Electric Aircraft for Border Security and Fire Extinction

Arun Krishna[1,a)], Aswin P[2,b)], Nidheesh P S[3,c)], Sradha Biju[4,d] , Beena MVarghese[5,e]

[1,2,3,4]*Department of Electrical and Electronics Engineering, Mar Athanasius College of Engineering,Kothamangalam, Ernakulam, India*

Abstract: An electric aircraft commonly referred as piolet less aircraft with the capability to fly and stay airborne without recuring any human onboard operator providing most cost efficient operation than equivalent manned system and performing cost efficient critical mission without risking human life, also referred as Unmanned Aerial Vehicle (UAVs). Unmanned Aerial Vehicle can be remotely piloted, whereby control commands are provided from a ground base station through a remote control. The Unmanned Aerial Vehicle are capable of performing the control operation onboard through autopilot and different sensors such as CameraModule Sensor, RF sensor. These sensors can be used for the application of fire detection and border security.Wildfire are common phenomenon that occurs across the globe nowadays, hectors of forest covers are burneddown due to the fire. Effective detection and extinguish is a case of prior importance for the social ecosystem.Meanwhile social harmony is also been disturbed due to the intrusion of armies of other countries at the border. The software analysis of controller's used in Unmanned Aerial Vehicle with optimum sensors has been done using MATLAB. The hardware implementation of the same has been carried out as two parts: where the mechanical structure such as aerofoil, fuselage and wing has been designed and analysed using Solidworks. Electrical components are arranged as per the applications required. The Electric aircraft has been tested to achieve 60m height and the dropping mechanism has been tested to establish the applications required.

INTRODUCTION

Unmanned Aerial Vehicles (UAVs) provides the ability to perform a variety of experimental test of systems and unproven research technologies, including new autopilot systems and obstacle avoidance capabilities without riskingthe lives of human pilots. A fixed wing UAV was constructed using variety of materials and manufacturing processesfor the testing Integrated systems. The aircraft is designed for high volume and high weight payloads so a variety of experimental systems.

An unmanned aerial vehicle (UAV), commonly known as a drone, as an unmanned air vehicle system (UAS), orby several other names, is an aircraft without a human pilot aboard. The flight of UAVs may operate with various degrees of autonomy either under remote control by a human operator, or fully or intermittently autonomously, by onboard computers. Now a days there are wide ranges of applications where UAV or drones are being used. Most of these includes military and commercial surveillance, search and rescue and most importantly in research purpose. Socurrently a large amount of focus is given on the development of UAV structures for better performance, maneuverability, stability during operation. Keeping these facts on mind current focus is to analyze the performance of high lift airfoil and select the best suitable airfoil for UAV, designed with high lift coefficient, low Reynolds numbercharacters to perform military and research based operations. This research will lead the UAV researchers and commercial producers to design and fabricate advanced UAVs with vast range of sophisticated works.

The growing interest in research of UAV, equipped with increased payload, shortened take-off and landing distances and lower stall speed, has created a need for the comparative analysis of performance of different high lift airfoils. A reasonable selection of high lift low Reynolds number airfoil is very important part of aerodynamic design process for this kind of low speed UAVs. As a result, performance analysis and comparison of high lift airfoil for low speed UAV, has earned an enormous importance in modern day Aerospace Engineering. The methodology of this research will be useful in further development of the research of aerodynamic characteristics of high lift airfoil.

Electric aircraft is an UAV model that has a structure to fly in greater speed compared to the other UAVs, this advantage of the system can be used for various applications that requires a quick response. The system designed canbe used for various application such as Area mapping, Border Security and Fire Extinguish. In area mapping the cameras that are incooperated into the system can be used to capture images of a region which is then been introducedinto mapping software's such as QGIS that can provide detailed and precise maps of the area.

For border security application the computational power of the existing camera circuits are altered for quick capture and transmission of the data. Also this models can be designed as aircraft models and when operated above 121 metrescan be used to mimic as enemy aircraft models so that at instance sight the model is not been analysed by the enemies.The fire extinguish circuit under slight modification can be used as carrier of weapons that can add the extra dimensionfor border security.

Electric aircraft are also used for the detection and extinguish of the forest fires that are creating great problems tothe ecosystem at borders and dense forest[2]. The machine learning codes introduced in camera module can be used to detect the fire, on detection the flight is been lowered to the area of interest which on proximity of the fire triggersthe drop circuit to drop the carbon ball at centre of gravity of fire..

