



STUDY OF HOVERBIKE

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ABSTRACT

This paper discusses modeling of ducted-fan FLYING BIKE OR HOVERCRAFT for defense surveying and spying purpose. I inspire by movie star wars to make HOVERBIKE. It is a compact aerial vehicle with ducted fan configuration which can able to survey and spy the surroundings and also a simple design is used for commercial purposes like motor bike. It does not allow our soldier to direct interference of unknown areas of danger. It can have capacity of single OR double seated system. It consists of a co-axial type propeller mounted on hi speed brushless electric motor or for commercial purposes we can also use motor bike engines. It was powered by rechargeable LI-PO fuel cells. Thrust vectoring can be done by special design and technique so that it can able to fly almost in all directions. It is designed with ducted fan, so that the slip of air is less. Hence its aerodynamic efficiency is so high. Moreover it can able to take off and land vertically from any terrain (land of particular kind). It does not need any runway. Overall the basic flying bike costs only 3 LAKH RUPEES.

A REVOLUTION IN AVIATION:

- 1) We combined the simplicity of a motorbike and the freedom of a helicopter to create the world's first flying motorcycle. his paper discusses the modeling of a ducted-fan FLYING BIKE for defense surveying and spying purpose. It is a compact aerial vehicle with 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.
- 2) It does not allow our soldier to direct interference of unknown areas of danger. It can have a capacity of single or double seated system.
- 3)It consists of a co-axial type propeller mounted on hi speed brushless electric motor or for commercial purposes we can also use motor bike engines.
- 4) Thrust vectoring can be done by special design and technique so 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 does not need any runway.
- 5) The Hover bike flies like a quad copter and can be flown unmanned or manned while being a safe-low level aerial work-horse with low on-going maintenance.
- 6)The Hover bike has been designed from the very beginning to replace conventional helicopters such as the Robinson R22 in everyday one man operational areas like cattle mustering and survey, not just for the obvious fact that it is inefficient and dangerous to place complex conventional helicopters in such harsh working environments
- 7) Our goal is to produce an extremely reliable helicopter, designed with rugged simplicity at its heart and true pilot safety built into design and operation of aircraft.

8)The vehicle is controlled by deflecting thrust from its two propellers using control vanes – these are a bit like rudders or ailerons on a PLANEN .The most noticeable feature of the new Hover bike and the 1/3rd scale drone is unique patent pending offset and overlapping rotor blades, designed to reduce weight and plan form area. Just like the manned vehicle, the ducting around the propellers is safety feature, and the vehicle is light weight and powerful, while folding to a compact size for transportation.

Keywords Ducted-Fan, MASS PILOTING SYSTEM, pilot seat controllable actuators, swash plates, Whirl motion, pendulum action

I.INTRODUCTION

1.1After watchingStar Wars movie, you were probably convinced that the coolest mode of transport is the hover bike.

1.2A California engineering firm tried to made the dream a reality by creating a futuristic flying vehicle similar to those ridden in sci-fi movies.

1.3The hover bike has twin ducted rotors facing the ground that let it float from the ground, and two control sticks that allow it to change direction.

1.4Aerofex tested the hover bike for speed and stability at the Mojave Desert. The hi-tech vehicle flew through the desert at speed of up to 50km/h. Although it was slower than the "Star Wars" speeder bikes, the machine proved that flying can be as easy as riding an ordinary bike.

1.5However, the chance of finding a hover bike in the market won't happen anytime soon. AEROFEX said that it has no plan of selling the vehicle and the technology was just intended to develop unmanned drones.

1.6The aerospace company however said that a second prototype will be tested in October and the unmanned hovering drone in 2013.

1.7Since the video was posted, it has racked up more than 151,000 views on YouTube. Many viewers were thrilled at the idea of riding their own speeder bike soon, while others were anxious about the machine's safety.

II.BACKGROUND

2.1 A hovercraft is a vehicle that is hovering just above the ground or over snow or water by a cushion of air. In a hovercraft a similar cushion of air is maintained by pumping in a steady air supply, to keep pace with the linkage round the sides.

2.2 There is always some leakage because the craft has to be free to move, but the designers use various methods to keep leakage as small as possible so that only minimum power is required to keep up the air supply. There are various ways of creating of air cushion and reducing leakage.

2.3 When the fan rotates, the air pressure is pushed inside the skirt to create lifting and the hovercraft hovers with almost no friction. A well designed hovercraft has much better performance than the normal boat because it has less drag and requires less horsepower to move. This condition results higher speed and less fuel consumption.



