DESIGN AND FABRICATION OF A FIXED-WING UNMANNED AERIAL VEHICLE (FLYING-V)

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ABSTRACT

UAV is depicted as an ethereal vehicle that doesn't bring a human administrator, makes utilize of streamlined strengths to offer vehicle lift, can fly autonomously or be piloted remotely, may be expendable or recoverable, and may bring a deadly or nonlethal payload. It is managed both autonomously via way of means of on-board computer systems or via way of means of far-flung management of a pilot on the ground. A Drone has been constructed that may be operated via way of means radiofrequency controller. Microcontroller fundamentally based ramble control contraption has furthermore been utilized wherein an RF transmitter and collector working withinside the recurrence of 2.4 GHz is used for far off operation for the Drone. Prior, Rambles had been sent for naval force bundles such as spying on household and worldwide dangers. The fixed-wing designed UAV has diverse advantages like longer flight capability, large regions protected in much less time, higher exceptional photographic results, higher manipulation of flight parameters, better flight protection, and excessive variety and endurance.

KEY WORDS: Unmanned aerial vehicle, Lift, Transmitter and Receiver, Fixed wing aircraft.

INTRODUCTION

The Flying-V was truly sketched out by a understudy, Justas Benad, who worked at Airbus as an understudy. His unique conception associated two fuselage barrels into a V-shape together and putting a streamlined shell around it. after examining and approving the introductory plan of Benad, Dr. Vos accepted this unused V-shaped plane concept may gotten to be a reality. The huge reason for making this unused plane arrangement is fuel preservation. There are three things that make the Flying V superior than a typical plane when it comes to efficiency, it is 10% smaller than a normal airplane by means of the exterior range. That diminishes the grinding drag of the plane. It also has very large winglets that effectively increase the airplane's span, reducing the drag once again. And, thirdly, since we are conveying the weight along the side, we are too able to decrease the basic weight of the plane. The combination of these three angles decreases by and large vitality utilization by 20%. The scale appear of the Flying V is built from fiberglass composite texture with packages of carbon fiber for extra robustness. One of the foremost challenges was to keep the total weight underneath the coordinated 25-kilogram most noteworthy weight compel. This implied a few of the electronic components had to be built and planned by the group to meet both the fastidious plan criteria and directions.

DESIGN SPECIFICATIONS

- First, we consider the chord length (distance between the trailing edge and leading edge) = 14cm.
- Chosen airfoil= NACA 4412 (level foot sort)
- Airfoil thickness= 12 to 15% of the chord length= 12% of 14 = 1.75 cm.
- Wingspan= 5.5 times the chord length= 5.5*14= 77 cm.
- Aspect ratio= wingspan/chord length= 77/14=5.5.
- Fuselage length= 50% to 53% of the wingspan= 52% * 77 = 40.04 cm.
- Nose length(F1) = 35% of fuselage length= 35% of 40.04= 14.014 cm
- Fuselage height= 10 to 15% of the fuselage length= 10% of 40.04= 4.004 cm.
- Ailerons= 3/5 times the size of wing chord= 3/5*14= 4 cm.
- ROUGH ESTIMATION OF THE C.G

  =50% * chord length = 20 cm

WEIGHT ESTIMATION OF COMPONENTS

NAME OF THE COMPONENT	NUMBER OF COMPONENTS	WEIGHT OF THE COMPONENT
10*4.5 propeller	1	9.5 grams
2200 mAH Lipo Battery	1	176 grams
Tower pro SG90 Servo	2	20.18 grams
30A ESC	1	29 grams
Receiver	1	16 grams
3D printed model		658.32 grams
OVERALL STRUCTURE WEIGHT		909 GRAMS

