Career Episode 1

Design of Radio-Controlled Glider

A) Introduction

[CE 1.1]

Project: Design of Radio-Controller Glider

Duration: [Date] – [Date]

Location: [Location]

Organization: [Organization]

Position: Avionics Engineering Student

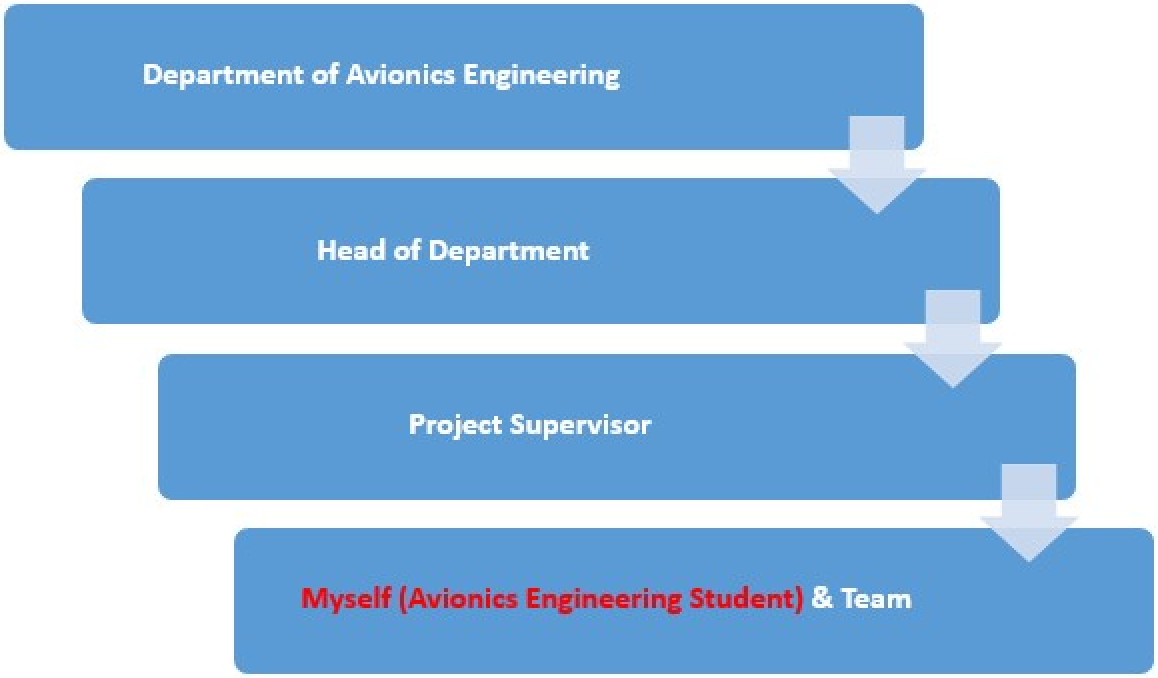
B) Background

[CE 1.2] In the research analysis, there was a radio-controlled glider specifically built with the designing and construction. Renewable energy was mainly obtained from the generator during glides, particularly when harnessing of thermal columns were done.

[CE 1.3] The work aim was designing of radio-controlled glider using composite materials with improved energy efficiency and lighter weight. The implementation of the system was done utilizing a duct-fan model and it enhanced airflow to the system. I carried out test flight measurements which indicated efficient battery recharging mainly obtained during glides. The implemented system can be executed in manned or unmanned gliders.

[CE 1.4] The project goal was designing a radio-controlled glider which was split into three distinct classes from advanced, regular, and micro. I placed the designed glider into micro class and the design was driven from the micro class requirements. I fit the aircraft and launcher components into a box with the set interior dimensions. I realized that the aircraft was needed to assemble within four minutes.

