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DESIGN OF PROPELLER POWERED VEHICLE

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Abstract-In the last decade many researches have been carried out on wind driven vehicle; a large number of academic publications have been presented. There have been many "Down Wind Faster than the Wind (DWFTTW)" arguments based on energy flow. Wind driven vehicle systems travel faster than the wind along its direction. Here an attempt has been to run a car by using propeller i.e "Propeller powered aircraft". It is one type of simple power system vehicle, which can use for the ground vehicle. In the current scenario the construction of vehicle is very tough challenge for their complex design. It requires lots of time and precaution. It can't be constructed by a single engineer or expert. Propeller powered vehicle is one of the solution to solve these challenge. Propeller power car has a simple design. Propeller is placed at front or back of the main body which gives power to the car. And direction is controlled by the hinges which are connected to the wheel and rudder positioned back of the car, which is controlled by the remote. I n defense shifting a vehicle is a very complex task; propeller power car is the solution for them it can be easily dismantled and easily assembled. In any type of emergency assemble it within an hour and can be used. I t is pollution free vehicle. Here an attempt has been made by fabricating small scaled modeled and we observed that it is having good balancing; no issue in direction control and its drifting was very good.
Key Words- Airfoil, DWFTTW, Momentum, Propeller, and Thrust Force.

I. INTRODUCATION

In the last decade many researches have been working on propeller driven vehicle; a large number of academic publications have been presented. Here an attempt has been to run a car by using propeller i.e "Propeller powered aircraft". This paper discusses about the feasibility of propeller power aircraft. Here the propeller power car has been tested on three types of two types of ground surface and compare with the theoretical results. It is one type of simple power system vehicle, which can use for the ground vehicle. In the current scenario the construction of vehicle is very tough challenge for their complex design. It requires lots of time and precaution. It can't be constructed by a single engineer or expert. Propeller powered vehicle is one of the solution to solve these challenge. Propeller power car has a simple design. Propeller is placed at front or back of the main body which gives power to the car. And direction is controlled by the hinges which are connected to the wheel and rudder positioned back of the car, which is controlled by the remote. I n defense shifting a vehicle is a very complex task; propeller power car is the solution for them it can be easily dismantled and easily assembled. In any type of emergency assemble it within an hour and can be used. I t is pollution free vehicle. Here an attempt has been made by fabricating small scaled modeled and we observed that it is having good balancing; no issue in direction control and its drifting was very good.

Propeller power vehicle are small model radio-controlled that moving by electric motor. The Propeller power vehicle is run remotely with the help of a transmitter with joysticks that can be used to run the car and perform different maneuvers. The transmitter comes also with a receiver which is installed inside the Model Propeller power vehicle which receives the commands send by the transmitter and controls servos. The servos are small motors which are mechanically linked to the control surfaces e.g., rudder for yaw control. The servos moves the control rods (which are small rods that connect the servo to different control e.g. to rudder etc) which in turn moves the control

surface be it is rudder. A Propeller power vehicle can be controlled by using the transmitter from where we can control yaw \of our RC Airplane and I can also control the throttle settings. The receiver which accepts the transmitter signal and the servos attached to it are run on rechargeable batteries. Most popular rechargeable batteries for RC Airplanes use include Ni-Cad (Nickel Cadmium) and Li-Po (Lithium Polymer). Lithium Polymer lasts longer and more powerful than there Ni-Cad counterparts but a bit more expensive.

We observed that the theoretical value is much different from the experimental value; it may because of surface friction and wind flow. Inside the Test section the value is nearby close to the theoretical value. In stability point of view this vehicle has great grip the ground and because of constant point of center of gravitation. It has great drifting affect at high speed of the vehicle.

Parts of Propeller power vehicle

The parts of the Propeller power vehicle,

RC Electric Motors

Electric motors are most used in many model RC Car because of the ease in use. Electric Motors give the advantage of low-cost, easy to use. The throttle of electric motors is controlled using a speed controller which comes with the motor. The speed controller lead is connected to the receiver. The transmitter than can control the throttle of electric motor just as other controls.