TABLE 1.1

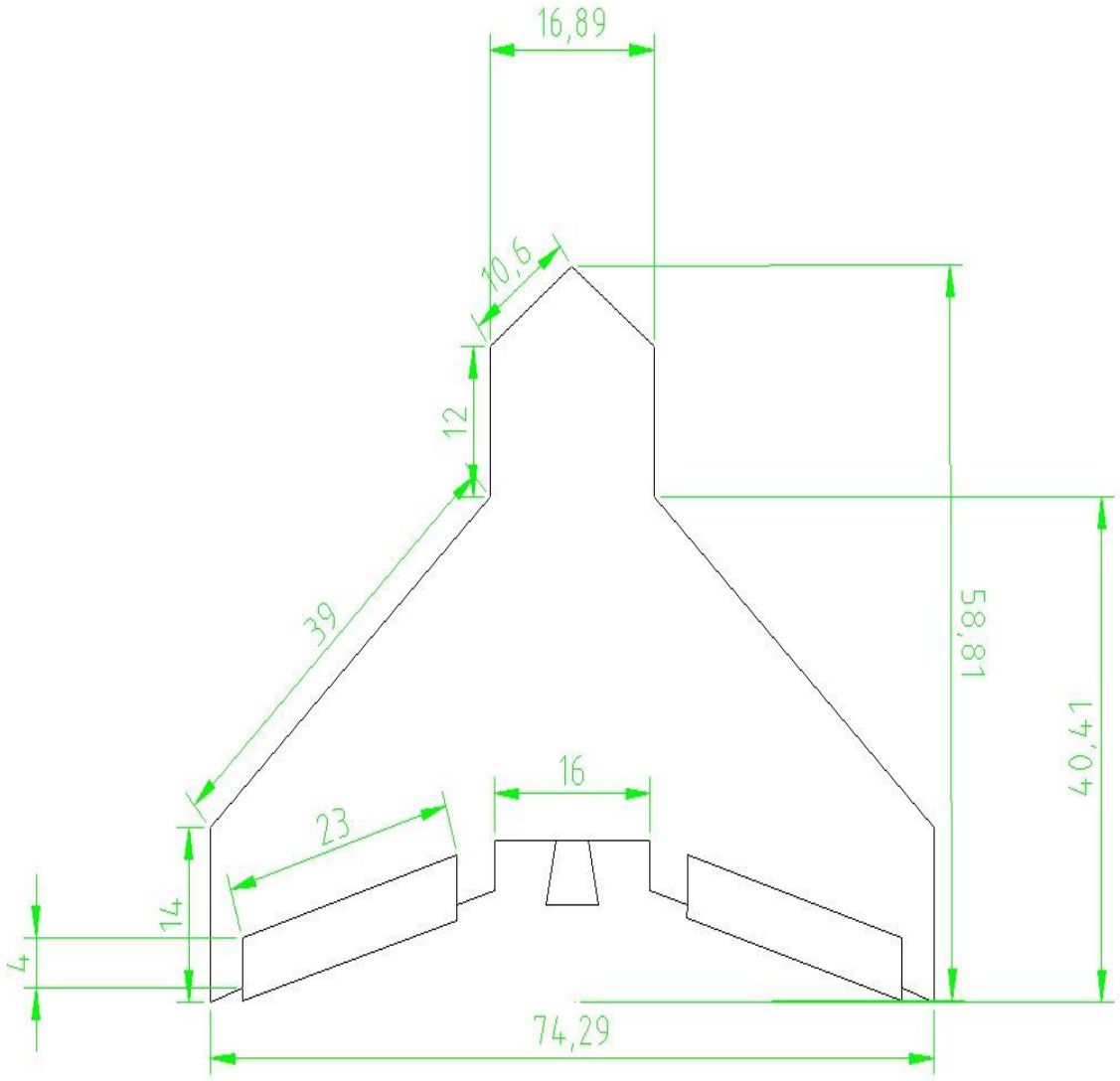

FIG 1.1 CAD DESIGN WITH DIMENSIONS OF THE UAV

COMPUTATIONAL DESIGNS

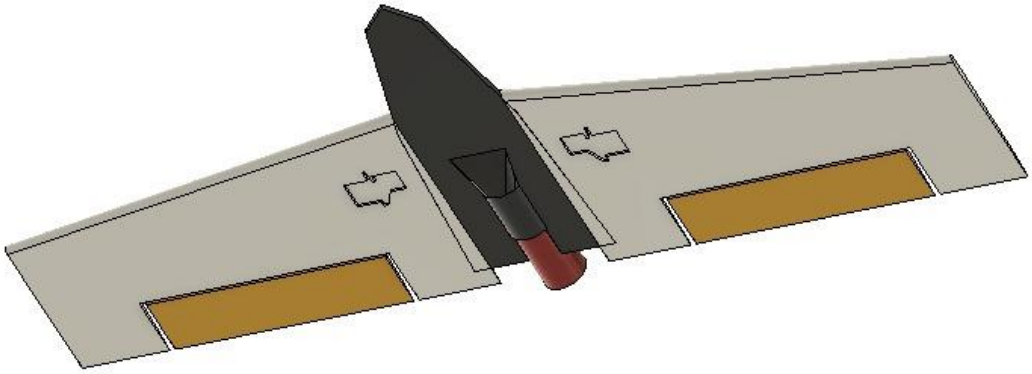

FIG 1.2 DOWN VIEW OF THE DESIGN DONE IN CATIA V5

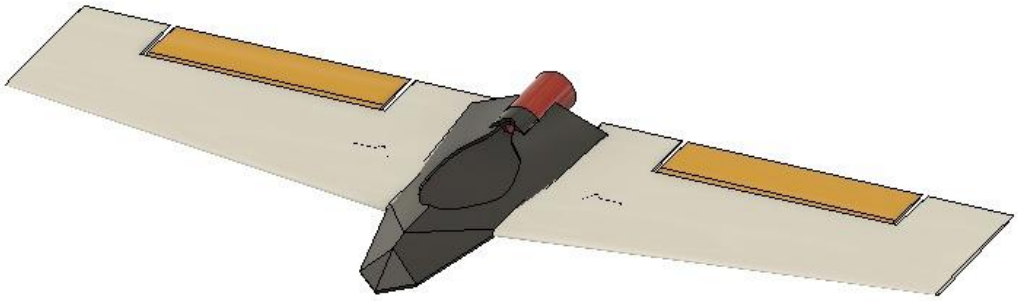

FIG 1.3 TOP VIEW OF THE DESIGN DONE IN CATIA V5

EXPERIMENTAL APPROACH:

Experimental setup

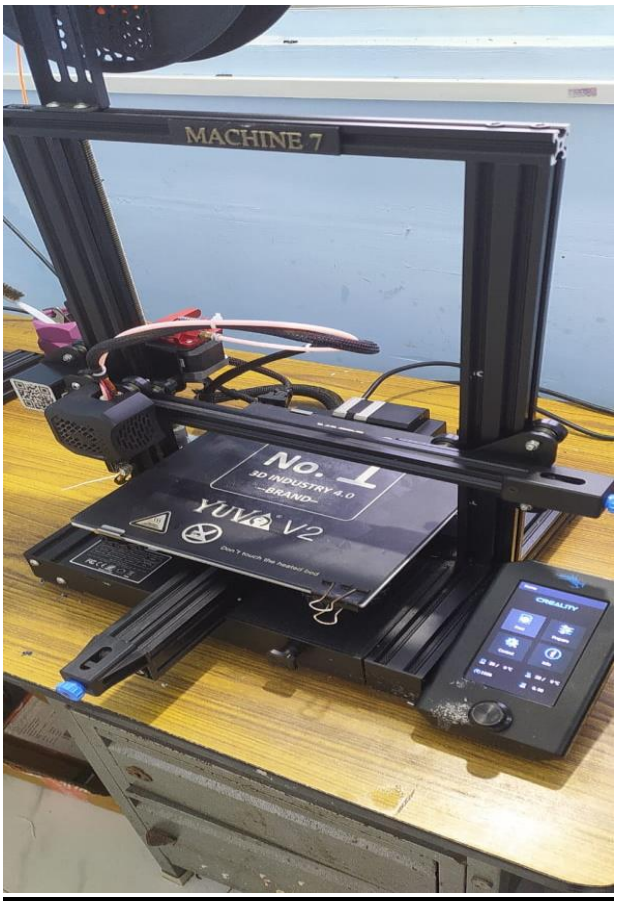

FIG 1.4: CREALITY ENDER V3 3D PRINTER USED FOR 3D PRINTING

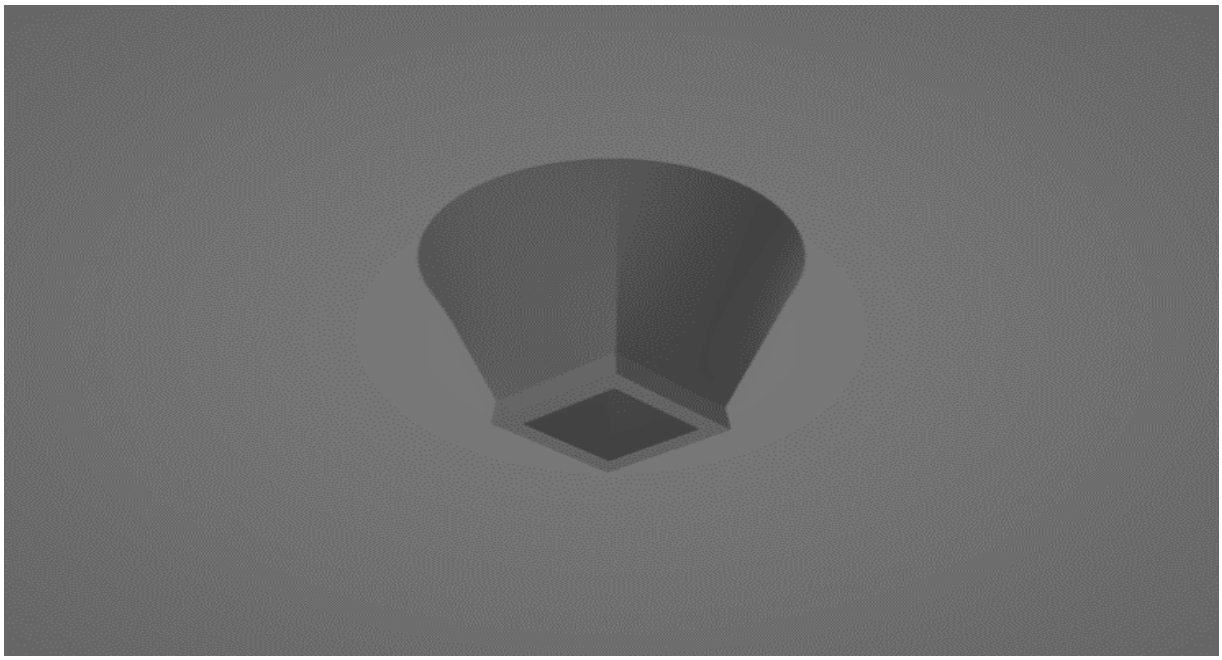

FIG 1.5: STL MODEL OF THE NOZZLE USED FOR CONNECTING THE MOTOR AND BODY

The body of aircraft we used is 3D printed model which can be flexible and less in weight. For this model we have attached Ailerons, servos, a 3D printed component joining the body and motor as an extension.

FIG 1.6 HANGING TEST FOR C.G OBSERVATION

We have used one 10*4.5 propeller with 9.5 grams attached to the Ready to sky 920KV motor which offers 0.5 kgs of thrust. And the Electronic speed controller called ESC's which weights 29 grams connected to it. And one 2200 mAH Lipo battery weights 176 grams, 2 tower pro SG90 Servo weights 20.18 grams and a receiver of 16 grams connected to each other to test run our flight. And our 3D printed model weight is estimated as 658.32 grams. And our total structural weight is estimated as 909 grams.

With all these components attached to our flight, we have tested the center of gravity of it as shown in above diagram. We have hanged it on our terrace, so its C.G is acted at middle of our flight. After C.G test we have tested how much thrust its producing while hanging itself. We have used 2 servos connected to receiver for working of both the Ailerons for change in direction and pitch and yaw changes. And finally, we test our flight like a Glider with our own hands to launch

it.