LITERATURE REVIEW

Airfoil Selection And Software Analysis Of The Wings

Currently a large amount of focus is given on the development of UAV structures for better performance, maneuverability, stability during operation. Keeping these facts on mind our current focus is to analyze the performance of high lift airfoil and select the best suitable airfoil for UAV, designed with high lift coefficient, low Reynolds number characteristics to perform military and research based operations. An airfoil-shaped body moved through a fluid produces an aerodynamic force. Subsonic flight airfoils have a characteristic shape with a rounded leading edge, followed by a sharp trailing edge, often with a symmetric curvature of upper and lower surfaces. This research will lead the UAV researchers and commercial producers to design and fabricate advanced UAVs with vast range of sophisticated works. A reasonable selection of high lift low Reynolds number airfoil is very important part of aerodynamic design process for this kind of low speed UAV (Mirza Md Symon Reza, Samsul Arfin Mahmood, Asif Iqbal)

Design, Manufacturing And Testing

The use of UAVs in “dull, dirty and dangerous” duties is becoming more and more common by civil and militaryusers worldwide. Similar to manned aircraft, there are tremendous efforts to increase range and endurance of UAVs. This can be achieved by better engine technologies which consumes less fuel, lighter materials to decrease overall weight, better aerodynamics of UAV body including fuselage, wing, tail, nacelle etc. Improvements on all of these potential areas contributes to the total performance and endurance increase of the UAV. The main reason for using wingtip devices is reduction of lift induced drag force. During flight, drag force is generated by the aircraft’s wet areaslike fuselage, tail and main wing. Since the wing provides the lift which is required to balance the aircraft weight, liftinduced drag becomes the major contributor in the total drag force. Lift is generated due to the difference in air pressure between the top and bottom of a wing. This pressure difference also forces the air trail off the tips of wing and thus creates wingtip vortices, in spirals. Reducing the magnitude and effect of tip vortex and minimizing the induced dragis one of the objectives for aircraft designer. (Jordan Janas, Piergiovanni Marzocca, Daniel Valyou and Matthew Abell)

Propeller Model Using CFD Method

Most small and medium-size UAVs typically use commercially available propellers for cost efficiency and rapid prototyping. Propeller is an important part for UAV performance. However, the wake from the propeller or propellerinduced-flow could interfere with the UAV aerodynamics. For UAV design and aerodynamics analysis, the computational fluid dynamics (CFD) method is a cost-efficient, popular method. These small propellers typically operate at high RPM and cause the passing airflow to have a relatively high velocity (comparing to the UAV operatingspeed). Since this wake from the propeller (propeller induced-flow) could interfere with the UAV aerodynamics therefore, the propeller induced-flow must be accounted during the design process in order to obtain actual UAV aerodynamic properties. In the design of UAV, the airflow around the airframe and aerodynamic data can be analyzedusing computational fluid dynamics (CFD) methods. The CFD computation can be used to investigate the performanceand airflow of full-scale aircraft rotor and wind turbine. The advantage of using CFD computations is that its results can show very detailed information of the airflow. However, the flow simulation of UAV with spinning propeller blades would require extensively higher computation resources and time consumption.(Thanan Yomchinda)

Testing Strategies For UAV

Capacity to manufacture complex structures directly without the need for a mold gives additive manufacturing (AM) technologies a major advantage compared with conventional manufacturing. An interesting and challenging field is to manufacture unmanned aerial vehicle (UAV) components and models using three-dimensional (3D) printing. This study focuses on the design, preliminary aerodynamics analysis, manufacture, and assembly of a small UAV using fused deposition modeling (FDM) technology. From the preliminary aerodynamic analysis of the UAV model it was found that the highest Cl/Cd of the UAV model is 14.67 at a 4° angle of attack, which corresponds with cruiseairspeed. The UAV model developed in this paper presents dense ribs for wings and formers for fuselage, all of themmanufactured by FDM technology. The study also includes a description of the 3D printing procedure of the components of the UAV model and the results of the flight tests. Following the flight tests, it can be said that the UAVmodel made by FDM technology is stable and has a wide airspeed range available, stall characteristics are good, and it operates with good aerodynamic characteristics and high maneuverability. Thus, the manufacturing technique presented in this paper can be used in the fast and efficient manufacture of scale aircraft prototypes with the purpose of determining the flight performance by conducting flight tests.(Onut Stelian Pascariu, Sebastian Marian Zaharia)

ELECTRIC AIRCRAFT STRATEGY

Comparison With Other UAVs

On comparing with other existing UAVs such as drone used by the armies, the fixed wing UAVs has got greater performance and efficiency. The flight time offered by fixed wing UAVs compared to drone with equivalent battery pack having same payload is greater than 3 times what offered by the drones. Thus the payload that a fixed wing modelcan carry tends to be higher and can be used for various application than a single application provided by other models.The altitude climb offered by these models can be decide by the operator by the selection of efficient power plant, thepower plant selected for the operation of the aircraft at a particular height would be more cost efficient than operatinga drone at the same altitude. Also, the stability of fixed wing model is greater compared to the other models due to thegliding phenomenon provided by the selection of perfect aerofoil design. The operating range of these models can beincreased with the use of transmitter- receiver modules of increased ranges.

