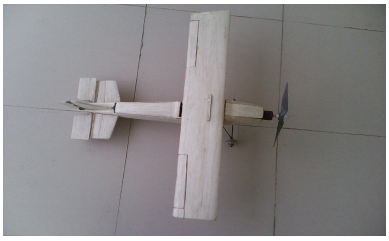
AVIATOR DESIGN



TECHFEST – IIT MUMBAI

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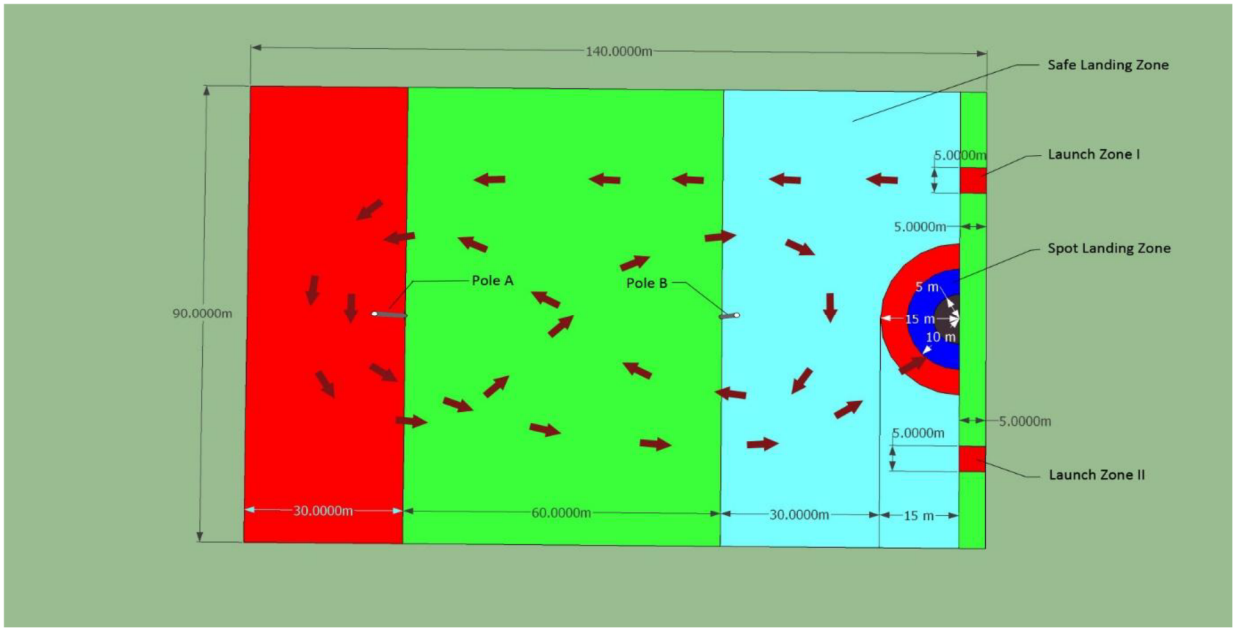
Objective:

To design and make a fast, light, wireless remote controlled aircraft (using electric motors only) and to be fly as conditions given in the arena.