RESULTS AND DISCUSSION

FIG 1.7: NOZZLE 3D PRINTED FOR ASSEMBLING THE MOTOR AND THE BODY TOGETHER

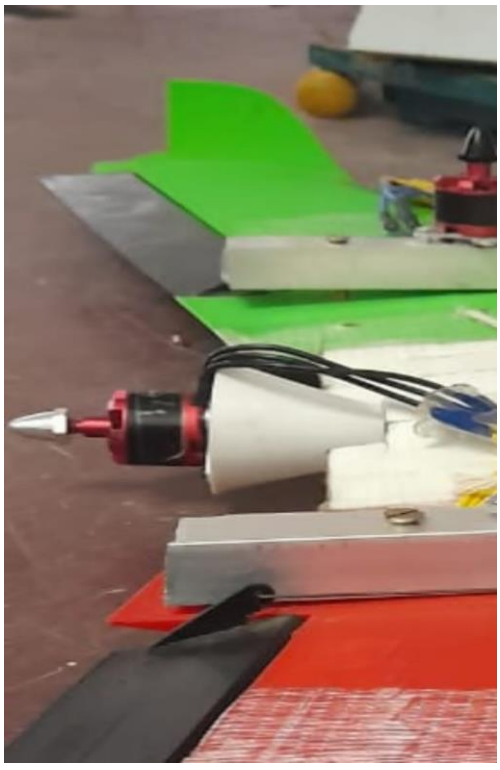

FIG 1.8: MOTOR ATTACHED TO THE BODY WITH THE HELP OF THE NOZZLE SHAPED CONNECTOR

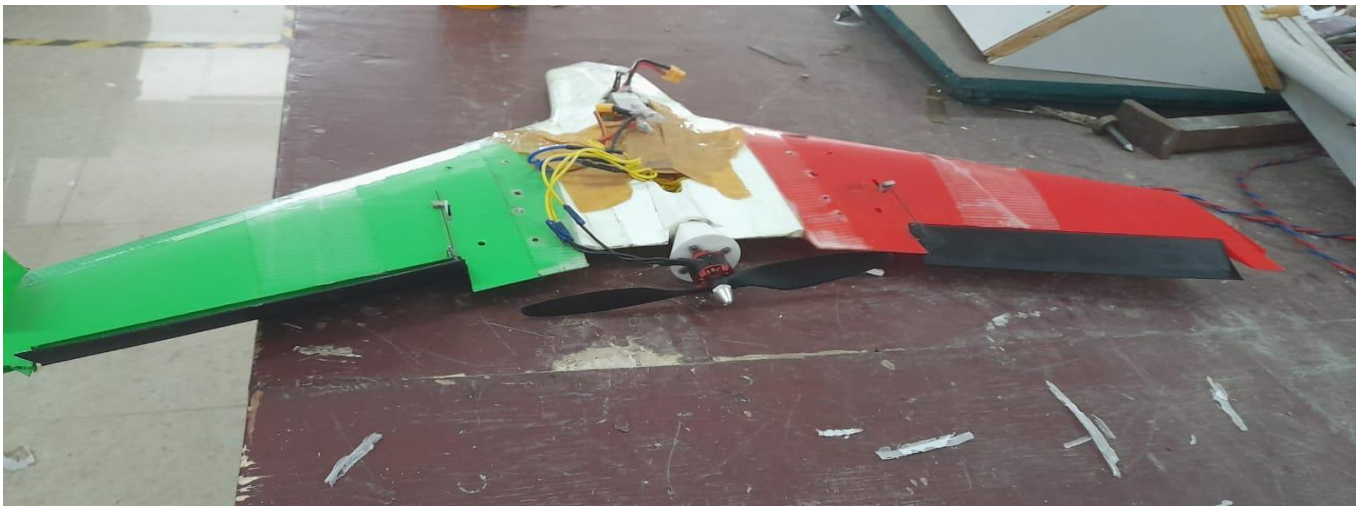

FIG 1.8: FINAL DESIGN OF THE UAV

FIG 1.9 LAUNCHING OF THE UAV

CONCLUSION

It has seen to have more smooth and steady flight compared to the other UAVs. The take-off and landing if planned and executed properly the flight path and the flight can be smoothly achieved with increased efficiency and range. More subjective contentions in support of the Flying V which can be determined are the compactness and straightforwardness of the setup (less parts, no high-lift gadgets, no fairings, straight lines) and the protecting of the motors from the ground (moo commotion). Exceptional is additionally the circular lift conveyance of the actually steady plan utilizing as it were a direct wing bend and no reflexed camber lines. A radio-controlled model of the Flying V was displayed in this work to illustrate these streamlined characteristics and back the estimations and re-enactments which were made.
A few proposals for future work on the concept are:

1. Plan of a structure essential to survey the mass nittier gritty
2. More point by point streamlined features calculations essential (wave drag estimation, 3D impacts, moo speed – $C_{L\ max}$)
3. Take-off and landing calculation fundamental (focuses of intrigued: take-off turn, bank points, motor disappointment, cross wind landing)