FIGURE 1. Drone Model

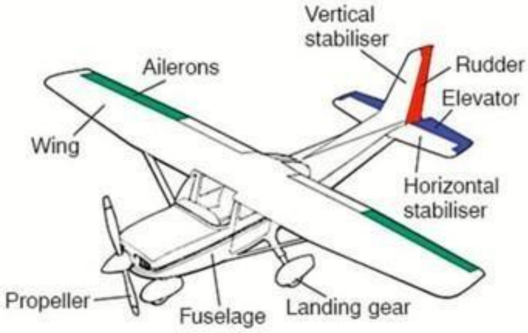

FIGURE 2. Fixed Wing Model

System Modelling

FIGURE 3. Step by step process of Electric Aircraft

As shown in the figure 3, to obtain the aircraft system the following steps should be followed.

Powerplant Selection

Power plant selection is one of the most important and primary requirements for the system. The torque and weight isthe factors on which the power plant depends. The driving of the motor which provides the initial momentum for thelift can be only possible with the better power plant selection. Powerplant is the basic circuitry battery connected to motor via Electric Speed Controller. By utilising the torque to weight ratio of aircraft optimum powerplant is selected.

Airfoil Selection

An airfoil is the shape of wing. An aircraft has four basic forces that act upon it, which are lift, drag, thrust and gravitational force. So main work is related to these forces and their characteristics on different environmental and operational conditions.Lift is the force that acts at a right angle to the direction of motion through air. Thrust is the force that a flying machine in the direction of motion and drag is the force that acts opposite to the direction of motion.The aircraft requires high lift, low drag, low Reynolds number airfoil which is only possible with help of designing compactable airfoil using Ansys software. This could lead to the selection of wings of the flight so as to meet the liftto drag ratio provided.

Wing Selection

Different types of aircraft wings are available. They are rectangular, elliptical, trapezoidal etc. Wing Span of the electric aircraft is 53”. The main reason for using wingtip devices is reduction of lift-induced drag force. During flight,drag force is generated by the aircraft’s wet areas like fuselage, tail and main wing. Since the wing provides the lift which is required to balance the aircraft weight, lift induced drag becomes the major contributor in the total drag force.Lift is generated due to the difference in air pressure between the top and bottom of a wing. This pressure difference also forces the air trail off the tips of wing and thus creates wingtip vortices, in spirals. Solidworks or ansys can be used for the design and analysis of wing.

Fuselage Selection

Fuselage is the aircraft’s main body section. A well defined fuselage will ensure that the intented payload is adequatelyand efficiently met. The use of streamlined fuselage is to reduce the drag associated with the speed of flight. Light weight materials are used in the manufacturing of fuselage. Here we are using Foamed Polypropylene blocks for fuselage. Along with the streamlined body concern, fuselage has been designed to accompanies battery and other receiver modules to avoid unnecessary aero-dynamical drag. The rounded edges with the pouches created for batteryand receiver modules create a stable and efficient fuselage design

FIGURE 4. Fuselage of Electric Aircraft

Structural And CFD Analysis

The structural analysis of the system are carried out using the Solidwork and Ansys software’s which provides the structural and integral stability of the system. By the data provided by the software’s Computational Fluid Dynamics(CFD) analysis of the system is carried out which gives the aerodynamic flow of the system where it makes up a comparison between the virtual propeller and practical propeller to give a precise data. Based on the results of the analysis alteration are made to the system parameters to bring up the required system. The Figure 5 depicts the computational Fluid Dynamics of the propeller at mean throttle. The analysis of the airflow through the system showsthat the propeller system is stable with low deviation from the virtual propeller design. No overflow or lower flow ofthe air is found during the analysis of the system.