[CE 1.5]



[CE 1.6] Duties:

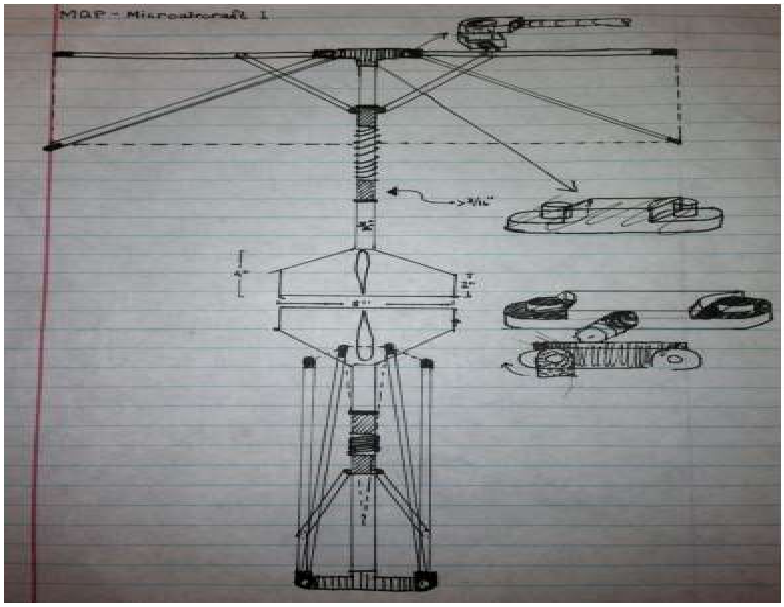
- I carried out prototype design implementation which was associated with the overall supporting wing area.
- I carried out multiple hand launches testing which was linked with the decent tail and the design proved to be adequate at lower speeds.
- I conducted the radio components weights setting which was based on the set specifications.
- I attained the sizing of the tail which was based on wing geometry determination associated with the aircraft sizing.

C) Personal Engineering Activity

[CE 1.7] I initiated the work with the research being made of the initial pushing for sizing limits obtained from the guidelines and it was due to the bigger wingspan and wing area which resulted in higher lift forces. The WPI entry was carried from a two-pound payload and decided to utilize the same payload as a baseline. I determined payload combination which was linked with the weight for building up a gross weight for input values acted as the minimum lift needed for flight in the lift. I decided that utilizing collapsible carbon fiber rods acted as a leading edge and it resulted in a wingspan of up to 2 meters. I initiated the prototype working which was supported with the total wing area of 1 sq.m with setting up the length to 1 meter. I obtained the design wing which is below:

I implemented the design which mainly focused on achieving the maximum possible payload via large wing area usage and with higher lift forces. I properly tensioned the fabric wing which proved to be the optimum aspect of the concept. I placed the carbon fiber ribs from the leading edge center to the corners and trailing edge midpoints mainly held for maintaining the rigid airfoil. I conducted multiple hand launches once a decent tail was obtained and the design was proved itself to be adequate even at lower speeds. The working was done for losses minimization of propellers with the appropriate duct-fan design. I worked on limiting the propeller dimensions and reduced blade tip losses which were efficient at obtaining the thrust at lower speed. I obtained the equally-placed notches which had direct link with the airflow towards the fan and it created a vortex with enhancing the air output speed. There was the lab test mainly yielded at 12% increment in wind speed at 75 km/h. A standard 5 blade fan normally utilized and provided insight for further turbine design.

[CE 1.8] I worked on the low weight design in which aircraft dimensions altered with a new target weight. I obtained the reduction in the wingspan to 0.5m and with an overall length of 0.5m. I realized that the fuselage was able to contain the needed volume of payload mainly attached to the body of the aircraft with electronic components mainly added for obtaining the final weight of 0.2kg. I drafted a new folding mechanism with the team which mainly tested fixed-wing launches for determining in case if the aircraft was able to withstand the launch forces.



I then decided that the advantages of the reduced drag did not offset the mechanism added weight and it was not counted on the final aircraft. I carried out the glider materials selection which was of composite nature and the benefits were mainly based on rigidity, higher strength, lower weight, and higher tolerance to corrosion. I evaluated the fibrous composite materials nature which provided higher fracture toughness degree. There were various fibers combination utilized like fiber-glass, micro-glass and Kevlar.

