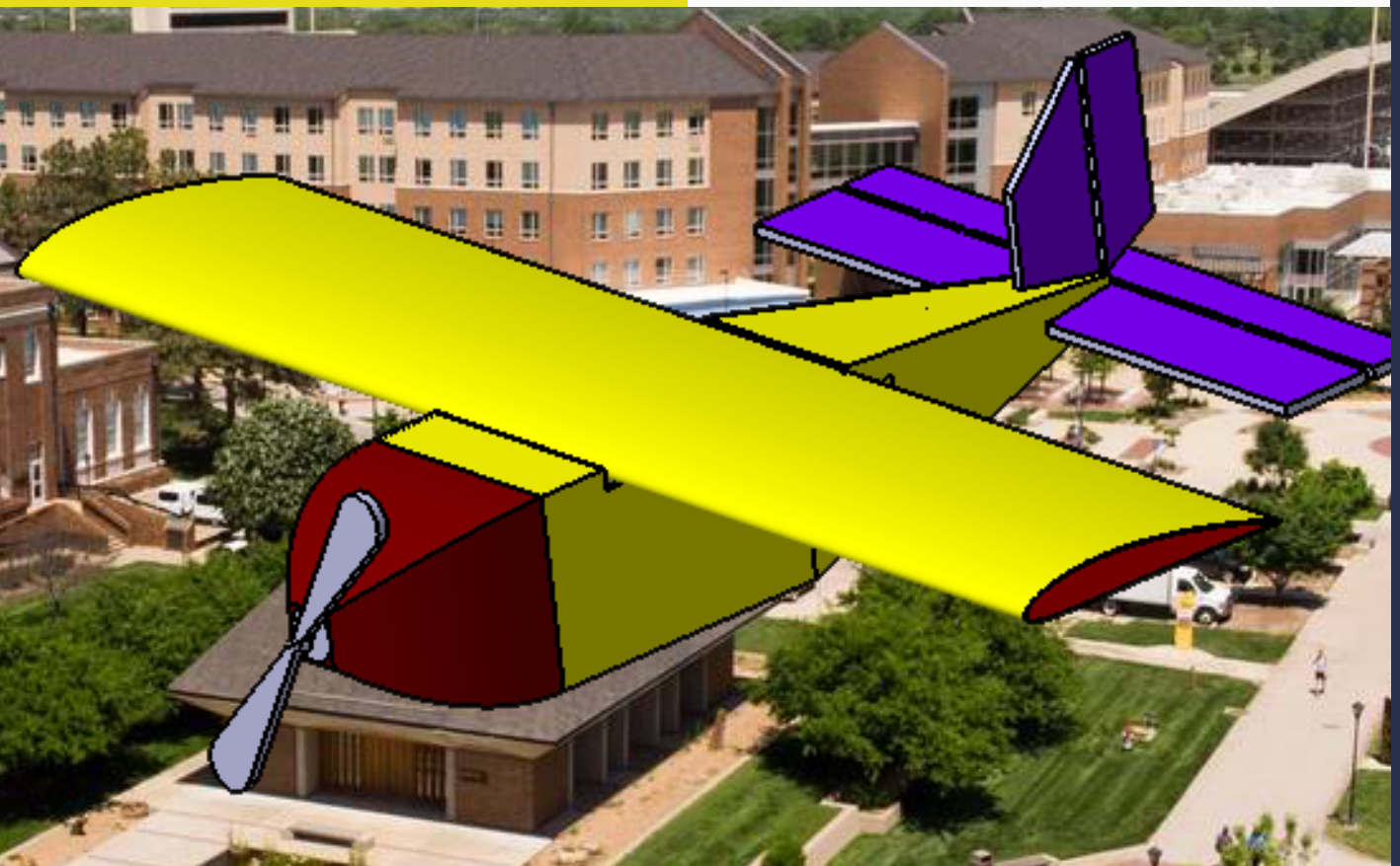
BOEING

Payload Dropping Mechanism

The Payload consist of tennis balls attached to hooks in the payload compartment. A servo is connected to the hooks to release the Payload.

Autonomous Release

The autonomous release mechanism consist of an arduino with a GPS module which will sense the location of the vehicle and trigger the servo after the second lap



Aircraft Overview

Dimensions

Wing Span	36 in
Wing Area	288 sq-in
Fuselage Length	25 in
Fuselage Height	5 in

Weights

Empty Weight	1.5 lbs
Propulsion system	0.7 lbs
Payload weight	0.5 lbs
Total Weight	2 lbs

Performance

Maximum Speed	80 ft/s
Cruise Speed	60 ft/s
Stall Speed	32 ft/s
Endurance	98 sec