Chassis

Chassis is the main structural element of the Propeller power vehicle or the body of the RC Air CAR. The Engine is also mounted to the chassis. The chassis is made up of bulk-heads. The bulk-heads are structural members which give strength and rigidity to the chassis, support load and weight of the Propeller power vehicle. The Engine bulk-head is made relatively stronger as compared to other bulk-heads of Propeller power vehicle chassis because it carriers the load of the engine as well as encounters vibrations during engine operation so it must be strong to resist all the loads. The chassis also houses all the electronic components necessary for Propeller power vehicle including ESC (electronic speed controller) in case of electric Propeller power vehicle, Receiver, Servos, Batteries.

Propeller

The propeller is basically a wing section made of airfoil sections just like a wing but it is twisted along the span. The propeller is mounted to the engine in propeller driven Propeller power vehicle.

Spinner

A spinner is used to house the central hub of the propeller and makes the Propeller power vehicle more aerodynamically efficient.

II. CONSTRUCTION OF PROPELLOR POWER VEHICLE

The basic understanding of the aerodynamic concepts and the correct scaling down methods can enable a designer to build a successful Propeller power vehicle. This construction has an advantage of understanding the properties of the materials used, mechanisms design, concept creation and grading the components. The quality of the materials has to be given consideration for long life of the flight and better functionality.

Air Car Structure

To build a successful structure, one that will allow the radio control equipment to operate the model accurately, it is important to pay attention to the three A's.

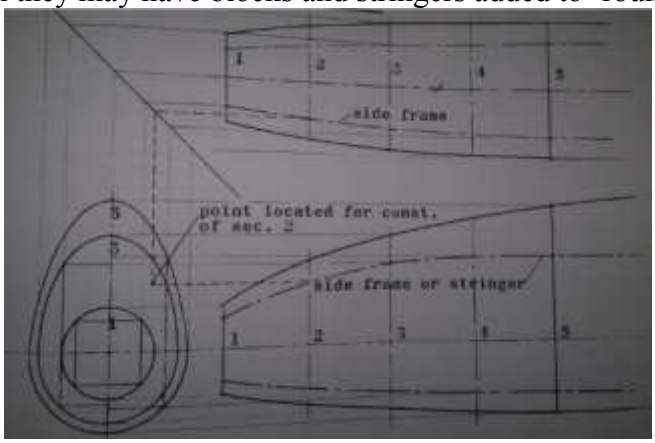
Accuracy-Cut all parts as accurately as possible so that they fit without gaps or having to force fit joints.

Alignment-Square and true construction at all times and correct alignment of wings and tail surfaces on the completed model.

Avoirdupois-Weight is a key property. Keep the weight as low as possible.

Main Body

Most Main body of car, whether built from the longerons, uprights etc. or sheeted, are box-like in structure, although they may have blocks and stringers added to 'round-off' the appearance.



When cutting the uprights and the cross pieces for built up main body cut them together in pairs; this reduces the time taken and also ensures consistency. The ideal method is to use a construction jig but many models require a completely new jig for its parts.

Installations

The installations will be divided into four parts as follows:

1. Hinges
2. Linkages
3. Special Linkages
4. Radio equipment

Hinges

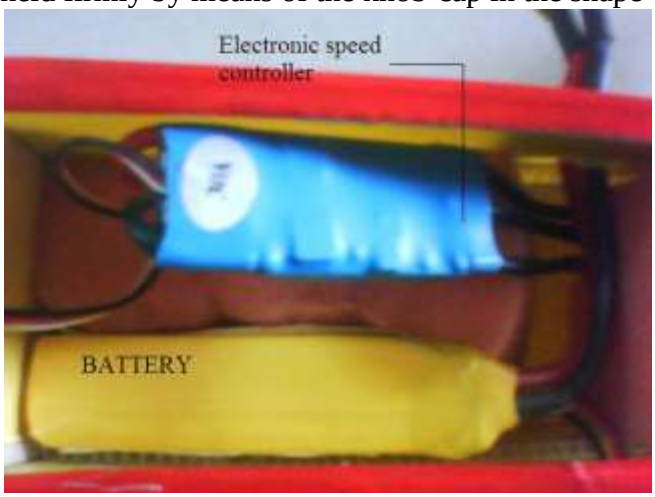
The whole effort to improve the resolution of the equipment can be nullified by poor job of hinging of the control surfaces and installations of the pushrods and control horns. The aims to achieve a good control surface hinge are:

1. Freedom of movement.
2. Close coupling of the control surface to the wing, fin or tail plane.
3. Strength of the hinge.