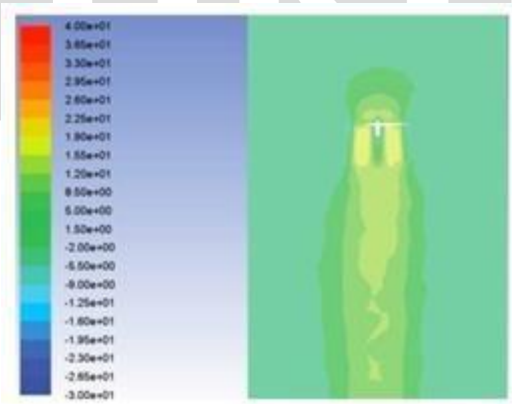

FIGURE 5. CFD analysis of propeller

Dropping Mechanism

A UAV dropping mechanism is a system that enables a UAV to release various objects while in flight. There are different types of UAV dropping mechanisms available in the market, and the payload release mechanism is one of them. The payload release mechanism is typically attached to the bottom of the aircraft and is used to release objects.This mechanism is designed to be lightweight and durable so that it does not affect the drone’s flight performance. It usually consists of a sliding pin mechanism that is driven by a high-quality metal-geared servo. The payload release mechanism can be operated remotely, usually through a remote control or a ground control station. This allows for precise and controlled releases, which is especially important when dropping objects in sensitive or dangerous areas. UAV dropping mechanisms, including the payload release mechanism, are commonly used in various applications such as search and rescue, surveillance, agriculture, and delivery services. As with any aviation equipment, UAV dropping mechanisms are subject to strict regulations and safety standards to ensure that they are operated safely andeffectively at all times. The mechanism typically includes a slot that is covered and opened by the sliding pin mechanism. The hanging of a payload can be passed through this slot when it is opened, and the object is then releasedwhen the slot is closed again. The slot is designed to ensure that the payload is released smoothly and safely, withoutcausing any damage to the UAV or the surrounding environment. The drop structure consist of an aerodynamic bodyto cut the opposing air force while travelling towards the point of interest. The structure carries the extinguish mediuminside whereas a bore of 2 centimeter is made at the front tip which is filled with explosive to create an area splash rather than a point act. For this aircraft payload is ABC powder, which is a fire extinguisher, this can be used for stopping all types of fire. On detection of fire flight is been lowered to the area of fire. This fire catches the explosivematerial placed on the container which carrying ABC powder and the container breaks. Thereby extinguishes the fire.

FIGURE 6. Dropping Mechanism of Electric Aircraft

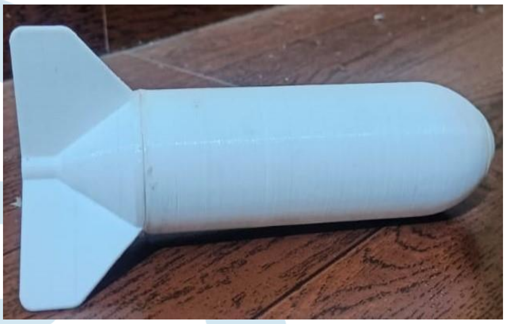

FIGURE 7. Drop Structure

DESIGN PROCESS OF THE SYSTEM

System Modeling

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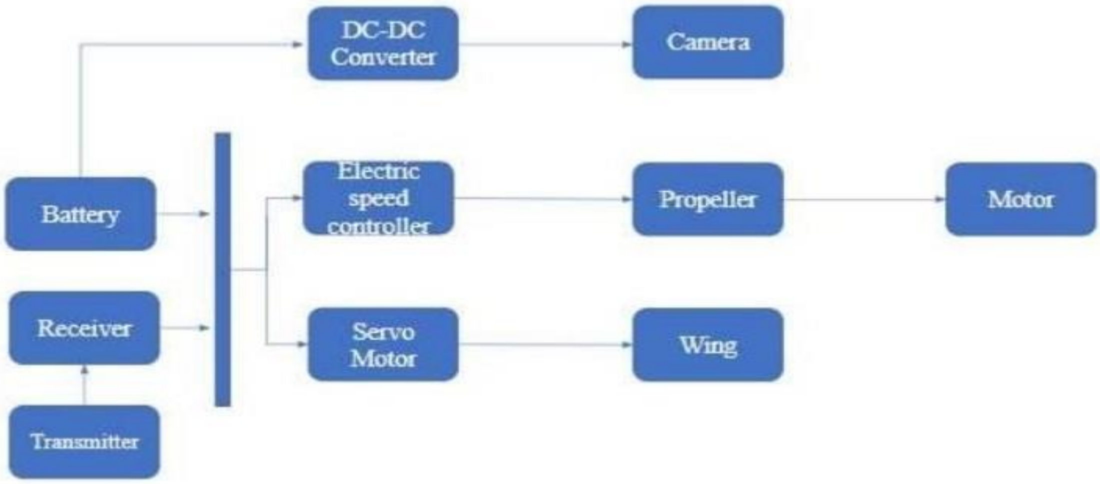

FIGURE 8. Block diagram of Electric Aircraft

The aircraft system is been autopiloted with the help of a transmitter receiver module which controls the electric speedcontroller and the Servo motor used. According to the throttle provided by the transmitter the ESC provides a currentproportional to the speed required for the flight which will be drawn by the motor and to the propeller.The change inthe direction is also controlled by the action provided with transmitter receiver module, the signals provided triggers the servo which help in change of direction. Based on the weight and wing span of the system the design for each components are carried out.

