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Design Development and Fabrication of Unmanned Aerial Vehicle

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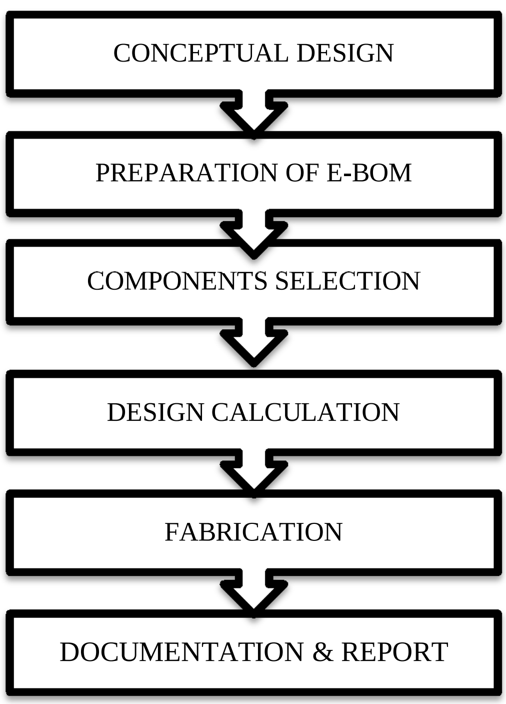
***Abstract:** UAV or an unmanned aerial vehicle is a remote-controlled aircraft. It can be operated remotely in real-time or pre-programmed to fly autonomously on the pre-defined routes. These aircraft help police, fire and other first responders save lives in the event of natural disasters, locate missing children and help fight wildfires. They assist the Coast Guard in rescue missions and help the Border Patrol keep our nation secure. They boost agricultural production and allow us to better protect the environment. Moreover, UAS have virtually no limitations, with the ability carry out such work in hazardous conditions, darkness, extreme heat and a host of other conditions that may pose significant risks to manned aircraft.*
***Keywords:** Remote controlled, Pre-programmed, Fly autonomusly*

I. INTRODUCTION

Airplane, also called aero plane or plane, any of a class of fixed-wing aircraft that is heavier than air, propelled by a screw propeller or a high-velocity jet, and supported by the dynamic reaction of the air against its wings.Aerodynamics and the loads are derived from aerodynamic considerations. Usage and analysis of airfoil shapes for determination of lift and moment coefficients, pressure distributions. Structural design, analysis, and testing of our model is made. Solid modeling of the plane, electronics and radio control. Work delegation and time budgeting are the main aspect in this project. The goal of this undertaking is to gather engineering knowledge and skill, master new techniques and information and apply these to produce a successful design and fabrication of a radio-controlled aircraft.The aircraft should be able to perform such that it is capable of earning points at each level of the event. That is, it should be capable of lifting as much weight as possible while at the same time maintaining a very less weight of itself. Aerobatic performance is of no concern; rather, good lifting qualities at low speed and stable configuration are primary factors to be considered.

II. METHODOLOGY



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III. LITERATURE SURVEY

From the journal,we gain some knowledge about electric circuit system of UAV, with capacity of motor and battery and also it helps to short list the wings type and aero foil model. Deformation analysis is the determination of geometrical changes of an object to be monitored. Equivalent street analysis is used to predict yielding of art materials under multiaxial loading.Equivalent static strain is pressure that is put on something when its pulled or pushed by a physical force and main wing with NACA 23012 air foil,stabilizer air foil NACA 0006.

IV. PROBLEM IDENTIFICATION

A. Specification Of The Problem

We Indians are struggling to detect the forest fire and unable to rescue the animals.satellite and airborne systems are used in order to have a broad overview of the forest fire evolution, but the monitoring activities are still carried out mainly by people.Different types of data related to the farm, crop, land and atmospheric conditions can't be collected. This data is used to ensure healthy crops and successful harvest. It is difficult to know the magnitude of destruction immediately after a disaster. There is an urgent need to find ground information quickly. Sending search and rescue teams to such an area without prior knowledge of ground conditions may result in a waste of precious time. It is a common problem faced by many countries to securing their borders when it becomes thousands of miles with improper whether conditions.

