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ELECTRIC AIRCRAFT

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1. Components:

Body – Aluminum ,Titanium and Graphene(Selected because of their following properties)

Density of Aluminium=2.7 g/cm^3
Density ofTitanium = 4.5 g/cm^3
Density of graphene= 2.267g/cm^3
Graphene is one of the lightest material we can see. It has a C- structure .As per my research, this material is 200 times more resistant than steel and 5 times lighter than aluminium. It is widely studied for its potential use in various fields such as electronics, energy storage and bio-medicine. These are very strong metals; these are heat resistant (perfect for building aircrafts as they are continuously in contact of sunlight.)
Most of the planes fly in the lower stratosphere (Thousands of feet above the sea level) so they are comparatively closer to the Sun than the ground. So, resistance of heat is an unavoidable point. They are corrosion resistant. They are malleable and ductile which helps in development of a plane's complex structure. Main point is that they are being used for manufacturing since the start due to their light weight. (Comparatively less mg)

a) Power source: Huge solar panels and lithium ion batteries. (Lithium ions batteries selected due to the following properties)

They pack the most power into the lowest mass of any conventional battery. They also have a long cycle life which is extremely necessary for a long duration of flight. They can also be paired withsolar batteries so that the excessive solar energy can be stored in the lithium batteries .They also have a very high power density (between 260-270 W/kg and it can be more if built accordingly) as mentioned before which is going to be very helpful while operating the powerful engines at full pace for better velocity. While designing an object which is aerodynamic and flies, the main point of concern is the mg or simply the weight. Due to the weight problem I am designing a completely light aircraft (a lighter aircraft from the frame to the batteries, everything is light) . They are also currently being used for similar purposes due to the qualities mentioned above.

b) Thrust causer(engines): 4 turbo jet engines (for horizontal fast motion) and 4 cyclo-rotors (for verticaltakeoff and will help the aircraft to hover like a aliens UFO).
(Some good properties of turbo jet engine):
Its velocity at the exhaust is much higher than the flow velocity of a turbofan. (First reason for not using turbofan)
The temperature changes in a turbofan as the exhausts are not as significant as a turbo jet which further reduces noise. They have a comparatively higher RPM as compared to turbo fan. Main reason is that they can overall generate more horizontal thrust, so more speed for covering longer ranges in a short period of time.

Main features of the plane which will make it standout:
a) Longer range: I havedesigned an aircraft which will have an impressive range for an electric aircraft. It can be done by the use of two battery packs: one is the big and powerful lithium ion battery(main power source) other is the solar battery (supplementary battery) which is going to be on the whole roof of the plane. We will be able to the pair the solar battery with the lithium ion battery as well as use it independently (this power system is designed in such a way that we can use it either way and the final result will still be extremely long range.

- According to my research planes consume about 10 % of the power (fuel) while take-off, 85% of the fuel while flight time and the remaining 5% is used while landing. The majority of the fuel is consumed during the flight so in order to increase the range we must target the flight time fuel consumed (85%) and come up with a solution if we want to produce a long range vehicle. That is exactly why I have come up with the idea of two battery pack as mentioned above.

The main battery pack (powerful one) will supply the energy for take-off and landing as they require comparatively more power than gliding at a uniform speed (no matter whether the type of take is vertical or horizontal the lithium battery will provide the power). Now, to understand the use of comparatively weak solar batteries we must dive into physics a bit. (If a body is at rest and we need to accelerate the body till it reaches a speed limit) this is going to demand way more force than the force which required to maintain the

alreadyaccquired uniform speed by the plane using lithium batteries. This is when the solar batteries come into action,after the plane reaches its assigned height and position the pilot will be able to completely eliminate the use of lithium batteries and will be able to completely switch to solar batteries for the remaining distance for the plane to travel and again switch to lithium batteries while landing (as it requires more power so the solar batteries won't be able to generate that much power). If the pilot wants to use both the batteries together while flight , he can do it to and it will also increase the net range of the plane by a significant amount .
How can the pilots use both the batteries together?
Ans- As mentioned before, lithium batteries can be paired to the solar batteries. So while flight if the pilot pairs both of the 2 batteries (after the solar battery is finished charging it will supply some power down to the lithium batteries and will again reach to a limit there is still more energy which can be stored in the solar batteries (after giving most of its energy to the lithium battery for longer range) so the solar batteries will again start charging and it will keep on doing this cycle for longer range(other method for using the 2 batteries for longer range).