4. Common estimate and capacity of Flying V sort of airplane will be vital for advance ponders (family concept)
5. The take-off method has to planned properly in both the ways for runway take-off and also for hand-thrown model. If possible can also go for the slingshot method.

REFERENCES

1. https://www.slashgear.com/flying-v-drone-aircraft-conducts-its-first-successful-test-flight-08637144
2. https://thewest.com.au/news/aviation/fuel-efficient-flying-v-scale-prototype-plane-due-to-fly-in-october-2019-ng-b881219010z
3. https://www.jbenad.com/flyingv
4. https://www.ainonline.com/aviation-news/air-transport/2019-06-17/flying-v-concept-secures-klm-backing
5. https://edition.cnn.com/travel/article/flying-v-maiden-flight-intl-scli-grm/index.html
6. https://www.tudelft.nl/en/ae/flying-v/
7. https://www.equinoxsdrones.com/blog/10-major-pros-cons-of-unmanned-aerial-vehicle-uav-drones
8. https://www.aerospace-technology.com/projects/flying-v-aircraft/
9. E. Torenbeek, Synthesis of Subsonic Airplane Design, Delft, Zuid-Holland: Delft University Press, 1982.
10. D. Raymer, Aircraft Design: A Conceptual Approach, 3. ed., Reston, Virginia: American Institute of Aeronautics and Astronautics Inc., 1999
11. L. Errera, "Wikipedia Image: Airbus A350-900 XWB MSN 001," June 2013. [Online]. Available: https://de.wikipedia.org/wiki/Datei:Airbus_A350-900_XWB_Airbus_Industries_%28AIB%29_MSN_001_-_F-WXWB_%289087432464%29.jpg. [Accessed August 2015]