B. Objective

1) To manufacture the air craft in the type Unmanned Aerial Vehicle.
2) Ultimate standard as followed in the time of manufacture.

V. DESIGN PROTOTYE

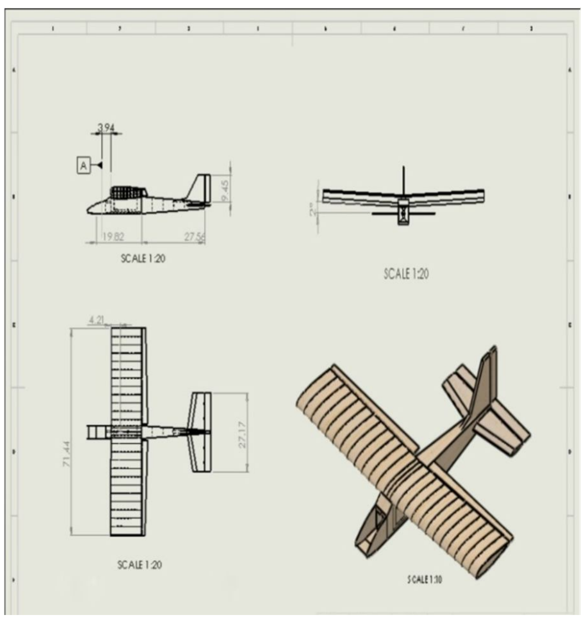

Fig.1 2-D Diagram of aircraft

VI. DESIGN CACULATION

A. Airfoil Selection

The primary step is the airfoil selection. Initially case studies of various airfoils are

1) Coefficient of Lift (Cl) vs. Angle of Attack (alpha)
2) Coefficient of Lift (Cl) vs. Coefficient of Drag (Cd)
3) Coefficient of Pitching moment (Cm) vs. Angle of Attack (alpha)
4) R_n= (velocity * chord width of airfoil)/ kinematic viscosity

According to the flight requirements and the time of flight limitations the cruising speed (velocity) was chosen as 22.37 miles per hour(10m/s). Thus for the chord width of 13.386 inches, the Reynolds number was calculated as 229730.

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By comparing the characteristics of four airfoils NACA 23012, NACA 2412, NACA 65-206and CLARK-Y (11.7% smoothed), the best airfoil is selected.