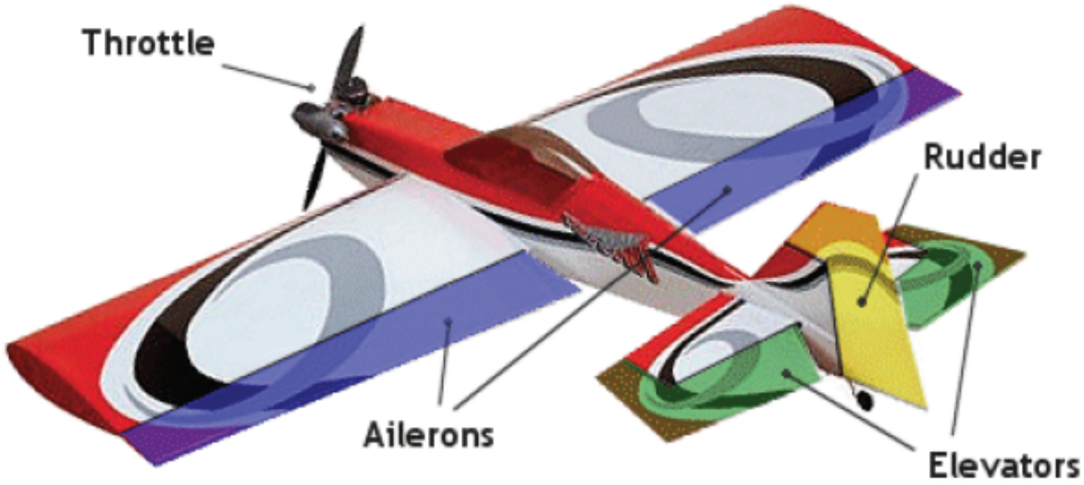


Required components:

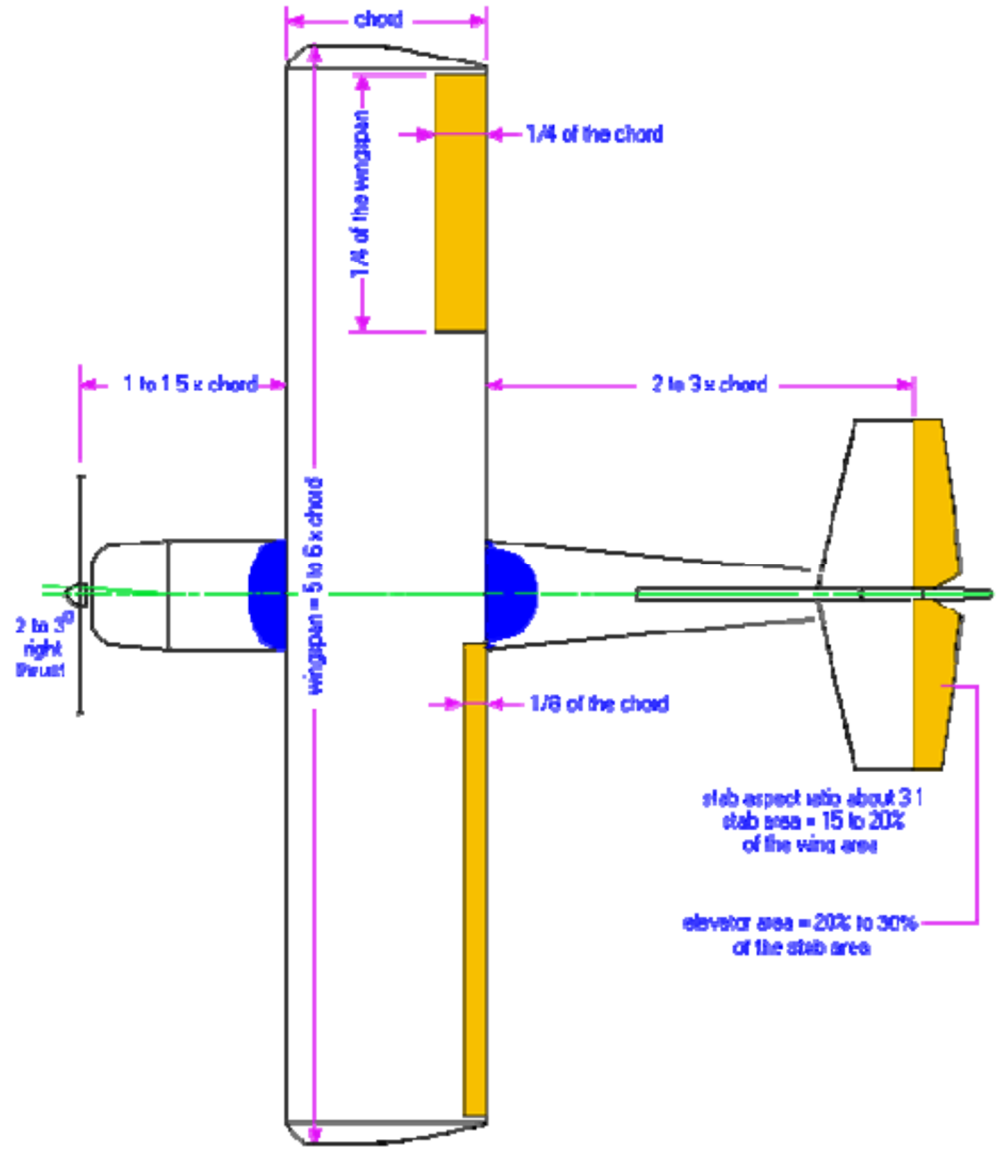
Component name	Quantity	purpose	Picture
Balsawood / fabricate sun board	4 to 5 sheets (1m/12cm/10mm)	For making the external body parts	
Brushless Electric Motor	1	For generating thrust force by using propeller	
electric propeller	1(10"X7")	Generate thrust force by drawing air from surroundings and passes over the body.	
Brushless speed controller	1	To vary the input voltage and current to get desired output propeller speed	
Li-Po battery	1(1600 mAh, 11.1 V, 25 C)	Li Po battery is so weightless compared to all have a good work in provide constant power to run the motor	 (specifications of battery is to be taken from basic design)

