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# Flying Hover Bike [Within 3 Lakhs] A Small Aerial Vehicle For Commercial Or Surveying Purposes

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***Abstract:***
*This paper discusses the modeling of a ducted-fan FLYING BIKE for defense surveying and spying purpose. It is a compact aerial vehicle with a ducted fan configuration which can able to survey and spy the surroundings and also a simple design is used for commercial purposes like a motor bike. It does not allows our soldier to direct interference of unknown areas of danger. It can have a capacity of single or double seater system. It consists of a co-axial type propeller mounted on a hi speed brushless electric motor or for commercial purposes we can also use motor bike engines. It was powered by a rechargeable li-po fuel cells . Thrust vectoring can be done by a special design and techinique so that it can able to fly at almost in all directions. It is designed with a ducted fan so that the slip of air is less. Hence its aerodynamic efficiency is high. Moreover it can able to take off and land vertically from any terrain. It doesnot need any runway. Overall the basic flying bike costs only 3 Lakh Rupee.*

***Key words:*** *Ducted-Fan , MASS PILOTING SYSTEM.*

**1.Introduction**

This ducted-fan type bike is easy to operate and can be applied to various purposes because it does not need a runaway and is capable of hovering from any terrain. For this reason, the military has shown continued interest in ducted-fan vehicles. A ducted-fan bike is mobile and can be deployed rapidly, which makes it well-suited for a variety of missions such as reconnaissance and surveillance performed by soldiers at the platoon or squad level. Also, it is aerodynamically efficient because the lift generated by the duct can create a thrust force that is higher than the other VTOL vehicles, which have no duct and therefore no hovering flight mode. In the case of the ducted-fan type flying bike, its rotor is covered with duct which lowers the risks of rotor damage caused by tiny bugs and foreign object. Furthermore, it can be designed in a family of models from basic, medium and advanced levels, as well as be operated manually to perform numerous tasks such as reconnaissance and surveillance. Finally, the duct-fan type bike was developed under an innovative operational concept of landing on small areas such as the roof of a building, and of preventing excessive fuel consumption during hover flight .

A ducted-fan flying bike has very peculiar configurations and therefore, it is necessary to consider the exact dynamic modeling of this flying bike. The unstable flow due to the complicated design of the inner duct combined with static and dynamic instabilities makes the aircraft extremely hard to control. Dynamic instability is a unique feature of the VTOL hovering vehicles. Nevertheless, flight control performances such as flight condition, airspeed, and altitude can be greatly enhanced through exact dynamic modeling of a basic air vehicle. Hence, it is vital to investigate the tendencies of aircraft and understand instability through the analysis of dynamic modeling before designing flight control systems.

**2.Dynamic modeling**

*2.1.Vehicle Configuration and Coordinate System*

The ducted fan hover bike shown in Fig. 1 is used for dynamic modeling. The maximum rpm of the ducted fan HOVER BIKE is around 6,500 rpm. This micro HOVER BIKE has 4 control vanes that can control all 3 conditions as well as the heaving motion. Four control surfaces are located at the end of the duct. Deflections of each control surface range from -30° to +30°, providing enough power for the roll, pitch, and yaw controls.

A coordinate system, which also depicts characteristics of helicopters is used because, it has similar dynamic features such as the thrust vector, anti-torque, gyroscopic coupling, and velocity that are induced by the main rotor. Pitch angle and angle of attack is zero at hovering flight: as the vehicle goes forward, it moves in the direction of the negative coordinates.