NACA 23012 NACA 2412

NACA 65206 CLARK-Y

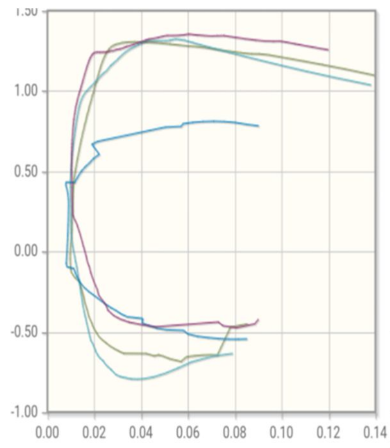

Fig..2 Cl Vs Cd

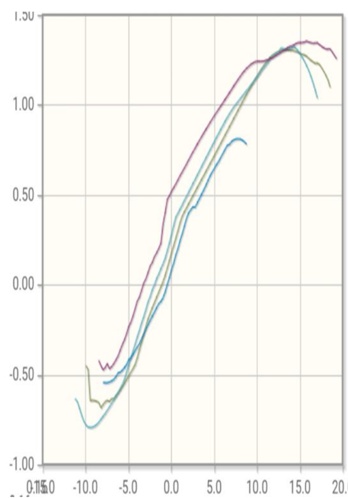

Fig..3 Cl Vs Alpha

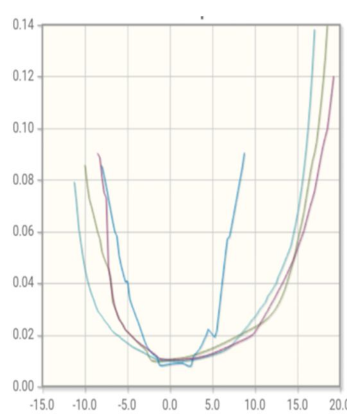

Fig.4 Cd Vs Alpha

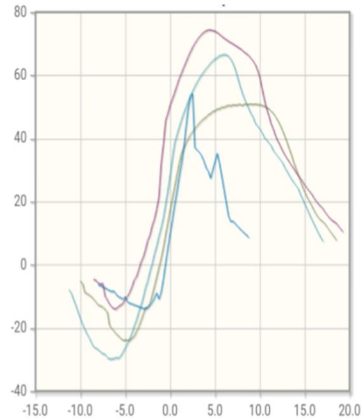

Fig.5 Cl/Cd Vs Alpha

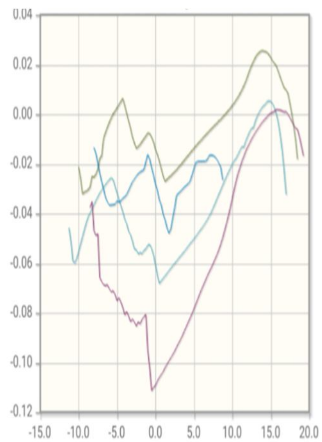

Figure.6 Cm Vs Alpha

1) *Result:* From the graphs shown above, the airfoil which suits our aircraft requirement within the R_n range of about 191,455 was found to be NACA 23012 for our main wing.

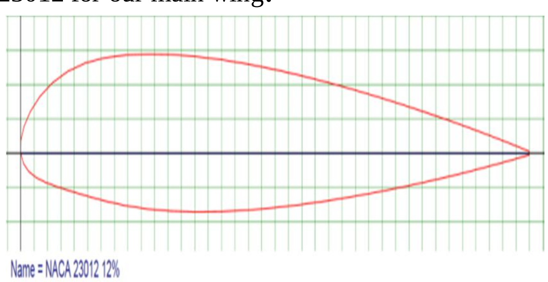

Fig.7The airfoil plot NACA 23012

B. Aspect Ratio

The aspect ratio of a wing is the ratio of its span to its mean chord. It is equal to the square of the wingspan divided by the wing area. Thus, a long, narrow wing has a high aspect ratio, whereas a short, wide wing has a low aspect ratio.Aspect ratio and other features of the planform are often used to predict the aerodynamic efficiency of a wing because the lift-to-drag ratio increases with aspect ratio, improving fuel economy in aircraft.Maneuverability is mainly affected by aspect ratio.A low aspect-ratio wing will have a higher roll angular acceleration than one of high aspect ratio, because a high-aspect-ratio wing has a higher moment of inertia to overcome. In a steady roll, the longer wing gives a higher roll moment because of the longer moment arm of the aileron. Low aspect ratio wings are usually used on fighter aircraft, not only for the higher roll rates, but especially for longer chord and thinner airfoils involved in supersonic flight.

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For a constant-chord wing of chord c and span b, the aspect ratio is given by:

AR= (b/c)   or AR= (b^2/A)