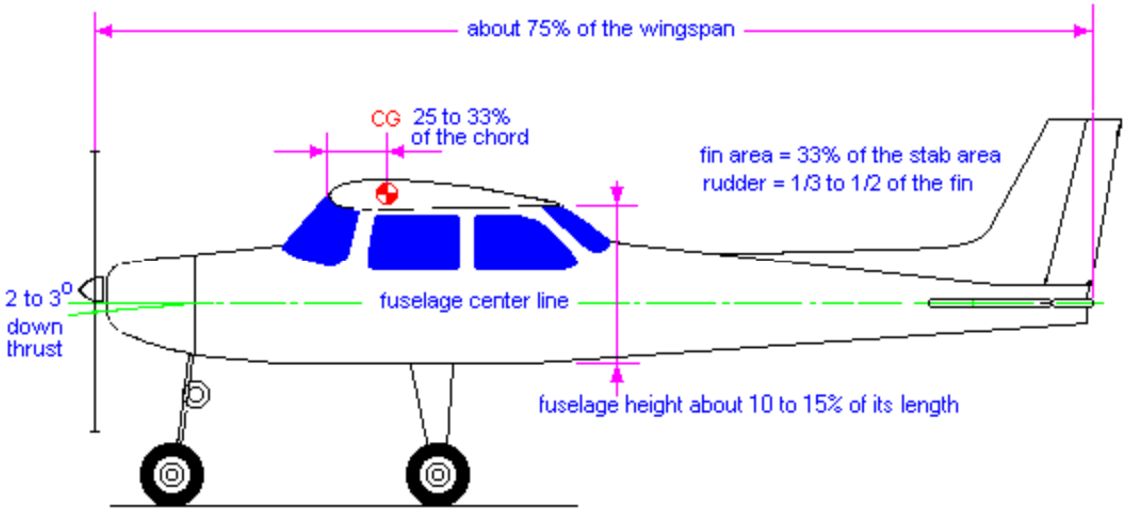
Servo motors	4	To provide the motion for rudder, wing, elevator mechanisms .	
Thin gauge wire		To connect the servos and different parts of body	
Wireless radio 4 channel remote controller, receiver	1(2.4 GHZ)	To control the motion of aircraft.	

Design Conditions:



Above: location of ailerons, elevators and rudder on an rc airplane.


chord
1/4 of the wingspan
1/4 of the chord
1 to 1.5 x chord
2 to 3 x chord
wingspan = 5 to 6 x chord
2 to 3° right thrust
1/6 of the chord
stab aspect ratio about 3:1
stab area = 15 to 20% of the wing area
elevator area = 20% to 30% of the stab area


about 75% of the wingspan
CG 25 to 33% of the chord
fin area = 33% of the stab area
rudder = 1/3 to 1/2 of the fin
2 to 3° down thrust
fuselage center line
fuselage height about 10 to 15% of its length

An aircraft is defined as an object that has the four forces of flight, namely lift, drag, weight (gravity) and thrust due to propeller acting on it at any point of time. The design has to overcome these forces design must possess the basic elements of the aircraft using from ancient days.