Total weight intended=2000g

Primary Calculation

Considering a thrust to weight ratio 0.8 (Ranges from 0.2-1.2)Thrust required[9] = 0.8 × weight = 0.8 × 2000 = 1600g

Power required in watts[9] = $\frac{\text{Weight of the aircraft (in gms)}}{4} = \frac{2000}{4} = 500W$ (1)

Based on thrust and power requirement motor calculations are carried out

Motor Selection

Taking average pitch speed as 45MP H standard (From Motor specification)

$$KV\ [8] = \frac{\text{Average pitch speed} * 1056}{\text{Voltage} * \text{Propeller Pitch}} = \frac{45 \times 1056}{14.8 \times 4.5} = 713.51KV \quad (2)$$

Propeller Selection

From the data sheet of the motor the following performance can be observed with the propeller of 12’×4.5”Propeller Diameter = 12”

Propeller P itch = 4.5” (3)

Electric Speed Controller Selection

Maximum Current Drawn is 40A (From Motor Specification)

Considering 120% of maximum current =48A

Battery Selection

$$C-rating[6] = \frac{\text{Maximum Current requirement of motor in mA}}{\text{Battery Capacity in mA}} = \frac{48000}{3300} = 15C \quad (4)$$

Based on the C rating and size 3300 mAh Li-po battery is opted Based on selection strategy the following components are choosen.

TABLE 1. Components required

Sl.No	**Components**	**Specifications**
1	Motor	5010 750KV Torque Brushless Motor
2	Propeller	1245 MR (12*4.5)
3	Electric speed controller	40A 2-4S
4	Battery	15V 3300mAh 4S 25C/50C
5	Servo motor	TowerPro SG-5010
6	RC Transmitter	Flysky FS-i6 2.4G
7	EEP Block	50mm
8	Camera Module	1000TVL 1/3 CCD 110 Degree 2.8mm

SIMULATION OF AIRCRAFT MODEL WITH RESULTS

Models

Lateral Control

As can be seen in Figure 9, the lateral controller consists of three cascaded SISO loops. It controls the course using the ailerons. The course is measured as an angle relative to north, typically given in the interval [0, 360]. The discontinuity at 0 / 360 needs to be considered in the calculation of the course error, otherwise the aircraft may not turn into the desired direction. For example, if the desired course is 355, and the actual course is 5, the aircraft shouldmake a left turn of 10, not a right turn of 350. Therefore, the course error is calculated. This course error is then fed to a proportional controller, whose output is the desired course change rate. However, as the next loop controls the attitude (bank angle), it expects a desired bank angle, which is calculated algebraically based on the force equilibriumin a steady turn. The bank angle is controlled by a PI-controller. The controller includes an anti-windup protection that turns the integrator action off when the aileron deflection reaches a limit. Lastly, the roll rate p is controlled in the innermost loop, using a proportional controller. This part essentially acts as a damping term for the attitude controller.

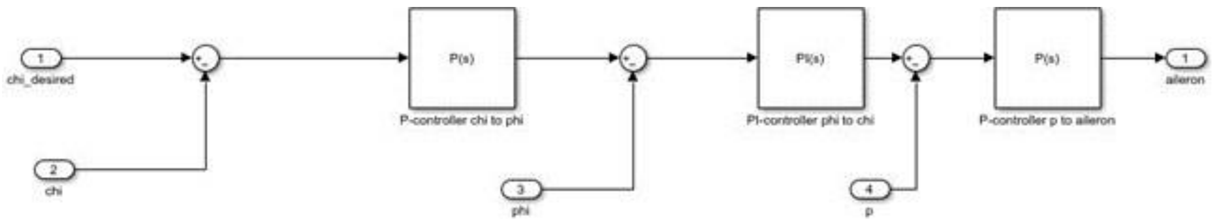

FIGURE 9. Simplified diagram of the lateral/directional controller

Altitude Control

The altitude control is similar in structure to the lateral control, but it includes an additional top-level control loop so it is a cascade of four SISO controllers. Figure 10 shows a simplified overview of the controller. The top-level loop isthe altitude controller: it produces a vertical speed command from the altitude error. The desired vertical speed is thenconverted to a desired flight path angle, which is the input to the next loop, a proportional-integral controller. This is limited to account for the limits of the aircraft's performance. The integral part is added at this point in order to ensurethat the flight path angle can be controlled without a steady state error. It includes an anti-windup protection that turnsoff the integral action whenever the elevator command reaches saturation. The last two loops are proportional controllers for angle of attack and pitching rate.

