College of Engineering
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Flying Squirrels

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Design, Build, Fly

I. Project

- Design: A payload aircraft to deliver vaccination components.
- Build: Various prototypes and ultimately the competition plane and its subsystems.
- Fly: Three missions as fast as possible, taking off within 25 ft
  - Mission 1: Fly 3 laps unloaded within 5 minutes; successful landing
  - Mission 2: Fly 3 laps within 5 minutes with syringe payload
  - Mission 3: Deliver as many vaccine packages as possible within 10 minutes

The mission scores are summed and multiplied by a design report score. The highest total score wins the competition!

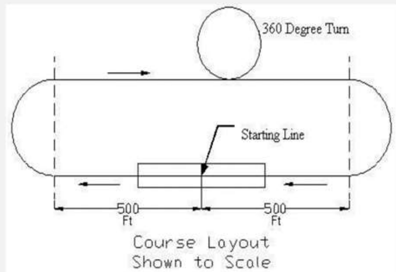

Figure 1

II. Methods

The team uses an iterative method to size the aircraft. The secondary design constraints of the aircraft are determined by the aerodynamic analyses in the preliminary design phase. The preliminary aerodynamic design focuses on the airfoil selection and flight speeds. The aerodynamic analysis begins with looking at the lift effect the airfoil shape has on the total lift the wing can generate. The dominant factor on lift is the camber of the airfoil. The team analyzes three airfoils to show which is best for the aircraft.

The team selects the Clark-Y airfoil based on the below analyses to accomplish the 25 ft. takeoff. XFOIL analyses also provide the drag coefficient at each angle of attack. Since the wing needs a high lift at the maximum lift coefficient, the drag is very low. In fact, it is lower than the drag of the other airfoils under similar conditions. This makes the Clark-Y airfoil the best choice for this aircraft.

The turning radii drop-off occurs as the g force increases. At high speeds, the turn radius is large to maintain the desired g force. Spreadsheet calculations assist in showing the relationship between the desired g force and the total lap flight time. The time saved per lap does not change significantly above 3 g's. The ideal flight range is between 35-55 mph. This range allows for variations in airspeed due to wind as well as for flexibility in further calculations involving airspeed.

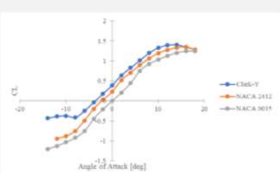

Figure 2

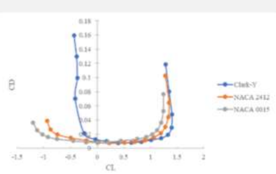

Figure 3

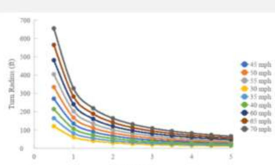

Figure 4

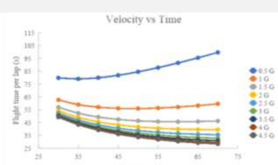

Figure 5

III. System Design

The team decomposes the structural design into several distinct components: fuselage (1), wings (2), empennage (3), nose (4), boom (5), motor mounts, and motor mounts (6). The fuselage is the main body of the plane, housing the delivery system, and providing connection points for the wings and tail.

The aerodynamic design focuses mainly on the take-off performance. The team identifies the 25 ft take-off distance requirement as the critical design point. By incorporating the necessary components to take off within 25 ft, the team is then able to trim the aircraft in flight to fly successful missions at the competition.

The electrical design focuses heavily on the propulsion and the static thrust. The requirements the aerodynamic team provide to the electrical team guide the thrust requirements. Due to the complexity of the calculations involved, eCalc, an online calculator, provides data, which testing verifies.

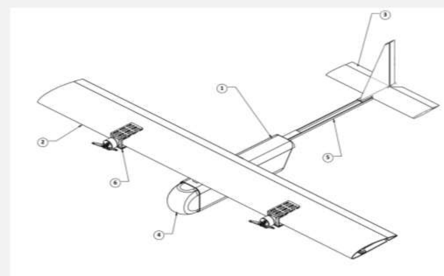

Figure 6

Figure 7

IV. Results and Conclusion

The team conducts several testing stages including four prototype planes. The design of the plane is iterated upon during each of these prototype builds. The differences between the initial design (figure 5) and the final product (figure 6) account for ease of manufacturing and corrected assumptions from design to reality. These changes include a solid boom and a foam nose and fuselage.

At the AIAA competition, the team shows that the aircraft can successfully complete Mission 1 and the Ground Mission. However, due to time constraints and high wind situations at competition, the team is not able to demonstrate successes on Mission 2 and Mission 3. However, the team remains confident that the aircraft can complete these missions should further testing be performed.