The main parts of the aircraft involves propeller, wings, and body

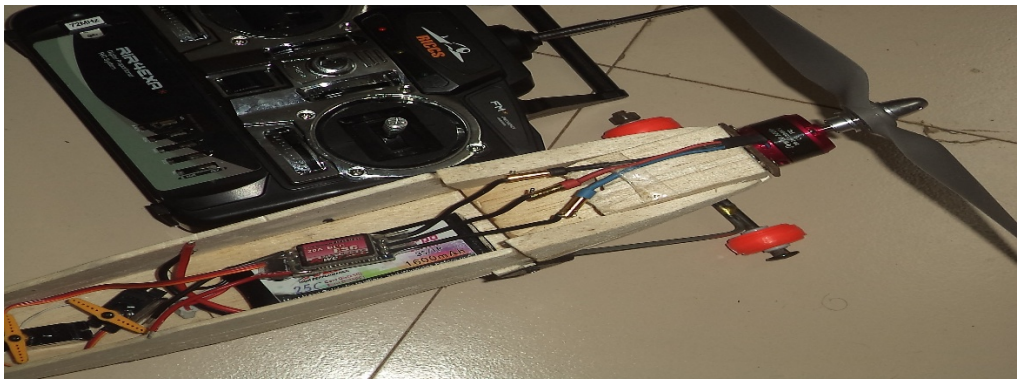
The above picture shows the dimensions as per aero modelling regulation parameters in which the shape of the body is designed.

Motor and battery specifications:

The specifications of the motor which we used in the design- power HD 2826 brushless outer runner with 1380 KV rating with maximum permissible current of 20 Amp and allowable voltage is 11.1 volts. Hence we get 15318 RPM for the propeller rotation. Maximum input power given to the motor is about 222W. As per our assumptions; the weight of the aircraft is 1.7lbs. Thus the power required to throttle the glider is 220 W. Here we used 20-25 A ESC to control the motor.

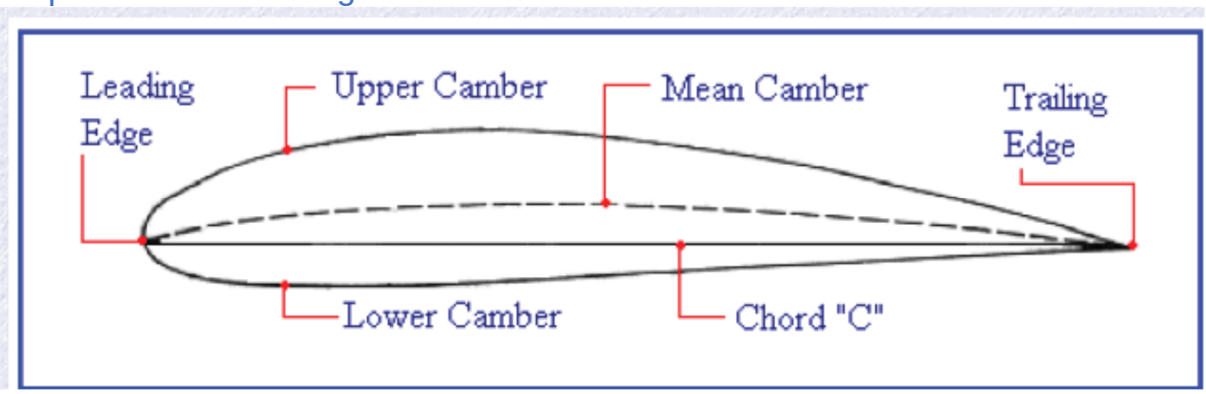
The specifications of the battery we used in the design- 1600 mAh, 11.1 V, 25 C rating Li-Po battery pack. The maximum current transfer to the motor is 40 A. Hence the maximum power can be drawn from the battery is 444 W. which is more than sufficient. Maximum burst time of the battery is 3 sec