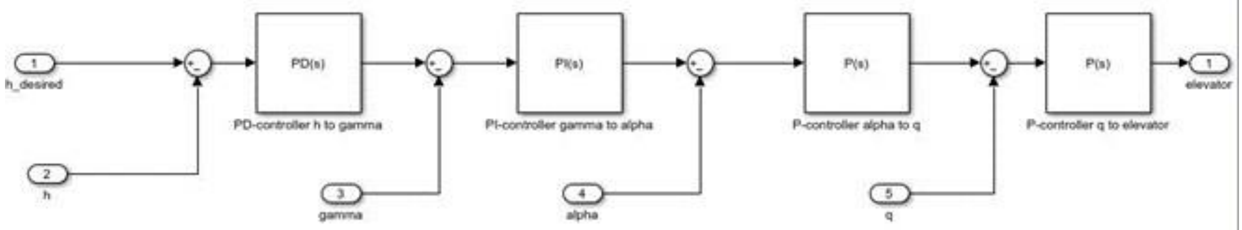

FIGURE 10. Simplified diagram of the altitude controller

Results

Climb And Descent

In altitude change manoeuvres, a major deficiency of the SISO control becomes apparent: due to the limited control authority of the throttle, compared to the elevator, an altitude command may well drive the airspeed to or beyond thelimits of safe flight. In the SISO controller as implemented here, a limit is placed on the commanded flight path angleto avoid unsafe situations. Here the green line shows the desired speed and height and the blue line shows the practicalscenario. Figure 11 shows the desired and practical conditions of the aircraft when it is undergoing 50m climb. Whenthe aircraft moves upwards there will be an upward shift in aileron. The speed eventually decreases. As a result the system will be unstable. Further when all the parameters of aircraft attains the desired value, the system reaches stablecondition with required speed. Figure 12 shows the aircraft's condition when it is undergoing a 50m descent. During decent the aileron will have a Downward movement. As a result the speed increases beyond the required speed.Further as the parameter attains the required value, the system attains stable condition with required speed.

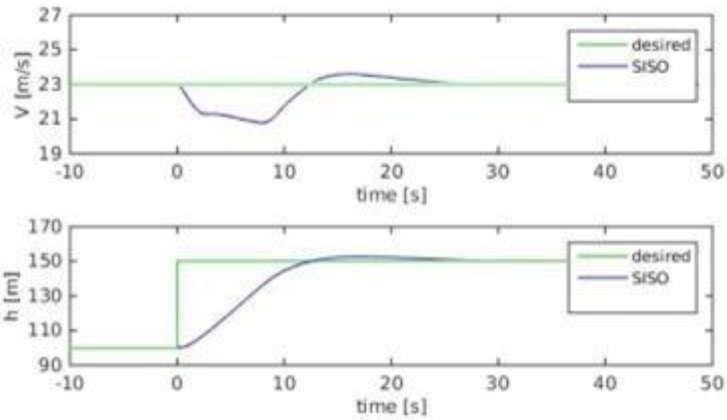

FIGURE 11. Simulation of a 50 m climb

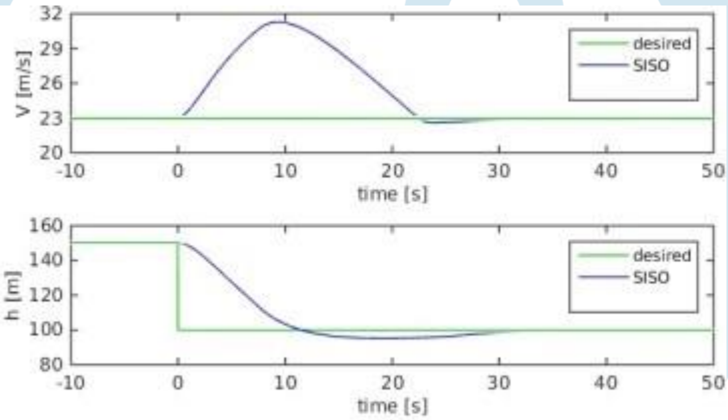

FIGURE 12. Simulation of a 50 m descent

EXPERIMENTAL SETUP AND RESULT

Experimental Setup

Design And Selection Of Airfoil

Necessary lifting force = payload ×gravitational acceleration = 800 ×9.8 = 7.84N

Wing area = lifting $\frac{\text{liftingpower}}{\text{airdensity} * \text{lift coefficient} * \text{velocity}^2}$ (5)

$= \frac{7.84}{1.2 \times 100} = 0.056m^2$

Mean Chord = $\frac{\text{Wing Area}}{\text{Wingspan}} = \frac{0.056}{1.3} = 0.043\text{m}$ (6)

Aspect Ratio = $\frac{\text{Wingspan}}{\text{Meanchord}} = \frac{1.3}{0.043} = 30$ (7)

Necessary Power = $\frac{0.5 \times \text{airdensity} \times \text{wingarea} \times \text{velocity} \times \text{drag coefficient}}{\text{Motor Efficiency}}$

Total length of wing=53”Wing chord length=9.5” Aileron Width=1.75”

$= \frac{0.5 \times 1.2 \times 0.056 \times 10 \times 0.05}{0.75}$

= 39.7W (8)

According to these calculations, the ClarkY aerofoil has been selected.