2.4 The hovercraft gets above twice the fuel mileage of a boat with similar size or capacity. The medium scaled hovercraft also works very well in water where the standing waves up to a meter high. By using the concept and equation of Bernoulli, the volumetric flow rate of the hovercraft fan can be obtained.

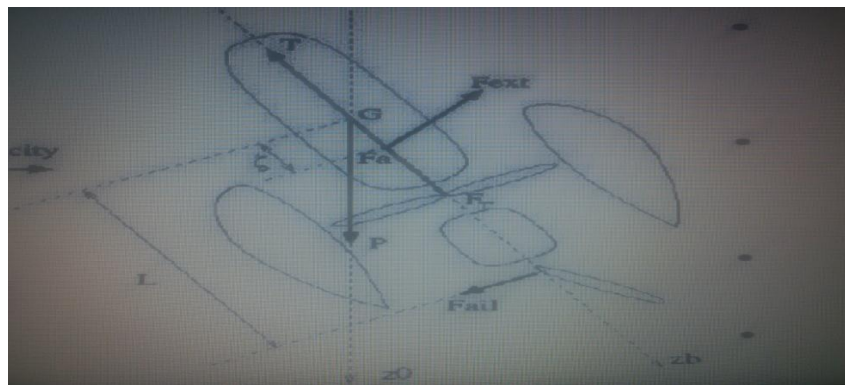
2.5 The first hovercraft is produced ever in Malaysia was by AFE manufacturing company with Japanese technology collaboration. The launching of the hovercraft in PUTRAJAYA in 2003 has paved way for new opportunity in manufacturing sector.

2.6 This event was a prelude for the event in 2006 where Malaysia will host World Hovercraft Championship. The hovercraft has been made in variety of shapes, sizes and types based on its characteristics and purpose. There are three main types or categories of hovercraft which are amphibious hovercraft, non-amphibious and the semi-amphibious hovercraft.

2.7 The weight of the hovercraft is one of the considerations important in the design. Light- weight materials are used for the construction. Moreover, the pressure must be created inside the plenum chamber in order to create the sufficient lift force to the hovercraft. In the model, the Peripheral Jet system is applied.

III. TRUST VECTORING

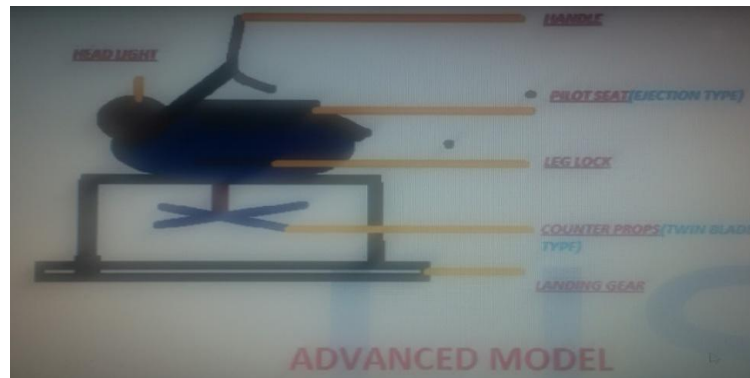
3.1 The thrust vectoring is done by a special process, in which 4 rudders are placed at the end of the duct in 4 different directions. Each rudder can be moved individually by means of a controllable actuators connected with pilot seat arrangement. And also a round shaped nozzle is fixed between these 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.



Trust Vectoring

IV. PILOTING SYSTEM

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



Piloting System

V. WHAT IS A MASS PILOTING SYSTEM

5.1 In the name itself I explain the operating principle of this vehicle. By applying the bodies' mass of the pilot he can able to control and manure 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.

VI. CLEAR EXPLANATION OF PILOTING

6.1 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.

VII. TO MOVE FORWARD:

7.1 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.

VIII. TO YAW AND ROLL:

8.1 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. 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.