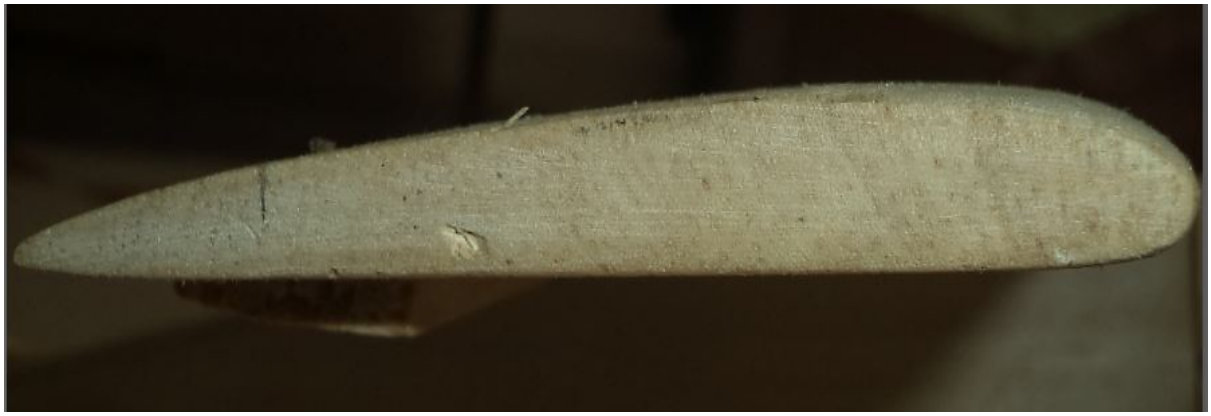
Connecting motor, esc, battery, radio receiver:



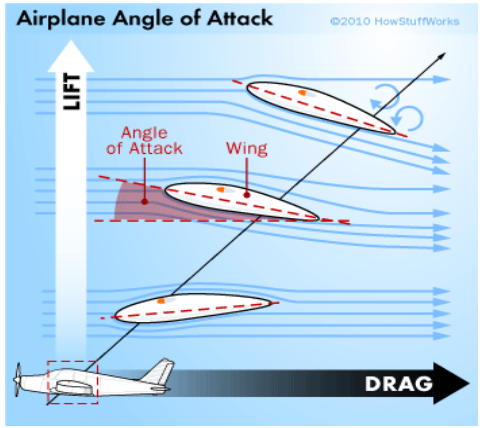
Wing cross section:

Wing cross section plays a major role in designing since which is mostly responsible for causing the lift force.





Here we can observe the air flow through the wing responsible for proper elevated lift



Mechanisms involved in design:

In this design we mainly focussed on three mechanisms which are involved with ailerons, elevator, and rudder. These three are very important in plane manoeuvring.

Ailerons are using for yaw controlling and pitch controlling; we design a suitable mechanism. We require alternating up and down motions for ailerons yaw control and both simultaneously we using a couple of shafts with 90 degrees bending at the two ends. One end of each is permanently fixed to each aileron and the other ends are using for giving motion from prime mover.

Elevators are using for take-off and landing, to acquire this motion we are fix a hinge joint to elevator to body of plane. We need to get the up and down motion from the mechanism to get the required control on plane. We are simply fixing the elevator to actuator for required motion.

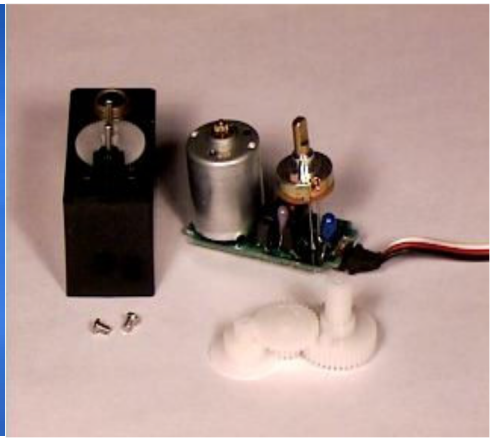
Rudder mechanism is using for turning of plane either to left or to right. We fix rudder to fin through hinge joint. We have to turn the rudder towards left or right to get required turnings. We are using two connecting rods of equal dimensions fixed to either sides of rudder at one end of each. The other end is giving to prime mover to get the motion.

