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STUDY OF CONSTRUCTION AND WORKING OF HOVER BIKE

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Abstract: *In this report, we discuss the future of automobile called as Hover Bike. This is a future evolution of transporting. 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 motorbike. Also, it can be used for various field of application area surveillance, material handling, movie industries, military and emergency services. It can have a capacity of single or double seater system. 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 the ducted fan so that the slip of the air is less. Hence its aerodynamic efficiency is so high. Moreover, it can able to take off and land vertically from any terrain. It does not need any runway.*

Keywords: Hover Bike, Quad-Copter, Overlapped Propeller, Battery.

1. INTRODUCTION

Today's aerospace industry focuses on two primary areas: transportation and military. The transportation sector focuses on designing larger, more efficient, and more reliable aircraft. The military focuses on designing more effective, manoeuver, and deadly weapons. There is also a private sector in the aerospace industry. Small single engine planes, new helicopters, and other unique flying devices all fall into this category. Beyond the private sector, there are also several commercial applications that could benefit greatly from the hover bike [2].

A hover bike is a combination between a motorcycle and a helicopter. It looks like simple bikes. 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. It would be able to take off and land vertically, for this reason, the military has shown continued interest in ducted-fan vehicles [2][3][4].

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 [7]. Ideally, such a vehicle would be able to allow people to navigate the earth in a new and unique way. Some test prototypes are in development but no commercial hover bike has been built yet.

2. OBJECTIVES

The main concept behind the making of Hover bike are:
-To solve the traffic problem.
-To conservation of fuel.
-To improve way of transport.
-To avoid unpredicted accident
-To reach some areas inaccessible to road vehicles and helicopters.
-To rescue people who fall through ice.
-To design for military for to supply ammos, weapons provide medical help.

3. HISTORY

The original Hover bike was built by Chris Malloy of New Zealand in 2006, after work and studies in his garage in suburban Sydney Australia. This project started out as a hobby, but quickly grew into a commercial enterprise, with interest from people and groups such as universities, farmers, search and rescue, private and military, with notable visits from the US Army G-3/5/7 and Locheed Martin "skunk works" Most of the frame of the original Hover bike was hand crafted from carbon fiber, Kevlar and aluminium with a foam core.

Fig-1: First Hover Bike Bi-copter prototype

Hover bike was hand crafted from carbon fiber, Kevlar and aluminium with a foam core. First Hover bike prototype is a bi-copter. The vehicle is controlled by deflecting thrust from its two propellers using control vanes – these are a bit like rudders or ailerons on a plane. The bi-copter is an elegant solution and vehicle – however the available technology is not ready yet for a practical vehicle with a bi-copter design [2].

4. LITERATURE REVIEW

Kailas Gaware et.all[1] (2018) concluded that Adventurous motorcyclists might be familiar with the thrill of getting airborne at the top of a rise, but the Hover Bike was set to take catching some air to a whole new level. When compared

with a helicopter, the Hover bike was cheaper, so that cheaper better product will not only take over the existing market but also its open the way for those people whose not afford the costs of a typical helicopter [1].

Ninad R. Patil et.all[2] (2017) concluded that the Original hover bike uses IC engine as a power source but they was proposing electric energy as a power source. So there was a contribution towards pollution control. The only disadvantage will be its high initial cost [2].

Umesh Carpenter et.all[3] (2017) analysed that the Hover bike has been designed from the very beginning to replace conventional helicopters in everyday one man operational areas like cattle mustering and survey, not just for the obvious fact that it was inefficient and dangerous to place complex conventional helicopters in such harsh working environments but also from a practical commercial position in which bringing to market a cheaper better product will not only take over the existing market but can open it up to far more new customers who before could not afford the upfront costs of a typical helicopter and the very expensive and often unlooked for maintenance costs [3].