8.2 This piloting system is similar to the pendulum action of a helicopter.

IX. MANUFACTURING EXPENSE

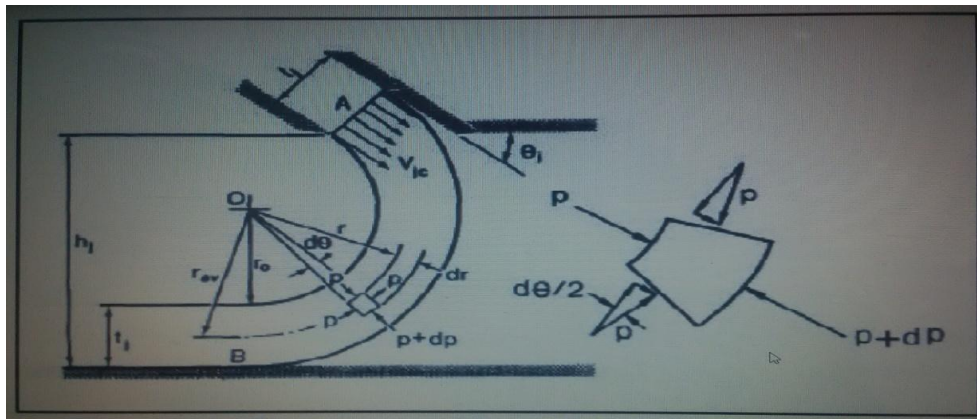
9.1 The total expense of the flying hover bike project is as follows:

Sr. no	PARTS	PRICE (in rupees)
1.	Engine with gear box	75,000/-
2.	Steel alloy for body	75,000/-
3.	Twin blade propellers	10,000/-
4.	Electronics and control parts	50,000/-
5.	Landing skies and pneumatic suspension	50,000/-



6. Other fabrication charges	40,000/-
7. Total	3, 00, 000/-

X. CALCULATION OF LIFT FORCE



10.1 GENERAL EQUATION

➤ $F_c = W = P_c A_c + J_j L_j \sin \theta_j$ (1)
(Oka for B E 2013)

- F_c = Lift force (N)
- W = Weight of the model (N)
- A_c = Area of cushion (m²)
- J_j = Momentum flux of air jet per unit length of the nozzle (Kg/s²)
- L_j = Nozzle perimeter (m)
- θ_j = Angle of the nozzle from the horizontal (°)

➤ $J_j = P_c r$ (2) (Oka for B E 2013)

- r = The average radius of the curvature of the length (m)
- P_c = Cushion pressure (Pa)
- h_j = The lift height (m)

➤ From the calculation, we get:

- $A_c = \text{Length} \times \text{Width} = 0.025 \text{ m}^2$
- $W = \text{Mass} \times \text{Gravity} = 0.8 \times 9.81 = 7.848 \text{ N}$
- $r = (h_j / (1 + \cos \theta_j))$
- $h_j = 6.2 \text{ cm} = 0.062 \text{ m}$ (measured)
- $\theta = 45^\circ$
- $r = (0.062 / (1 + 0.7071)) = 3.5147 \text{ m}$
- $J_j = 3.5147 P_c$
- $L_j = \pi \times t_j$
- $T_j = \text{orifice diameter (m)} = 0.06 \text{ m}$



- $L_j = 0.1885 \text{ m}$
 - Finally:
- $W = P_c A_c + J_j L_j \sin \theta_j$
- $W = P_c A_c + 3.5147 P_c (0.1885) \sin 45^\circ = P_c (A_c + (3.5147 * 0.1885 * \sin 45^\circ))$
- $P_c = W / (A_c + 0.4685) = 7.848 / (0.025 + 0.4685) = 15.9027 \text{ Pa} = 15.9027 \text{ N/m}^2$
- $P_c/P_j = (1 - e^{-2t_j/r_{av}})$ (3)
(Oka for B E 2013)
- $P_c/P_j = 1 - 0.9664339552976728 = 0.0335660447023272 \approx 0.03357$
- $P_j = (15.9027 / 0.03357) = 473.7176 \text{ Pa} = 473.7176 \text{ N/m}^2$
 - Total volume flow per second into the skirt is:
 - $Q_j = (L_j h_j / (1 + \cos \theta_j)) (2P_j/\rho)^{1/2} (1 - (1 - P_c/P_j)^{1/2})$ (4)
(Oka for B E 2013)
- $Q_j = (0.1885 \times 0.062 / (1 + \cos 45)) (2(473.7176) / 1.184)^{1/2} (1 - (1 - 15.9027 / 473.7176)^{1/2})$
- $Q_j = 3.9709 \times 10^{-3} \text{ m}^3/\text{s}$
 - Power required is given by:
- $P_{aj} = P_j Q_j = 473.7176 \times 3.9709 \times 10^{-3} = 1.881 \text{ W}$

XI. DESING

11.1 A computer aided drawing (CAD) software CATIA V5 is used in this study to design the hovercraft in the test section as shown in Figure 1 before the fabrication process is started.