We are using servo motors as actuators for this design. We required three servos for three mechanisms using in this design.

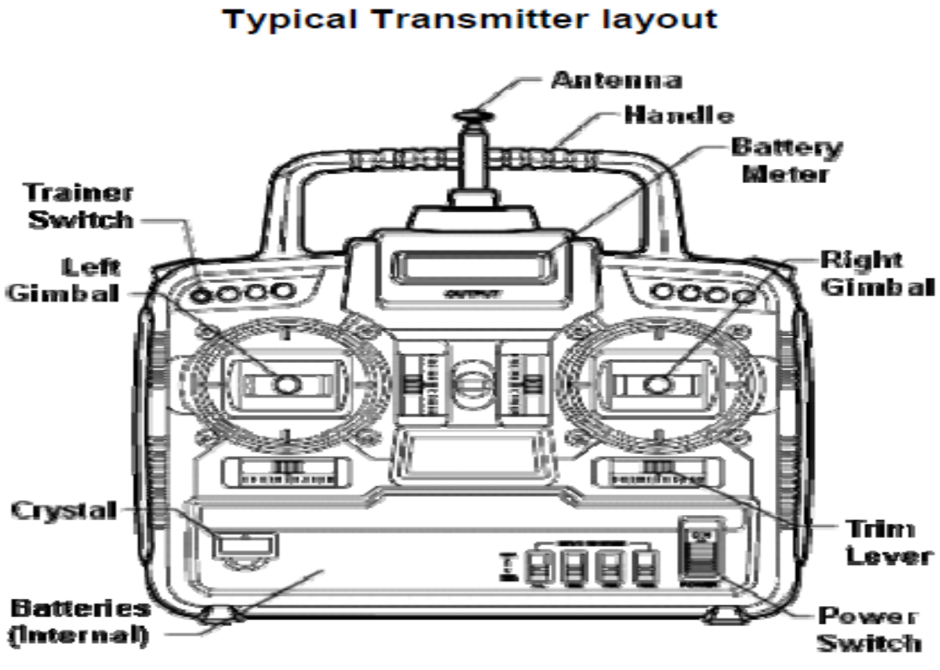
Servo motor:

A Servo is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft. As the coded signal changes, the angular position of the shaft changes.

Supply voltage: 6.0V
Stall Torque: 1.5kg.cm

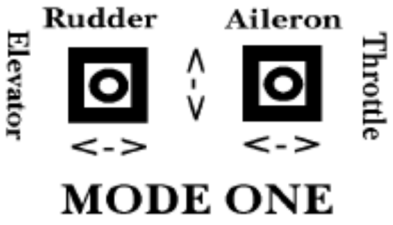


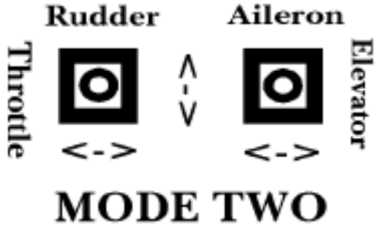
Using remote control:



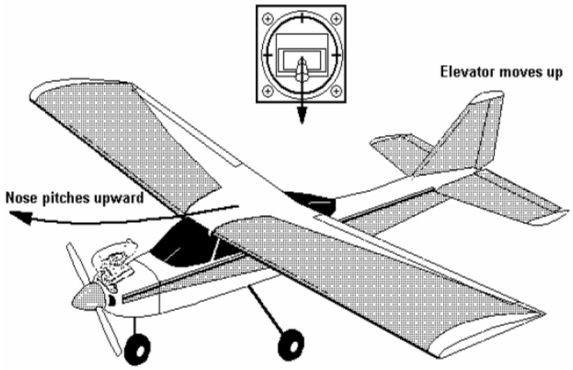
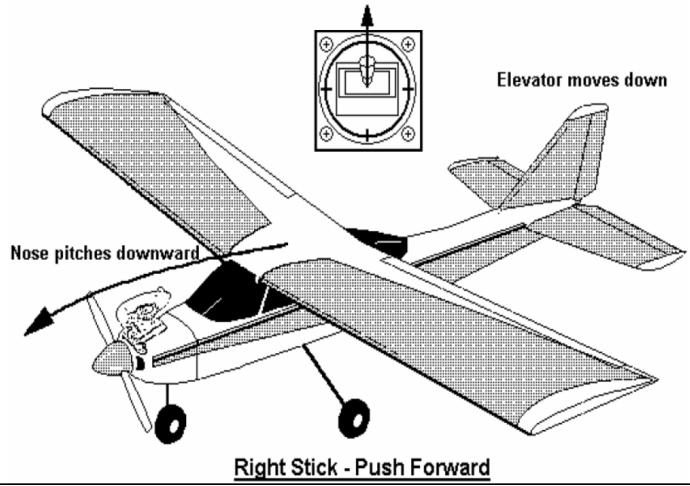
There are

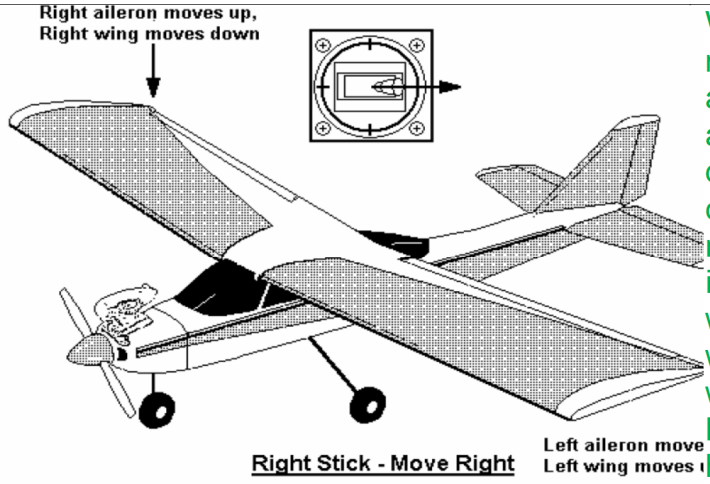
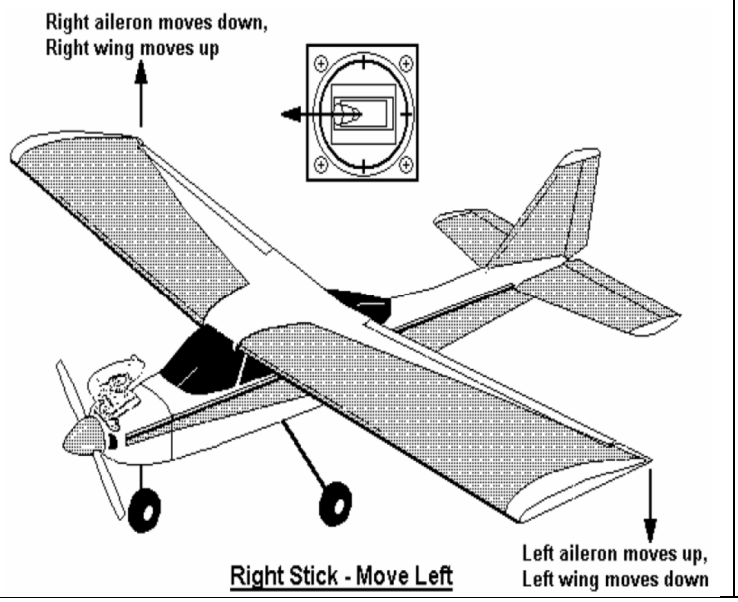
Two modes of transmission control:

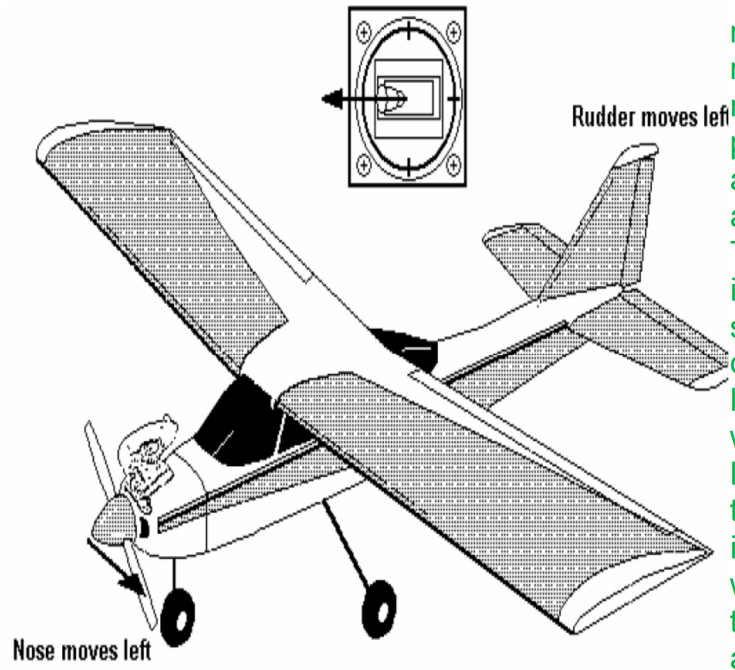
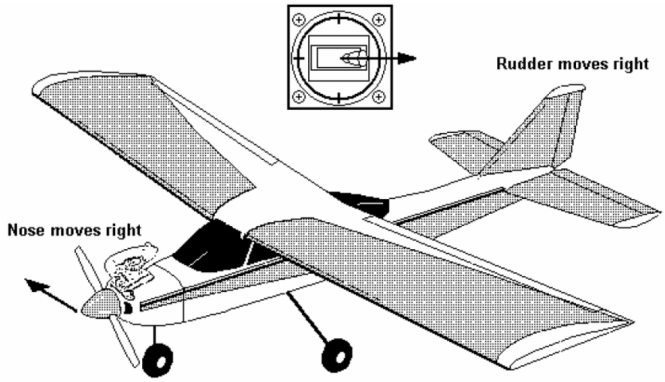




By using mode 2:

Controller	Picture	Description
To move the elevator upwards		This has the effect of pushing the tail of the model down, increasing the angle of attack of the wing and causing the nose to pitch upward. This also has the effect of increasing drag
To move the elevator downwards		Pushing forward on the right stick causes the elevator to move down. The tail lifts reducing the angle of attack on the wing, reducing lift and drag so that the model nose pitches downward

Aileron Move right		When the right stick is moved right, the left aileron deflects down and the right aileron deflects up. This causes the airplane to roll to the right. Lift is increased on the left wing and on the right wing it is reduced. It will continue to roll as long as the stick is held in the same position
Aileron move left		When the right stick is moved left , the opposite movements occur. The left aileron is deflected up and the right aileron down. By the same reasoning as before, the model rolls to the left. The right wing lifts up and the left wing drops. The roll will continue for as long as the stick is held in the same position.

Rudder Move left	 Left Stick - Move Left	When the left stick is moved left, the rudder moves to the left. The rear of the model is pushed to the left again trying to rotate about its central axis. The right wing increases its forward speed through the air causing an increase in lift and this time the left wing looses speed and lift. The combination of the yaw and the lift increase on the right wing results in a gentle turn to the left as long as the stick and rudder are held in position
Rudder Move right	 Left Stick - Move Right	Moving this stick to the right (below) causes the rudder to move right. This causes the model to swing or yaw to the right, trying to rotate about its central axis. The left wing moves slightly faster through the air increasing lift, whilst the right wing slows down reducing lift

Launching mechanism:

For proper launching; the wheels and its mechanism is supposed to be bear its weight when it comes down. So that it should be not only strong but also light weight. The wheels are so smoothen so that it somewhat free from friction and smooth run.

Finally we can design the aviator.