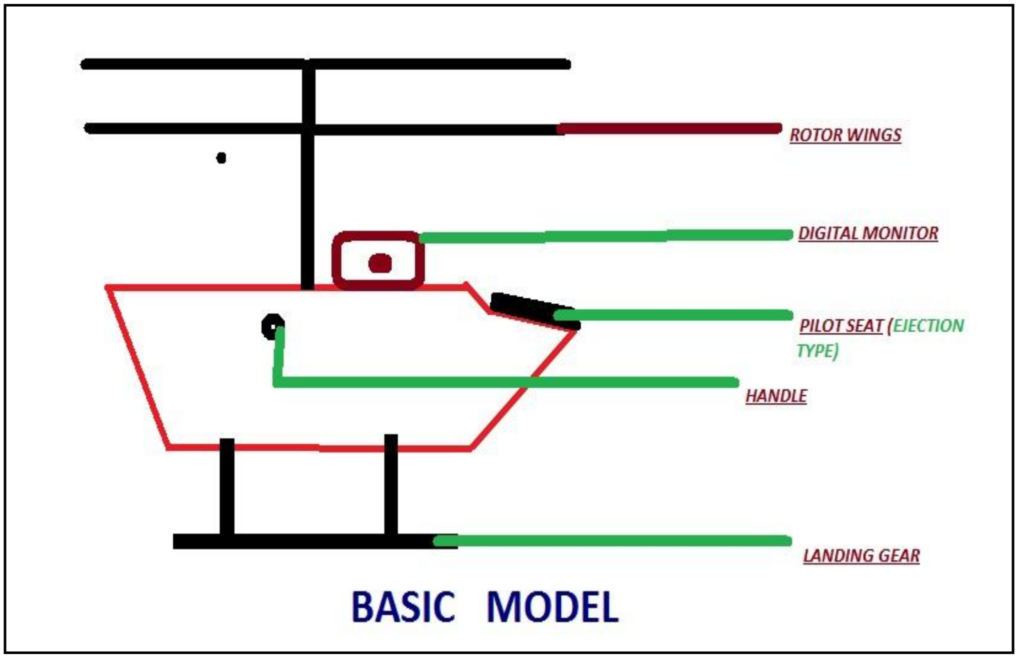



*Figure 1*

*2.2.Nonlinear Dynamic Equations*

Six degree-of-freedom (6-DOF) nonlinear-equations of motion are expressed in terms of the force and moment acting on the vehicle, which can be written as follows:

$$\dot{u} = vr - wq - gsin\theta + (X_{fuse} + X_{duct} + X_{cs})/m$$

$$\dot{v} = pw - ur + gsin\phi\sin\theta + (Y_{fuse} + Y_{duct} + Y_{cs})/m$$

$$\dot{w} = uq - vp + gcos\phi\cos\theta \\ + (Z_{fuse} + Z_{rotor} + Z_{duct} + Z_{stator} + Z_{cs})/m$$

$$\dot{p} = qr(I_{yy} - I_{zz})/I_{xx} + (L_{fuse} + L_{duct} + L_{gyro} + L_{cs})/I_{xx}$$

$$\dot{q} = pr(I_{zz} - I_{xx})/I_{yy} + (M_{fuse} + M_{duct} + M_{gyro} + M_{cs})/I_{yy}$$

$$\dot{r} = (N_{gyro} + N_{rotor} + N_{stator} + N_{cs})/I_{zz}$$

A stable pitch-up moment is generated by the distance between the center of gravity and the aerodynamic center. Because the aerodynamic center and the center of gravity of the vehicle have axis-symmetric configurations and are located on the z axis, the yaw moment is not generated. That is, the moment arm along the x- and y-axes is zero. The rotor modeling of the vehicle is based on the momentum theory and blade element theory applied to flight analysis of helicopters. Twist angle of each blade gets lower toward the blade tip. The main rotor system of conventional helicopters has swash-plate so that the thrust force can be either in the forward/backward or left/right directions, whereas in the case of the ducted-fan , it has fixed rotors located inside the duct. Thus, the force generated by the main rotor acts only on the z-axis. Considering the airspeed along the z-axis, the configuration of the blades, the inflow, and thrust of the rotor can be expressed as