- Solar batteries single handedly won't be able to provide sufficient energy for landing or take-off(only lithium batteries will) . Solar batteries can be used only after the plane reaching the assigned speed and its going to complete the journey in the same speed.(85 % of the lithium battery usage will be completely eliminated as the solar batteries would take up the role to maintain the uniform speed and still keep on charging while getting used.)

In case after completing almost 100% of of the solar battery due to rough use, there will still be an enormous amount of lithium battery left and pilot will be able to switch to the lithium ion batteries and let the solar battery again regain all the lost energy (will be able to again get back to use after recharging for a couple of minutes) after getting into full capacity it will transfer some of its power to the lithium battery (full charge for lithium batteries) and solar batteries will again regain full charge from sunlight. So, I have designed an infinite source of power for the aircraft (keep on flying forever in uniform speed by switching batteries and charging them at the same time).

The cyclo-rotor for vertical take-off and hovering
My aircraft model is going to have 4 cyclo-rotor (2 at the back side (left side and right side) 2 at the from just a little below the pilot cabin(a little backward)) 4 cyclo-rotors are there in order to maintain the centre of gravity.
Why cyclo-rotors(eVtol)instead of vtol system used in fighter jets?
Ans: Vtol systems takes a huge amount of space inside the jets, fighter jets can afford the lack of space but normal passenger jets cant, vtol also consumes a huge amount of fuel while takeoff (which won't be very efficient for a plane which runs on complete electricity). If we use the exact same vtol that fighter jets use we might end up losing all of our charge in just one takeoff. Vtol used in fighter jets wouldn't be very practical in electric jets as they run on jet fuel (high octane number which supports burning and releases extreme hot air from the back). Batteries wouldn't be able to generate the heat which is generated by high octane fuel burning.