Purushottam Jadhav et.all[4] **(**2016**)** concluded the advantage of hover bike or hover-craft was maintain conservation of fuels. The mechanical part was the most challenging issue. The hull of the model was made from the polystyrene due to light, low cost and easy to shape. It had high aerodynamic efficiency due to ducted fan arrangement [4].

Swaraj D. Lewis et.all[5] **(**2016**)** concluded that it could fly at a range of around 800m, endurance of maximum 5-10 minutes, payload obtained in case of two blade propeller was 0.3kgs and in case of three blade propeller was 0.5kgs [5].

B. Lokesh et.all[6] **(**2015**)** concluded that such type of bike is the need of today.
The designed light weight Hover Bike could successfully achieve lift and stability during flight [6].

5. CONSTRUCTIONAL DETAILS OF HOVER BIKE

Hover Bike 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.

Fig-2: Simple Design of Hover Bike

This is a simple construction of overlapped propeller quad-copter Hover Bike. It consists of coaxial type of propeller mounted on a high speed brushless electric motor and powered by rechargeable Li-Po fuel cells. 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.

The component used to build a Hover Bike are as follows:
5.1 Frame
5.2 Propeller
5.3 Battery
5.4 Electric motor
5.5 PDB
5.6 ESC

5.1 Frame:

The main goal of the practical design is to develop a lightweight frame, mount an engine with propellers on it, and implement a drive system to rotate the propellers and achieve lift.
We can use ANSYS and CATIA software for designing and analysis.

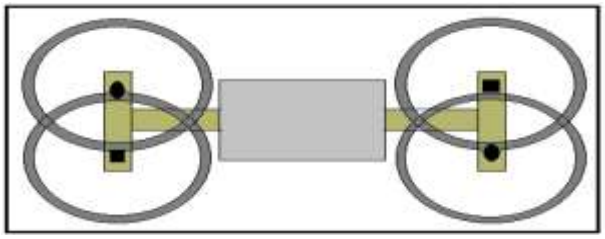

Fig-3: Schematic Diagram of Hover Bike (Top View)

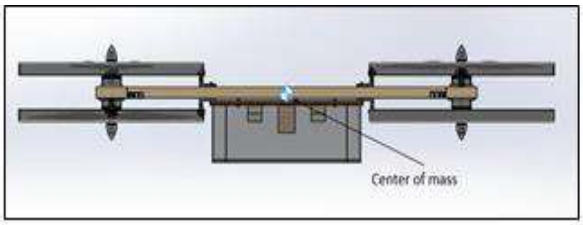

Fig-4: Schematic Diagram of Hover Bike (Front View)

As we discussed above, the original Hover Bike was Bi-copter, but because of this the Hover Bike can not stable in the air and much harder to handle. For proper handling and balancing we used four propeller and for compact size we choose overlapped construction, this is called as 'overlapped propeller quad-copter Hover Bike'.

The main ideas taken into consideration were the housing of the motor engine and the propellers, a place for the rider to sit.

Important factor consider for frame:
-Shape of the body should be aerodynamic to decrease the drag offered by air.
-It should cover less floor area.

-Housing for motor and propellers should be of low weight and compact.
-Material should be light weighted, low cost and easy to shape like carbon fiber, aluminium and polystyrene.
-The location of the weights relative to centre of gravity is very important for balancing.

5.2 Propeller:

Propellers are attached to the motors and these are the objects that create the thrust necessary to lift your drone into the air. Ducted fan type propeller is very efficient to produced high thrust. 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.

Fig-5: Ducted Propeller

The lower the number of blades on a propeller, the more efficient the propeller is. The more blades included the more blade area there is to create more pressure to lift. With the four-foot diameter propeller design, two blades give plenty of area for lift, and keep it an efficient design at the same time. We are using a 2 blade propellers in our Hover bike.

Important factor consider for Propeller:
-Number of Blade: When number of blade is more then create more thrust but it re required more power, because of this choose minimum number of blade.
-Size of blade should be low considering the size and weight of hover bike for compactness.
-Material should be light weighted, low cost and less corrosive.