$$v_b = v_z + \frac{2}{3}\omega_r r(\frac{3}{4}K_{twist})$$

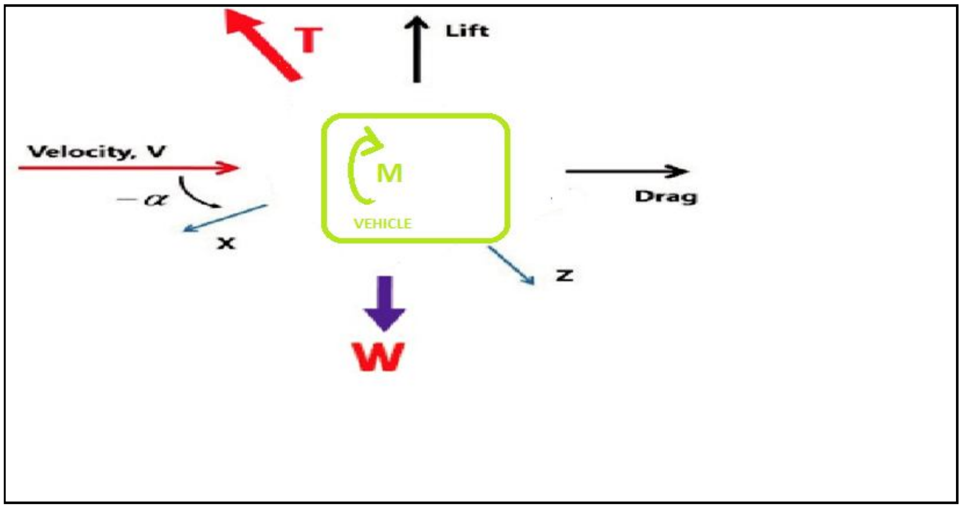



*Figure 2*

*2.3.Thrust Vectoring*

The thrust vectoring is done by a special process, in which 4 rudders are placed at the end of the duct in 4 different directions. Each rudder can be moved individually by means of a controllable actuators connected with pilot seat arrangement. And also a round shaped nozzle is fixed between these setup. By adjusting the rudders at the tip of the duct enables the vehicle to travel along almost all directions. The nozzle set up additionally improves the aerodynamic stability of the vehicle. An example of my model is below

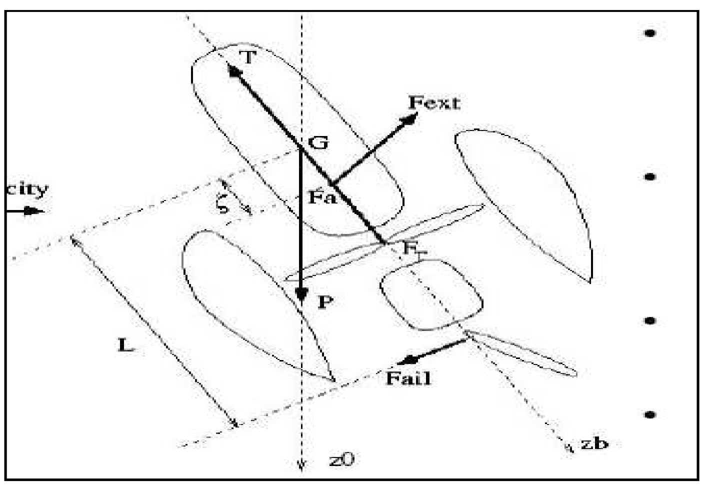
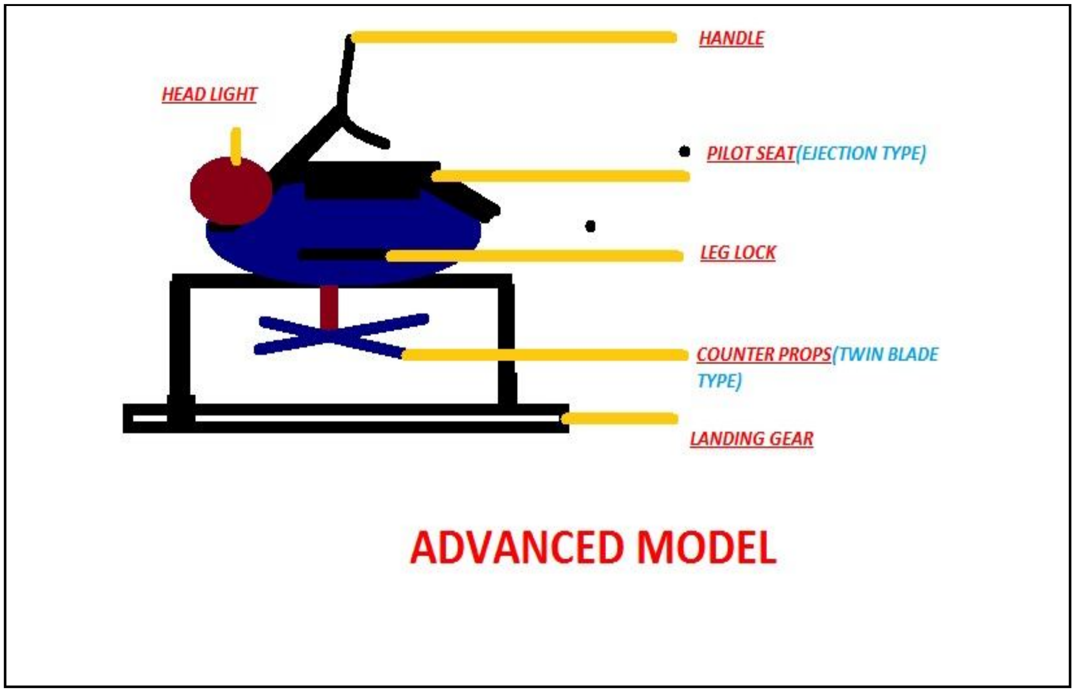