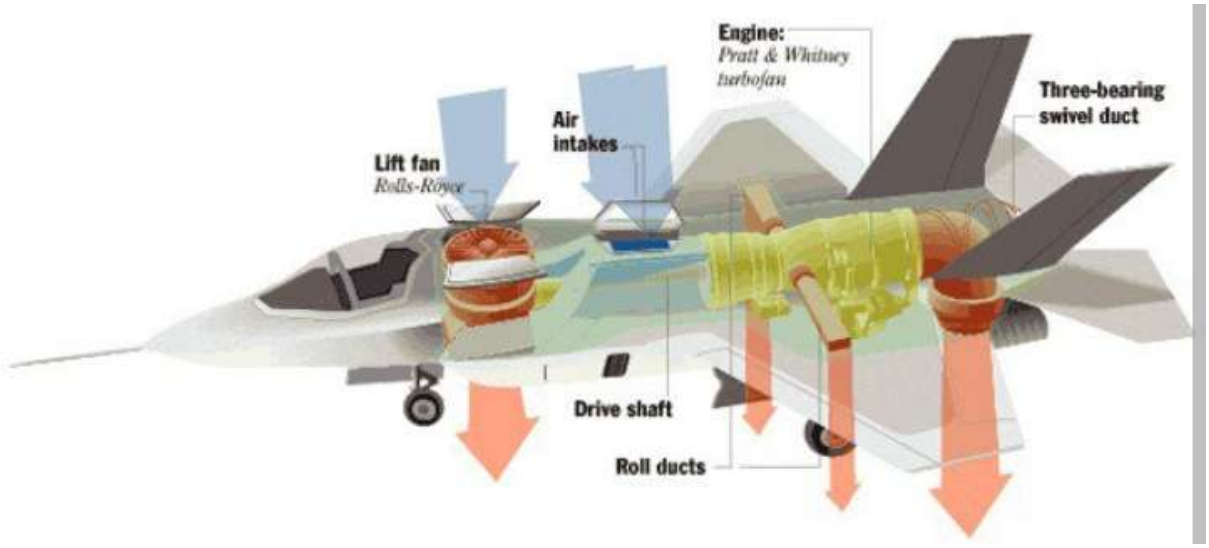


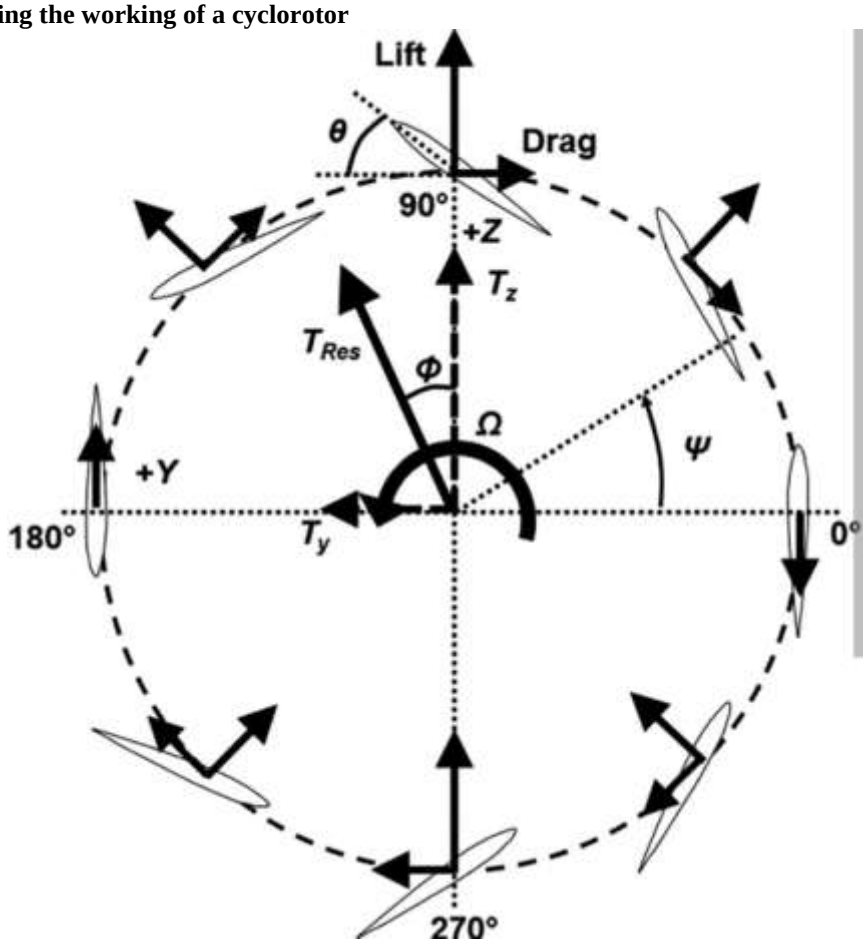
Diagram of the working of a Vtol system in a fighter plane
Why vertical take-off?
Ans : Its more practical for many areas and is more efficient. There are many areas in this world with poor geographic qualities (no plane areas) it can be extremely useful in such areas as it can be operated even a small