5.3 Battery:

Using bike engine in the hover is quite difficult because of its weight and difficulty in operating efficiently, but Electric motors are quiet, energy efficient, and environmentally friendly.

Using electrical power from a battery to move vehicles has been around for over a century. Early on it was not widely used because it was less understood, and harder to implement. Recently there has been much research done on improving batteries and electric motors to increase efficiency and power generation.

To get the longest flight time you should use the largest battery (in terms of capacity) that you possibly can, but still keep within the maximum take off weight of Hover Bike.

Probably the most important, but often overlooked factor to is the check the battery discharge C rating is the optimum for Hover Bike. Using a discharge rate (C rating) that is too low, can result in your battery being damaged, and your drone under-performing the battery cant release current fast enough to power your motors properly. Since higher C rating batteries are heavier, if the battery you are using has a C rating that is too high, you will just be carrying extra weight around that you don't need, ultimately reducing the flight time.

The number of batteries decide to use on drone does not ultimately make much difference as there are pros and cons of using more batteries. Firstly using more batteries has an added layer of safety as if one battery should fail, still have another that can use to quickly land [8][9][10].

Fig-6: Lithium Polymer Battery

One thing to bear in mind is to also make sure that your motors/ESC and other electronics are able to support the voltage of your battery. Some motors will only support a specific cell count lipo, or a specific range of voltages which might make the decision easier

5.4 Electric motor:

Electric motors are use for deliver the power from battery to propeller.

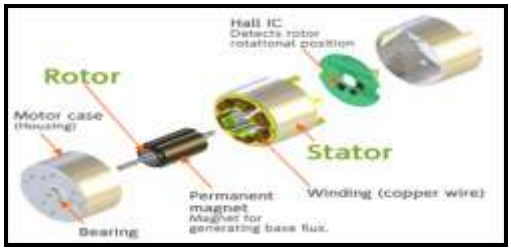

Fig-7: DC Motor

Four electric motors might be used, one to power each propeller. The main advantage of using an electric motor is that it could be mounted directly above the propeller, or

integrated directly with the propeller, meaning the motor drives the propeller without any need of a drive train [8][9][10].

Important factor consider for Electrical Motor:
-It should be provide quick acceleration.
-Speed of the motor should be high.
-It should be reliable.

5.5 PDB (Power Distribution Board)

As the name suggests, a PDB distribute the power on Hover Bike, and provides a neat and tidy way of connecting your battery to all of your ESC's on your aircraft.

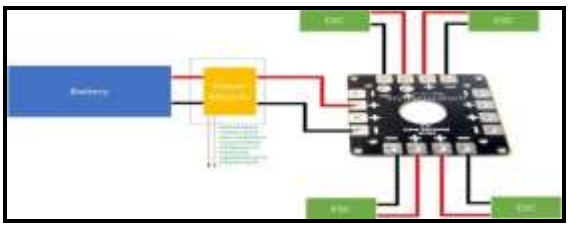

Fig-8: PDB Circuit Diagram

A PDB has positive pads/terminals which are all connected and negative terminals/pads which are all connected. This way when you solder all of the red wires from your ESC's and battery to the positive pads on the PDB, and the black wires to all the negative pads, they will all become connected so your battery can provide power to all of your ESC's as shown in the image above [8][9][10].

5.6 ESC (Electronic Speed Controller)

ESC are of course electronic speed controllers and these are the little devices that control the speed of your brushless motors. The first thing to consider when selecting ESCs is what size of ESC need for setup. Of course, when we talk about 'size' of ESC, we do not mean the physical size of the module, but of the amount of amperage it supplies to your motor. The standard range of ESC sizes is 12A-40A ESCs for quad-copters and other multi-rotors but we can get smaller and larger ones. To choose the right ESC for your needs, you have to also consider what motors you are going to use, and what propellers. the size of ESC that you need depends on your multi-rotor setup[8][9][10].