*Figure 3*

**3.Piloting System**

Here I have used a new type of manuaring system called MASS PILOTING SYSTEM




**4.Mass Piloting System**

*4.1.What Is A Mass Piloting System*

In the name itself I explain the operating principle of this vehicle. By applying the body mass of the pilot he can able to control and manuare the bike through the air. In this simple flight design there is no change in the pitch angles of the propeller to move, instead that the pilot use his body weight to change the direction of flight.

*4.2.Clear Explanation Of Piloting*

While starting the machine propeller starts and it produces the lift .So that it hovers and stands steadily in air the whirl motion can be controlled by tail rotor . The pilot is seated on the centre of gravity of bike.

*4.3.To Move Forward*

The pilot has to move forward and give more pressure on the handle . So that the flight was disturbed from its centre of gravity and due to slightly inclined propeller action the thrust is vectored in forward direction and hence the bike cruise forward.

*4.4.To Yaw And Roll*

The pilot has to move side wards, so that the centre of gravity gets disturbed and due to increase in pressure in right or left side in order to move the bike sidewards.

*4.5.Reverse Motion / Brake System*

The pilot has to move slightly backward to stop the bike and then return to the original position to made the bike stands steadily in air and by lowering the propeller speed he can able to land. For simple backward motion pilot has to move backwards strongly.
This piloting system is similar to the pendulum action of a helicopter.

**5.Conclusion**

Hence I conclude that this ducted fan HOVER BIKE is a promising concept in defense system and also for commercial purposes. It has high aerodynamic efficiency due to the ducted fan arrangement. It has an ability to fly at all directions by means of the specially designed thrust vectoring structure due to the rudder arrangement. It can able to take and land vertically in any terrain conditions. It can be easily manuarable and it can also have a wi-fi and Bluetooth enabled system for camera for spying purposes. Hence it is a complete device for the complete protection of a soldier and also a dream flying vehicle for commercial uses.
Note: This research is had its initial concept in Germany's concept of flying bike in world war and later it was stopped due to inefficient performance. Now I developed that concept and researched to use it for commercial and military purposes by this method of MASS PILOTING SYSTEM.

**6.Reference**


1. https://www.youtube.com/watch?v=BYta-DQOINw (this video gives the basic idea of this research)
2. Rotorcraft Flying Hand Book(2000), U.S. Department Of Transportation Federal Aviation Administration, Flight Standards Service. Page no:3.2 pendulum action-It gives the idea of MASS PILOTING SYSTEM.