[CE 1.9] I worked on the design utilizing various tools. I attached the rail which mirrored the box top dimensions and was placed on the longest axis. I noted that the rail extended a few inches past the edge and the distance varied specifically depending on the tubing slack. I tied the spear gun tubing which mainly secured around two arms and it executed parallel to the guide rail. I assembled the pieces for setting 45 degrees' launch angle and it allowed specifically from set rules. I carried out launch shuttle designing for housing the aircraft fuselage and protected during launch from shock forces. I made sure that the design was as light as possible for maintaining the best energy for the launch. I carried out calculations specifically related to the aircraft size and analyzed the performance. I performed the process analysis which was based on the traditional design with the exception which specifically performed the applicable steps to gliders. I obtained the table which indicated the weight buildup for the aircraft and it was utilized in preliminary lift calculations. I set weights for all the radio components which were selected from defined specifications. I also calculated the material densities with the wings, spar, and fuselage values.

Component	Weight (g)
Tail	7.0
Receiver	2.0
Servo	8 x 2

[CE 1.10] I validated the glider concept in which I investigated the difference among the proposed design aircraft weight and conventional aircraft weight. I set the data for a 7inch propeller along with a motor which was of 18gm. I brought additional weights which were equivalent to 180gms and the enhancement in weight led towards an increase in wing size for obtaining adequate lift for carrying the new weight and it also added an increment in overall weight. I conducted an analysis in which a successful glider at set weight was based on the selection of the potentially higher flight score than the conventional aircraft. I decided on the wingspan of 0.5m for working around the aircraft fitting challenge within the set dimensions. I selected a 0.12m chord for maintaining the same aspect ratio for the design and resulted in a 0.07m2 area with an aspect ratio of 4. I also determined an estimated flight velocity for obtaining a lift coefficient and underneath equation was used for calculating the flight velocity:

$$V_{max,\frac{L}{D}} = \sqrt{\frac{2W}{\rho S}\sqrt{\frac{K}{c_{D,0}}}}$$

I measured logger which was followed with electro-mechanical parameters and it included glider speed, turbine, altitude, current consumption, voltage and power consumption. I obtained the glider output altitude which was linked with the angular velocity and speed of the propeller.

[CE 1.11] I set the unknown values in the equation which were K and CD,O along with the parasitic drag coefficient. I estimated the coefficient which was 0.07 and it was an appropriate assumption for most aircraft. I calculated the variable 'K' utilizing the underneath equation:

$$K = \frac{1}{\pi A R e_0}$$

I obtained tail sizing which was after the determination of wing geometry along with aircraft general sizing. It led towards obtaining the tails sizing and Raymer's Aircraft equation was used for obtaining variables mandatory for evaluating the equations. I set the horizontal tail volume coefficient with a vertical tail volume coefficient mainly estimated to be 0.6 and 0.03 respectively. I assumed values for a sailplane which were the closest estimation for the glider. I evaluated the aircraft stability during the flight which included two critical points calculation and these were the gravity center, neutral point, XCG, and XNP. I determined the center of gravity from:

$$X_{CG} = \frac{1}{M}\sum(W \cdot d)$$

I obtained the power expected which was linked with the gain and the time mainly needed to recharge the batteries. There was average glider speed attained in the test flight which was 16m/sec. For recharging the 10 volts' battery at the average speed, it took approximately 4 hours for recharging 1000 maH for fully recharge the glider batteries.

D) Summary

[CE 1.12] I scaled down the rectangular wing to the quarter of the set size and the semi-circular wing was scaled down to the third of its size for fitting in the cross-section area of the wind tunnel. I decided to move forward with the rectangular wing design with the higher aspect ratio and the best data output of the two was obtained during wind tunnel testing. Once I scaled down the aircraft to a 0.5m wingspan, it led towards concluding that the raw wing tunnel data was valid due to the fact that the model mainly utilized 0.5m. In the project, I did different wind tunnel testing for different attack angles utilizing the process obtained for the set data. I set the tunnel velocity to 5Hz and the velocity was selected due to the initial flight velocity calculation which specifically yielded 6 meters per second velocity. My knowledge in the avionics engineering field is specifically enhanced with achieving the desired results.