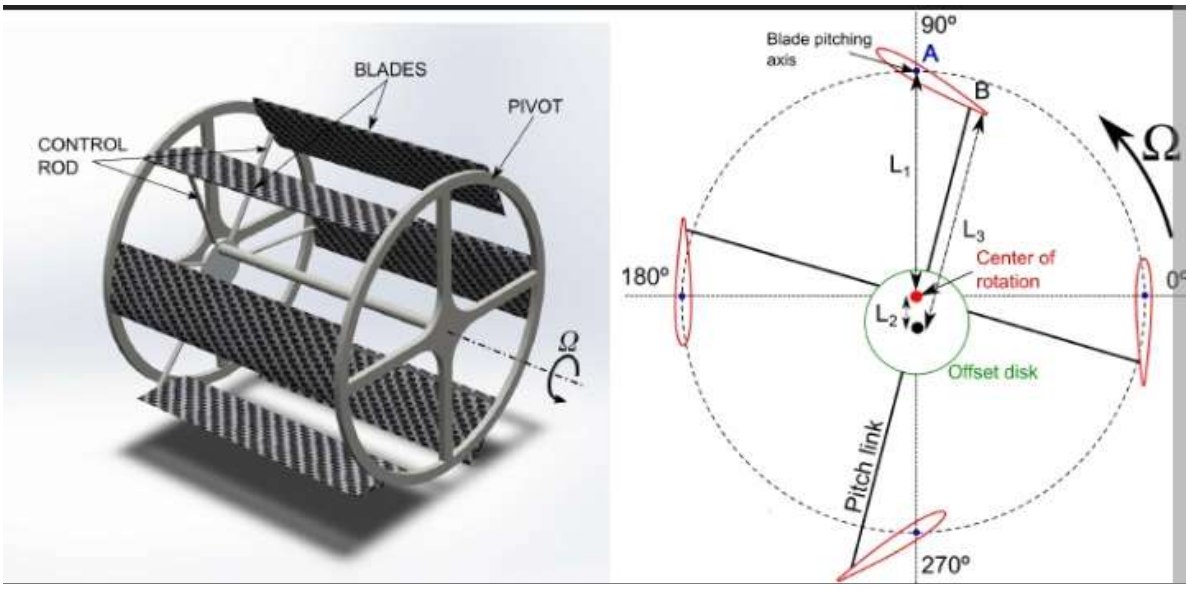
piece of land (no need for huge run-ways which are kilometers I length). It can be more practical as a private vehicle because of its cheap maintenance(no need to pay the airport a hefty amount for parking). We will be even able to park in our lawn (just like helicopter). It can even be used as rescue vehicles because of its practicality (can land anywhere and is very fast).

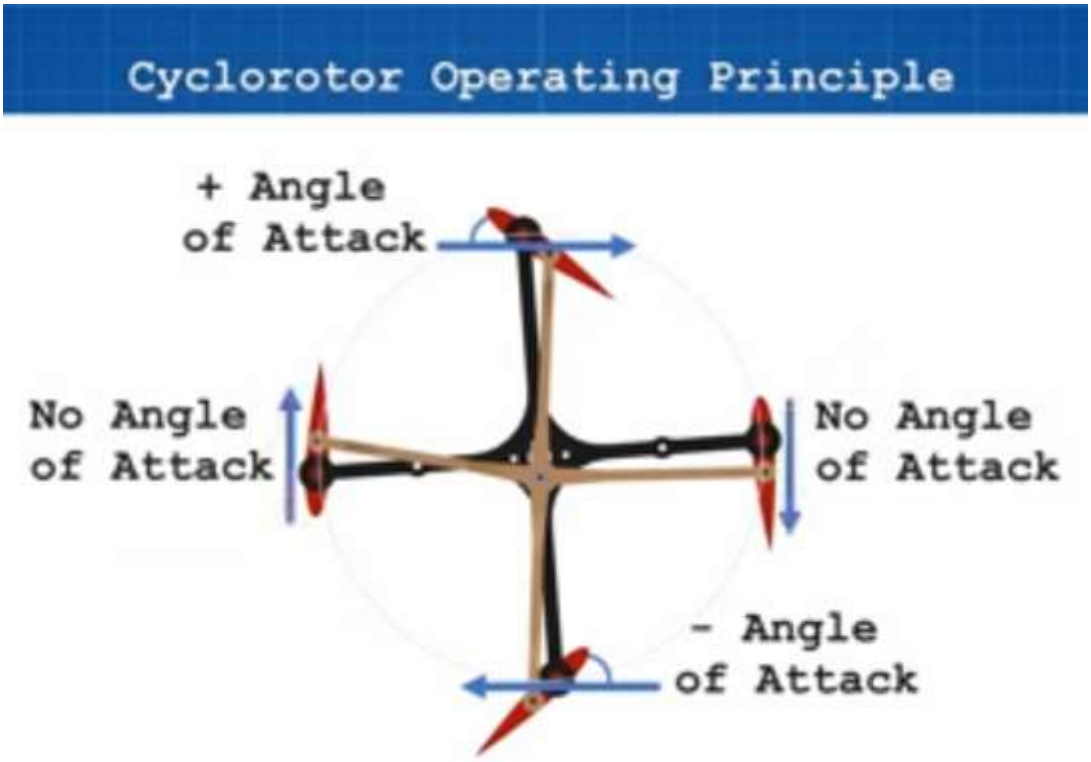
How does a cyclo-rotor work?