ACTUL PHOTO OF HOVERCRAFT

XII. TABLES

12. 1properties and Values

Properties	Value
Length	50 cm
Width	5 cm
Height	8 cm
Lift and Thrust Power	Battery
Lift Method	Propeller
Thrust Method	Ducted Propeller
Thrust Line Control	Servo Controlled
Body Material	Polystyrene
Model Weight	0.8kg

12.2 Hovercraft Model Indication



Figure-Indication Model Of Hovercraft

Label	Description
1	Playstation2Controller
2	ARDUINO Uno (Processing Unit)
3	Brushless Motor for lifting
4	Skirt/Air cushion
5	Brushless Motor for Propulsion
6	Rudder
7	Thrust Duct
8	Hull Base



12.3 Dimension of Model Hovercraft

No	Items	Amount
1	Hull length	0.5m
2	Hull width	0.05m
3	Air gap	1mm
4	Max gross weight	0.8kg

12.4 Hovercraft Model Measurement

Items	Unit	Amount
Approximate lift Perimeter	(m)	0.062
Total hover gap area	(m)	0.001
Total cushion area	(m ²)	0.025
Cushion pressure	(Pa)	15.9027
Expected actual air Velocity	(m/s)	14.26464
Lift air volume	(m ³)	0.00155
Estimated lift engine Power	(W)	1.881
Fan diameter	(m)	0.12

XIII. How it Works

The 'hover bike' is similar to a quad copter, using four standard helicopter style rotors, overlapped with each other. It is controlled using a standard RC handset, and can also be programmed to fly a set path. 'This drone was originally built as a proof of concept for our latest full-sized Hover bike prototype,' said Chris Malloy, the drone's inventor. 'After testing the 1/3rd Hover bike, we realized that it had lots of features that made it a fantastic drone, not only this - selling this scale Hover bike to the public would allow us to raise funds to continue the development of the manned version.





The full sized design uses a motorcycle engine and controls. However, the smaller version uses electric motors, and can be controlled using a standard RC helicopter controller. The drone is made up of four blades, which give it its stability. The firm says its full sized version could be used to commute on. The futuristic prototype has the potential to travel up to 92 miles or for about 45 minutes on one tank of fuel and is expected to come with a safety price tag of more than £45,000/-. So far the bike, which weighs 270 Kg s, has only been tested while tethered to the ground to prevent it flying too high, But plans to test its capabilities without any restrictions.

'We combined the simplicity of a motorbike and the freedom of a helicopter to create the world's first flying motorcycle,' it said. 'When compared with a helicopter, the Hover bike is cheaper, more rugged and easier to use - and represents a whole new way to fly. 'The Hover bike flies like a quad copter, and can be flown unmanned or manned, while being a safe - low level aerial workhorse with low on-going maintenance.'



Hover bike in Star wars Movie

XIV. CONCLUSION

More Advantage of hover bike or hover-craft is maintain conservation of fuels. The mechanical part is the most challenging issue; especially this is the model to the Hovercraft prototype in fabrication in the Faculty of Manufacturing Engineering. The hull of the model was made from the polystyrene due to light, low cost and easy to shape. The loss of the energy due to the air friction should be revised by fabricating a better thrust duct using different materials and method, a study that does not presented here in this paper. For the skirt, the soft rain coat is used. The location of the weights relative to centre of gravity is very important. Since this is only small model of 1/4 scale of Hovercraft prototype, the stability problem seems not very serious. But in the prototype, every position of the weight of the parts is measured precisely so that the prototype will have a reliable stability whether on the road, on the grass or in the water. For the electrical part, the model uses ARDUINO Uno to activate the ESC (Electronic Speed Controller) because both of these motor drivers need supply by the pulse width modulation signal (PWM) that supported 25 Ampere. Two brushless motors AXN-2208-2150 are used for the purpose of lifting and propulsion. The fabrication of the Hovercraft model has been



successful and the data of speed, air cushion pressure and power have been recorded for the use in the fabrication of the Hovercraft prototype in process. 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 ducted fan arrangement. It has 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 & land vertically in any terrain conditions. It can be easily man arable and it can also have Wi-Fi and Bluetooth enabled system for camera for spying purposes. Hence it is complete device for the complete protection of a soldier and also a dream flying a vehicle for commercial uses.

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