The linkage between the servo and the control surface, or control function is the area where most loss of control efficiency occurs. The inefficiency is caused by the wasted movements which ultimately may happen due to flexing control rods, over-large holes in horns and servo output arms and discs and a number of other reasons. To avoid it and obtain a greater accuracy of control, we take care to keep connection and connecting rod, as precise as possible. Many possible combinations of linkages, horns, cranks, etc. That it is impossible to discuss them all. But the one used in the plane alone is discussed in here. The following figure is self-explanative of the details used in the design

The Propeller

Installation the propeller is fixed to the motor on the shaft, which rests on the fuselage at the crevice provided at the front of the fuselage. This actually is being mounted using the x-mount supplied by the motor manufacturer along purchase. The x-mount holds the motor body firmly along with the fuselage by means of four screws. The Picture shows in detail how the motor and propeller is fixed. The propeller is held firmly by means of the knob-cap in the shape of a bullet.



This Electronic Speed Controller (ESC) contains a Battery Elimination Circuit (BEC) which may be used to power your receiver and servos under certain conditions. This will allow you to eliminate the separate onboard radio battery pack, and reduce the weight of your aircraft. The BEC may not be used simultaneously with and onboard radio battery pack. You must use one or the other, but not both. Up to 4 servos can be used when the voltage is 7.4V or less. With 11.1V or above, only 3 servos can be used.

If you are not using the BEC function, you must clip the red (+) wire on the ESC receiver lead.

To Enter Programming Mode:

1. Connect the motor and receiver to the ESC.
2. Remove battery power from the ESC.
3. Set the throttle stick to full power and then turn on the transmitter.
4. Reconnect battery power to the ESC.
5. If you are using a separate receiver batter y pack instead of using the BEC, connect the receiver battery pack and turn it on.
6. Secure the airplane and stay clear of the propeller
7. A sequence of one to three beeps will be followed.
8. The table below summarizes the simple options for the choices:
9. Move the throttle stock to the full down position if you confirm the option.
10. You should have only one choice between the lipo self-protection of NiMh/NiCd self-protection.
11. Once you confirm your choice, you will hear a sharper tone indicating this choice has been saved.
12. If you want to change the brake setting, repeat steps 2-10. CAUTION: At this point the throttle is armed. If you advance the throttle stick the motor will run. If you are not ready to fly, unplug the motor battery and then turn the transmitter off. Always turn the transmitter on (and the receiver if you are using a separate receiver battery) and be sure it is set at idle position before connecting the motor battery. All of your selected programming will be saved in the ESC. There is no need to program again unless you wish to change a setting. Note: If the motor rotates in the wrong direction, simply sway any two of the three wires from the speed controller to the motor.

Additional Features:

1. Soft start
2. Start prohibition if the throttle position is wrong.
3. Auto learning on the throttle response
4. Auto shut down of the power if the signal is wrong
5. Auto calibration of the motors
6. If there is no response on the receiver, the input will be automatically shut off The ESC can be used with 4-10NiCd/MiMh or 2-4 cell Lipo batteries and will automatically detect them. The BEC is functional with up to 3 Lipo cells. With 4 lipo cells you will need to disable the BEC.The only programmable feature on this ESC is the brake. The brake defaults to OFF. If you don't need to program the brake function, your ESC is plug and play and ready for use up to 3 cell Lipo or 10 cell NiCd/NiMh.