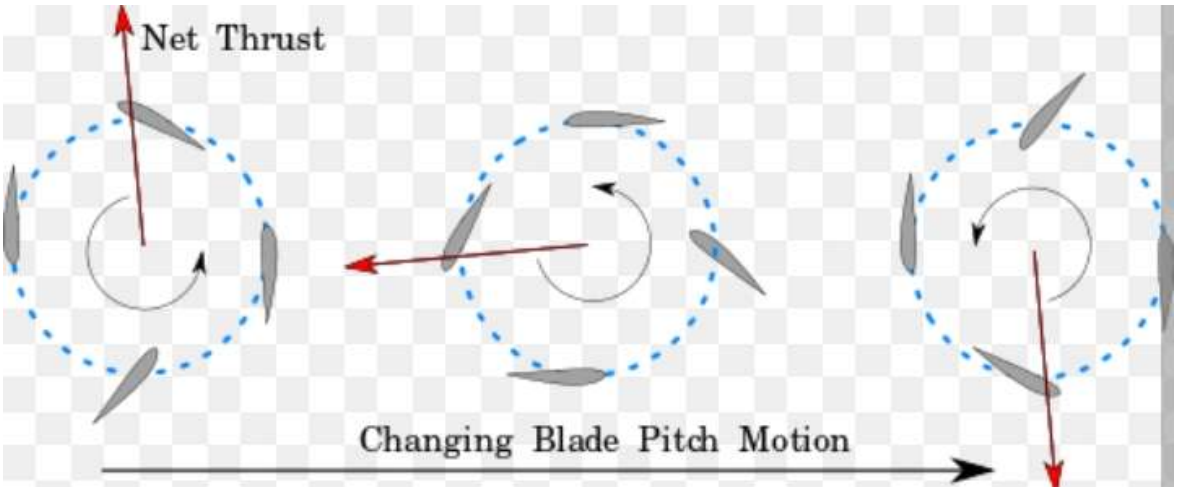
Ans:A cyclo-rotor several wings rotating around a central rotating axis at a constant speed. The wings are connected to a freely rotating hub with conrods. An eccentric position of the hub causes a periodic change of the pitch angle of attack of a wing during one revolution, which results in generating accelerated airflow and creates thrust. The distance between the rotation axis of the rotor and the rotation axis of the hub determines the thrust magnitude (force in the same direction of motion which is opposed by the drag). The position of the rotation axis of the hub in the peripheral direction determines the thrust direction 360 degrees around the rotation axis. During hover the blades are actuated to a positive pitch on the upper half of the revolution in a negative pitch over the lower half (induces a net upward aerodynamic force and opposite fluid down wash. This is a very old method discovered very early for vertical take-off, but wasn't a great success due to the poor infrastructure at that time. Now, we a developed a far better infrastructure and raw materials which can actually make the concept of cyclo-rotor legit.