TABLE 2. Electric Aircraft Dimensions

Sl.No	Specifications	Dimensions
1	Total length	53”
2	Wing Chord	9.5”
3	Aileron Width	1 ¾”
4	Tail Span	20”
5	Tail Chord	9”
6	Elevator Width	2”
7	Vert. Stabilizer Height	10.5”
8	Boom length	38”
9	Fuselage length	20”
10	Fuselage height	4”

Based on the calculations performed and along with the data from aerofoil tool and the rule book for aerodynamic aircraft design dimensions of various parts of the electric aircraft system has been sorted. The following structures with dimensions are mechanically joined to the main frame without disturbing the aerodynamics of the system.

Material Selection

The largest factors used in the selection of materials were the cost, part weight, and ease of manufacturing. Considering these factors Expandable polypropene (EPP) and dipron is selected. EPP foam is incredibly tough. When bent, it doesn’t break. When crushed, it heals itself and pops back out. When EPP is torn, the two halves match up perfectly and can be re-glued with an almost invisible repair. A Depron carbon fiber foam core laminate has the strength and stiffness of a carbon fiber laminate, but lacks the compresive strength and crushing resistance of a structural foam core. Available in gloss, matte or texture on one side and texture on other side for bonding to other surfaces.

Solid Works Model Of Aircraft

Reflections from airfoil design and fuselage design along with the idea of power train orientation an aircraft model isbeen designed using Solid Works platform. On the front view of the aircraft the proper orientation of the total designis inherited along with the placement of the landing gears used. The system uses two sets of landing gears one at the front end which tends to be the main landing gear made out of aluminium frames and rubber wheels. This landing gear is provided in such a way that it reflects proper angle for the take off of the aircraft from the rest position. The other one at the back end act as a supporting gear. Both the gears works together for the proper take off and landing of the electric aircraft system. The gears are placed such a way that it doesn’t effects the stability of the system duringflight.

FIGURE 13. Front view of the aircraft.

The bottom view depict the position of elevator and wings with the main frame of the structure. The elevator at backend is placed just after the end of main frame for the proper up and down functioning of the system provided by the servo’s.

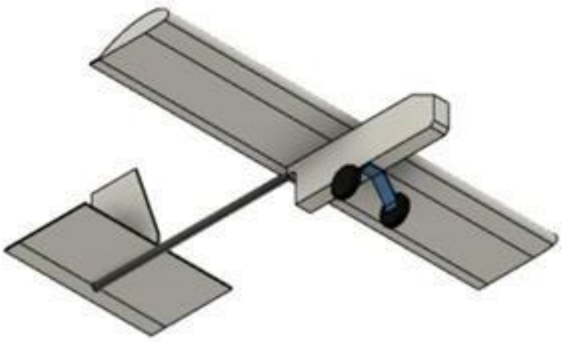

FIGURE 14. Bottom view of the aircraft.

The side view of the system provides the position of Rudder at the back end with the main frame of the system. The rudder is designed such a way that it provides proper directional change for the aircraft during the flight. It can providean directional change of 360 degree without effecting the stability of the system. These structures are made very thinto avoid effects of air drag.

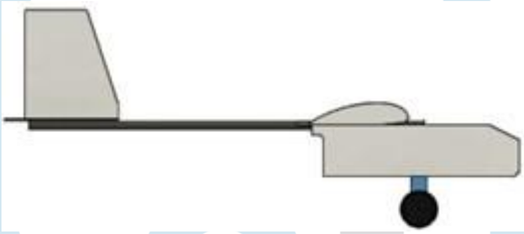

FIGURE 15. Side view of the aircraft.

The top view depict the alignment of the wings with the main frame. The aileron at the end of wings are positioned such a way that the up and down functioning of the aileron is ample for the proper working of the system.

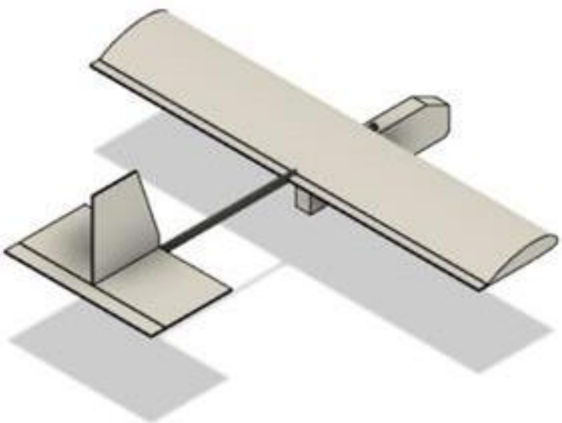

FIGURE 16. Top view of the aircraft.