III. EXPERIMNET AND RESEARCH ANALYSIS

Considering the forces acting on the vehicle as shown in the
Figure 1

$$F_{net} = F_p - F_t$$

Since we know that

$$P_p = P_t * \eta_g$$
$$Fp(V - W/\eta_p) = F_t V \eta_g$$
$$F_{net} = F_t\left(V/(V - W)\,\eta_g(\eta_p - 1)\right)$$

Which is positive only as long as

$$F = \frac{1.225\pi(0.0254 * d)^2}{4}\{RPM_{prop} * 0.0254 * Pitch\}^2$$

The RPM of motor is measured is measured by using device tachometer.
Experimental Result

S.No	RPM	Distance	Time	Velocity(m/s)
1.	400	100m	165s	0.60

2.	800	100m	115s	0.86
3.	1200	100m	75s	1.33
4.	1600	100m	45s	2.22

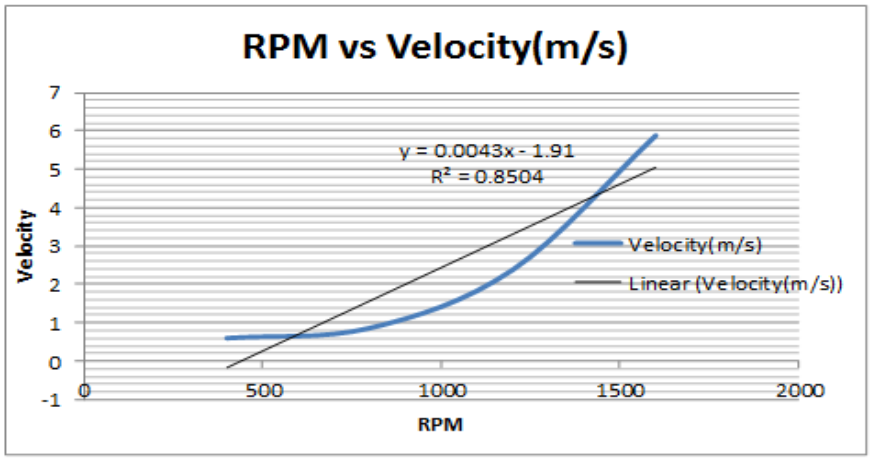
IV. CONCLUSIONS

There is a vehicle which can powered by propeller that can go in the downwind direction faster than the free stream wind speed (using a propeller in the air). The speed of the vehicle is controlled by RC. There does not exist a definite upper limit for vehicles of this kind. As long as efficiencies are improved, the velocities would also increase unasymptotically.

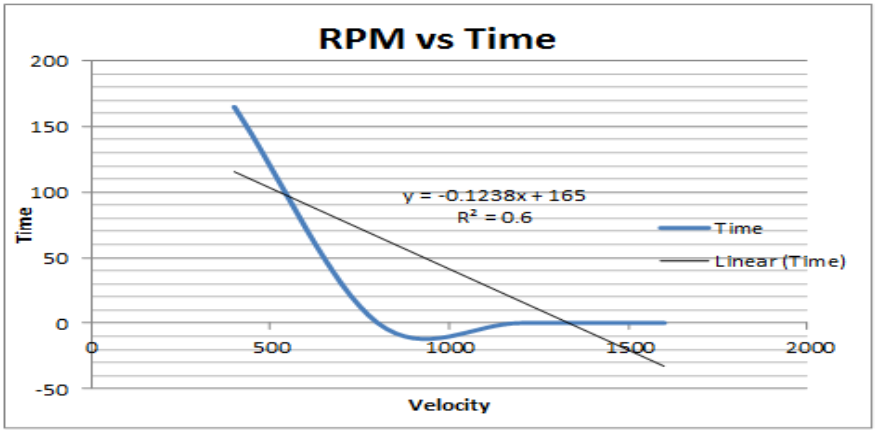
A variable pitch propeller is suggested so that by varying pitch angle we can maintain an optimal angle of attack (maximum lift to drag ratio) on the propeller blades as vehicle speed varies. Further analysis using computational software is suggested to understand the velocity and pressure changes that occur around the propeller in order to get a better design to travel faster downwind. The direction of the vehicle is totally controlled by the rudder mechanism of hinge mechanism and remote controlled.

It is pollution free vehicle. Here an attempt has been made by fabricating small scaled modeled and we observed that it is having good balancing; no issue in direction control and its drifting was very good.

From graph 1 & 2 we came to conclusion that the as we increasing the RPM of the motor the speed the speed of vehicle is not increasing linearly it's because starting the or at low RPM the motor was not able generate much thrust and due to that the static friction was acting during the time but when the vehicle achieve required thrust by controlling RPM of motor. The vehicle is accelerating with very high acceleration.



Graph 1



Graph 2

V. ACKNOWLEDGEMENT

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