Diagram showing the working of a cyclorotor




BLADES
PIVOT
CONTROL ROD
Ω
Blade pitching axis
90°
A
B
L1
L3
Center of rotation
180°
0°
L2
Offset disk
Pitch link
270°
Ω


Cyclorotor Operating Principle
+ Angle of Attack
No Angle of Attack
No Angle of Attack
- Angle of Attack



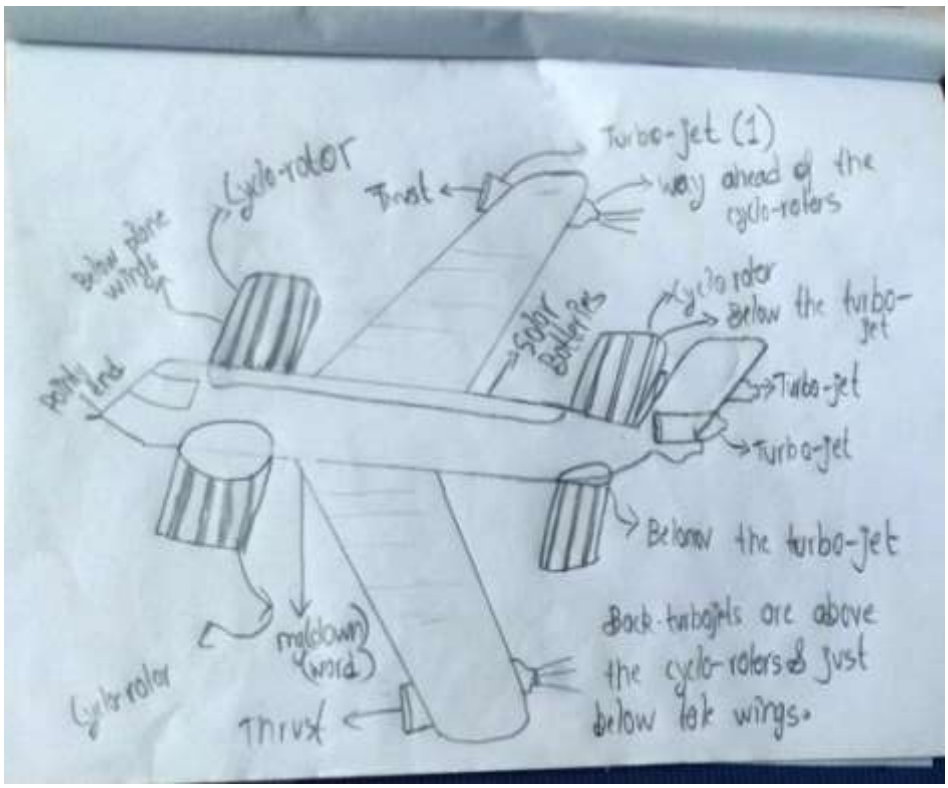
- **Pictures are taken from google**

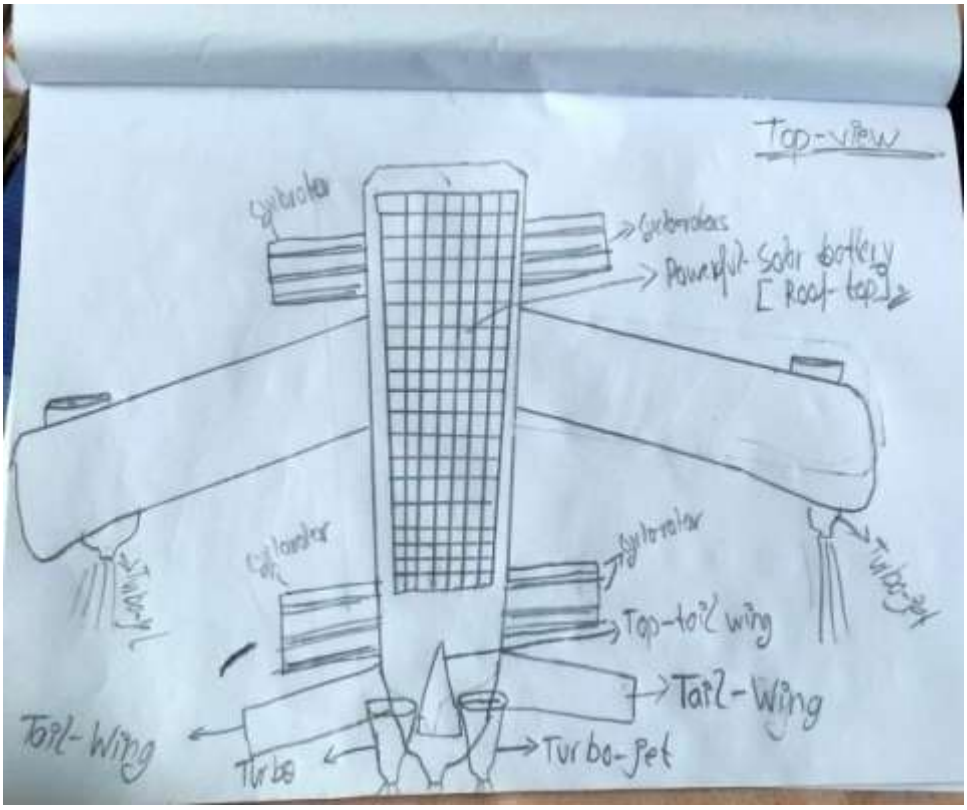
Types of take-off the planes can perform (according to the situation)