Fig-9: Electronic Speed Controller

6. WORKING PRICIPLE

The main principle behind the working of this new breed of vehicle is "3rd LAW OF MOTION" [3]. A Hover Bike is a type of aircraft that uses rotating, or spinning, wings called blades to fly. In order to fly, an object must have "lift," a force moving it upward. Wings are curved on top and flatter on the bottom. This shape is called an airfoil. That shape makes air flow over the top faster than under the bottom. As a result, there is less air pressure on top of the wing.

The Hover Bike is similar to quad copter. Control of hover bike is accomplished by turning the rotors in a particular direction. The balance of flight can be achieved as like helicopters. Hover Bike is accomplished by varying the speed of the four motors relative to each other.

As the propeller start the rotor pushes down on the air, the air pushes up on the rotor. This is the basic idea behind lift, which comes down to controlling the upward and downward force. The faster the rotors spin, the greater the lift, and vice-versa [8].

A Hover Bike can do three things in the vertical plane:
6.1 Climb or descend.
6.2 Hovering
6.3 Turning/Rotating

6.1 Climb or Descend:

The rotor blades of a Hover Bike are powered by batteries. As the propeller start to spin around, a high pressure region is generated below the blade and relative low pressure region is generated above the blade. This produces an upward force called **lift** on the rotor blades. The airfoils on the rotor blades generate lift that overcomes the weight of the Hover Bike, pushing it up into the air. If the lift is greater than the weight, the Hover Bike climbs; if it's less than the weight, the Hover Bike falls. When the lift and the weight are exactly equal, the Hover Bike hovers in mid-air.

Fig-10: Hover Bike Lift

Descending requires doing the exact opposite: Simply decrease the rotor thrust (speed) so the net force is downward.

6.2 Hovering:

6.2.1 To Move Forward:

For forward motion decrease the speed of front two propeller that is 'A' and 'B' and increase the speed of propeller 'C' and 'D' as shown in figure below.

FRONT SIDE

Fig-11: Schematic Diagram of Hover Bike (Top View)

Also the pilot has move to forward and give more pressure on front side so that Hover Bike will be disturb from its centre of gravity because of this propeller will be inclined and Hover Bike will be move forward

FRONT SIDE

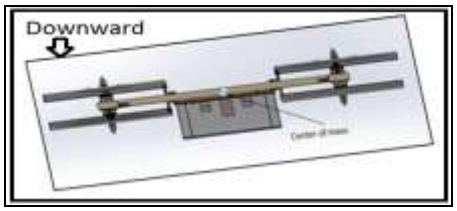

Fig-12: Schematic Diagram of Hover Bike (Front View)

6.2.2 To Move Backward:

For backward motion increase the speed of front two propeller that is 'A' and 'B' and decrease the speed of propeller 'C' and 'D' as shown in figure below.

FRONT SIDE

Fig-13: Schematic Diagram of Hover Bike (Top View)

Also the pilot has move to backward and give more pressure on back side so that Hover Bike will be disturb from its centre of gravity because of this propeller will be inclined and Hover Bike will be move backward.

FRONT SIDE

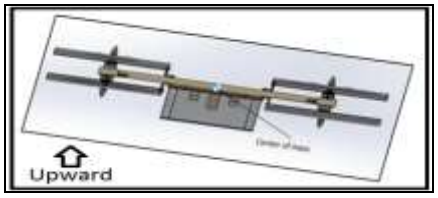

Fig-14: Schematic Diagram of Hover Bike (Front View)

6.3 Turning/Rotating

6.3.1 For Left Turn:

For left turn the pilot decrease the speed of propeller 'A' and increase the propeller speed 'D' as shown in figure below, and also the pilot move towards left side so that Hover Bike will be disturb from its centre of gravity and it will be turn left side.