Where b = span length of the wing

C = chord width of the wing

A = area of the wing

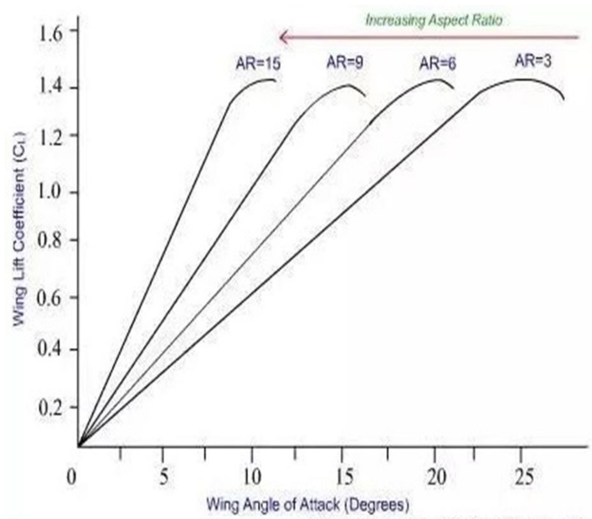

Fig..8 Aspect Ratio of wing

C. Angle Of Incidence

For NACA 23012 airfoil, zero lift occurs at approximately -1.2 degrees and also, αo =3.0 for C_L=0.9. Substituting AR =5.16 and the planform adjustment factor = 0 (approximately zero for the chosen wing planform due to its closeness to elliptical lift distribution).

The total angle of attack was calculated by using the formula,

$\alpha = \alpha0 + \{18.24 \text{ X } CL \text{ X } (1. + T)\}/AR$

Where, α = Total angle of attack

α0 = Section/airfoil angle of attack relative to zero lift angle of attack

CL = required coefficient of lift

T = Planform adjustment factor due to taper

AR = Aspect Ratio of wing

D. Mass Distribution And CG Balancing

Different weights for various components like motor, battery, servo motors, etc. were added in the fuselage at appropriate locations, so as to locate the CG near the aerodynamic centre.

Table.1 Mass distribution

Component	Mass (g)
Motor	118g
Battery	295g (±2%)
ESC & propeller	82 g
Servo motors	32g

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E. CG Balancing
Datum line was taken 10cm before wing root leading edge.

F. Without Payload
Centre of gravity is 4.21 inches and CG aft is 4.92 inches from wing leading edge.Neutral point aft is 6.95 inches with 6.64 neutral point inches.

G. With Payload
Cg is 5.57 inches and Cg aft is 6.27 inches with aerodynamic centre is 3.77 inches.Gross takeoff weight is 6 kilograms

H. Fuselage Dimensions
Length: 51.2 inches; Width: 4.5 inches;Height: 5.9 inches

I. Lift And Drag Analysis
The drag was calculated as follows for different angle of attack,

Drag Force = C_D * ½ * air density * V^2 * Wing area
Where, C_D is the coefficient of drag

Table.2 The drag was calculated as follows for different angle of attack

Alpha	Cl	Cd	Drag force (kg)
0	0.1833	0.01049	0.25711
0.5	0.2638	0.01069	0.262012
1	0.3491	0.01088	0.266669
1.5	0.4092	0.01109	0.271816
2	0.4546	0.01141	0.279659
2.5	0.4997	0.01186	0.290689
3	0.5441	0.01237	0.303189
3.5	0.5886	0.01291	0.316424
4	0.6329	0.01355	0.332111
4.5	0.6778	0.01415	0.346817
5	0.7228	0.01482	0.363238
5.5	0.7681	0.01556	0.381376
6	0.8138	0.01632	0.400003
6.5	0.8592	0.01702	0.41716
7	0.9048	0.01787	0.437994
7.5	0.9504	0.01878	0.460298
8	0.9962	0.01974	0.483827
8.5	1.0408	0.02046	0.501475
9	1.0843	0.02127	0.521328
9.5	1.1264	0.02211	0.541916
10	1.1667	0.02298	0.56324

J. Thrust Calculations
Thrust required (T_R)= weight of the plane/(Coefficient of lift/coefficient of drag)
Lift Force = C_L * ½ * air density (rho) * V^2 * Wing Area

VII. CONCLUSION

From the above information, we can conclude that, UAVs are now used widely to protect border areas from intruders. It helps gather intelligence information on the battlefield. The information proves useful in protecting borders, combat units, and security installations. Military personnel can avoid high-risk missions or go to such missions with better information on the ground situation. The aftermath of hurricanes and earthquakes, UAVs have been used to assess damage, locate victims, and deliver aid.Different types of data related to the farm, crop, land and atmospheric conditions can be collected. This data is used to ensure healthy crops and successful harvest.