Horizontal take-off: As mentioned above, the plane also has 4 very powerful turbo jet engines(2 under the wind and 2 two in the back side). These turbo jet engines can easily generate enough thrust to make the plane take-off in a horizontal runway (just like a normal plane) these engines normally produce 5000lbs to even 115000lbs of thrust. These engines are enough to get the planes to very fast velocity for take-off. (using lithium ion batteries)

Vertical take-off: This is where the cyclo-rotors come into action. A total of 4 cyclo- rotors (2 just below the cock-pit and 2 just below the tail) can easily lift the jet into a certain height and also hover around (like a UFO). This system will even help the jet to takeoff from an island just as big as the plane itself.

- The 2 turbo jet engines will be placed just under the 2 wings and they still won't be in the way of the cyclo-rotors due to their placing in the end of the 2 wings (which is way ahead of the cyclo-rotors).
- My aero –dynamic design will easily help the plane to reduce the drag by a significant amount and also increase the thrust in the same time.
- The plane is going to have to deal with less air drag(resistance) and is going to get more thrust(powerful 4 turbo-jet engines), the planes going to be very-very light because it's only going to be designed using very light raw materials(very less mg(weigh)). I have made a design which is going to overcome all the opposing forces while flight. (Thrust is directly proportional to the velocity of the jet , the energy consumption will be low as the plane is going to be very light and aerodynamic , so less thrust is going to be needed in order to overcome comparatively less air drag , which is going to result in longer battery life.
- The plane will first take-of with the help off cyclo-rotors(turbo jet engines are not going to be running during take-off), then after reaching a specific height the pilot will be able to switch on the 4 turbo-jet engines then they will max the thrust of the turbojets (4 cyclo-rotors will still be working till now as the plane hasn't reached the gliding speed yet). After reaching a fast speed (fast enough for the plane to glide in the air and not fall down) then the pilot will be able to switch off the cyclo-rotors as they are no longer required and the powerful turbojets will do the work till they reach their assigned destination. (If the pilot switches of the cyclo-rotors before the plane reaching a fast speed the plane will simply fall). Switch off only when the plane is at enough velocity.
- During landing same thing is going to repeat, but a bit opposite. The plane will slow down the velocity of the turbo jet engines and quickly switch on the cyclo-rotors at full pace , then after switching on the cyclo-rotors the pilot will be able to completely shut down the turbojets(only when the cyclo-rotors reach their full pace and is producing enough thrust). Then the pilot will be able to hover a little bit using the cyclo-rotors just like a drone and find the best spot to land.
- Horizontal landing is also possible with flaps and turbo jets (no need for cyclo-rotors in this case).Horizontal landing will be no different than the landing of a commercial aircraft.





Drawings are not as per scale.