FRONT SIDE

Fig-15: Schematic Diagram of Hover Bike (Top View)

6.3.2 For Right Turn:

For right turn the pilot decrease the speed of propeller 'B' and increase the propeller speed 'C' as shown in figure below, and also the pilot move towards right side so that Hover Bike will be disturb from its centre of gravity and it will be turn right side.

FRONT SIDE

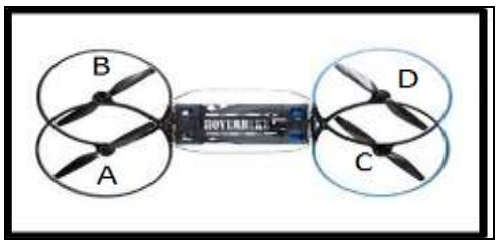

Fig-16: Schematic Diagram of Hover Bike (Top View)

7. DIFFERENT MANUFACTURER OF HOVER BIKE

In the world, there are different companies who manufacture the Hover Bike like Malloy Aeronautics, Hoversurf, Aerofex and EHang .

Classification based on some following criteria:

Table -1: Different Manufacturer of Hover Bike

Parameters	Manufacturer			
	Malloy Aeronautics	Hoversurf	Aerofex	EHang
Model name	Malloy	Scorpion-3	Aero-X	EHang 184
Power type	4 stroke petrol engine	Li-Po battery	3 rotor, rotary engine	Li-Po battery
Capacity	Single Seat	Single Seat	Double seat	Single seat

Speed	277 km/hr	70 km/hr	72 km/hr	100 km/hr
Altitude	Over 10000 feet	33 feet	10000 feet estimated	Upto 1640 feet
Useful Load	165kg	110kg	140kg	120kg

They are still work on this bike for further improvement [11][12][13][14][15].

8. ADVANTAGES

-Cost is low comparatively Putrajaya hovercraft and Robinson R22.

-Ability to take off and land vertically.

-No need of runway.

-Hover-craft is maintain conservation of fuels.

-The hover bike would be able to reach some areas inaccessible to road vehicles and helicopters.

-From this the traffic problems can be reduced.

-From this, air pollution can be reduced by using solar as fuel and can save fossil fuels for the future.

-Cities can be connected in a shorter duration as it doesn't depend on roads.

-It can also travel on rivers, over snow, lakes etc.

-From this the sound pollution that evolved during traffics can be reduced

-It is designed with ducted fan, so that the slip of air is less.

-Hence its aerodynamic efficiency is so high.

9. DISADVANTAGES

-Initial cost is high.

-Driver should be trained before riding the of hover bike.

-Since the drag is more it consumes more power.

10. APPLICATIONS

-By using hover bike, the ammos and weapons can be supplied during wars.

-Using Hover Bike medical helps can be provided.

-From this food can be provided to the soldiers present in extreme places easily.

-The enemy planes and missiles can be detected by flying above the terrain area.

-It can be use for Policing duties.

-Can be use for Traffic spotting.

-It can also use for delivery purpose.

-The full scaled model could be used as a future mode of transportation.

11. CONCLUSION

The present work on Hover Bike is concluded that;

-When hover bike is compared with a helicopter, the Hover bike is cheaper, more rugged and easier to use – and represents a whole new way to fly.

-Hover Bike is considered as a replacement of Robinson R22 helicopter.

-Stability of quad-copter Hover Bike is greater than bi-copter Hover Bike in air.

-When we replace engine by electric motor and batteries, there is a contribution towards to the pollution control and also the construction of Hover Bike is also simple. When we use the electric motor and batteries only disadvantage is the initial cost of the Hover Bike is high.

12. FUTURE SCOPE

With further developments, the applications of the "HOVER BIKE" can be improved like:

-It can be used for attacking on the enemy bases without losing any soldiers.

-Instant postal and courier delivery.

-Under water detection.

-Geographical pictures by installing high resolution cameras.

-It can also use for Agriculture purpose like; sowing of seeds, Sprinkle pesticides on crops.

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