Hardware Implementation

All innovations and results on the both mechanical and electrical side of the system has been incorporated togetherfor the formation of electric aircraft for border security, fire extinction and area mapping. The both labelled figures provides the complete idea on how the mechanical and electrical components are aligned to get an aerodynamically stable system. The receivers and battery pack is been incorporated along with the fuselage which provide better spacemanagement. Whole structure is aligned into an aluminium framework which act as the supporting structure for the system. The aileron, rudder and elevator helps in the total control of the structure during the flight. The ground stationcontrol of the structure is carried out by controlling these flight structures with transmitter-receiver communication over servo motors.

FIGURE 17. Front view .

FIGURE 18. Side view

Results

Stability of electric aircraft has been tested for different throttle. Limitations due to the altitude climb provided by thegovernment of India, the flight is been tested upto a limited altitude which marked less than half throttle of the system.The aero dynamic balance of the system towards practical condition such as wind, air thrust etc has been analysed andit reflected a greater stability of the system. All applications has been achieved and the result are depicted. The Figure19 depicts the testing of the electric aircraft system at an altitude less than 60 meter. The stability of the system towardsthe practical conditions has been analysed at different levels of altitude.

FIGURE 19. Flight Testing.

Fire Extinction And Border Security

The camera module mounted on the system capture the image and videos during the flight and is transmitted to the ground station via its transmitter. The data that get transmitted is made quick to meet with the speed of aircraft by introducing changes in transmission codes and by the channel switching. Thus within a limited time span large area of field is been inspected for fire and enemies. For Fire extinction, the transmitted data during the flight is analyzed and if fire been detected the flight is been lowered till the point of action. In manual mode of operation the dropping mechanism is linked with that of the transmitter with the help of codes. Thus, while reaching the point of interest thetrigger switch which activate the mechanism is pulled to drop the extinguish medium carried in the drop model. The drop model is designed such a way that it provides an area splash. In automatic mode of action mechanism is incorporated with a Carbon dioxide detector. The dropping mechanism has been tested for the application mentionedand provided the required output. For Border security the same data transmission method is been used for monitoringthe field. Due to its increased speed of flight large area is been scanned within limited time span. Thus, a person at theground station can observe for any intrusion taking place at the borders and can alert the army headquarters. The dropping mechanism incorporated in the system can be used to drop weapons and also under simple modification canbe used to handle weapons with the same codes under the action of drop.

Area Mapping

The image captured by the aircraft can be used for the creation of maps which would be helpful for the analysis of anarea under any interest. Various mapping strategies such as coordinate mapping, area mapping, area image mapping etc can be implemented with the help of numerous open platforms available such as geosetter, QGIS etc. These mapscreated or formed can be used to study various social factors associated with the area. In coordinate mapping system the image captured is sent along with the location coordinates which can be formed out from the application in use forthe capture of image. These coordinates along with the image can be used for the mapping technique under coordinatemapping. The coordinate mapping can be performed in any open source platform making it is easy for the analysis purpose. These geo-location data can be used for the studies such as changes that happens during an interval of time. The various mapping strategies available can be used according to the requirements of the consumer. The area map creation becomes very easy and flexible with the use of UAVs.The cost of labour, survey, miscellaneous expenses canbe reduced with the help of these Systems.

FIGURE 20. Image Captured by Aircraft

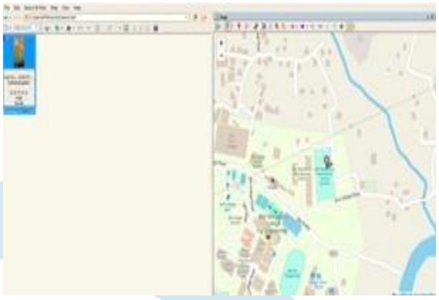

FIGURE 21. Coordinate Mapping

CONCLUSION

Unmanned Aerial Vehicles (UAVs) provide the ability to perform a variety of experimental tests of systems and unproven research technologies, including new autopilot systems and obstacle avoidance capabilities without risking manufacturing processes for the purpose of testing integrated systems. The aircraft is designed for high-volume and high-weight payloads so as to accommodate a variety of experimental systems configuration. The growing interest inresearch of UAV, equipped with increased payload, shortened take-off and landing distances and lower stall speed, has created a need for the comparatively a reasonable selection of high lift low Reynolds number airfoil is very important part of aerodynamic design process for this kind of low speed UAVs. As a result, performance analysis andcomparison of high lift airfoil for low speed UAV, has earned an enormous importance in modern day aerospace. TheUAV discussed can be used for the accomplishment of various application such as Area mapping, Fire extinguish, andfor Border security. Under slight modification the extinguish system can be used for carrying weapons that could otherdimension for border security

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