A. Fabrication Model

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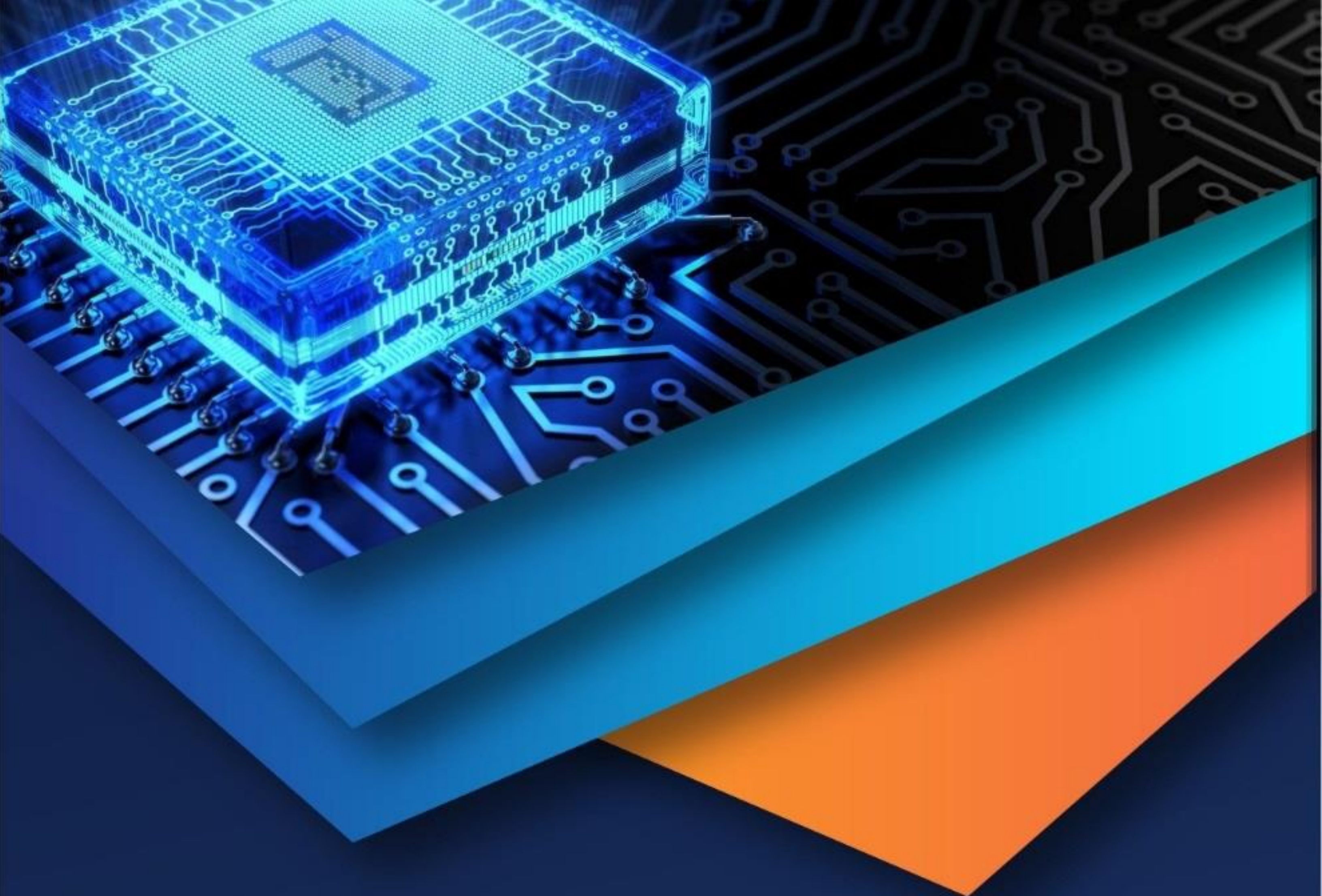

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