Prototype of The Hovercraft

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ABSTRACT

Vehicles designed to travel close to but above ground or water. These vehicles are supported in various ways. Some of them have a specially designed wing that will lift them just off the surface over which they travel when they have reached a sufficient horizontal speed (the ground effect). Hovercrafts are usually supported by fans that force air down under the vehicle to create lift, Air propellers, water propellers, or water jets usually provide forward propulsion.

Air-cushion vehicles can attain higher speeds than can either ships or most land vehicles and use much less power than helicopters of the same weight. Air-cushion suspension has also been applied to other forms of transportation, in particular trains, such as the French Aero train and the British hover train. Hovercraft is a transportation vehicle that rides slightly above the earth's surface. The air is continuously forced under the vehicle by a fan, generating the cushion that greatly reduces friction between the moving vehicle and surface. The air is delivered through ducts and injected at the periphery of the vehicle in a downward and inward direction. This type of vehicle can equally ride over ice, water, marsh, or relatively level land.

Keyword: -*Vehicle, Hovercraft, surface, water surface, land*

1. INTRODUCTION

A **hovercraft**, also known as an **air-cushion vehicle** or **ACV**, is a craft capable of travelling over land, water, mud or ice and other surfaces both at speed and when stationary. Hovercrafts are hybrid vessels operated by a pilot as an aircraft rather than a captain as a marine vessel.

Hovercraft use blowers to produce a large volume of air below the hull that is slightly above atmospheric pressure. The pressure difference between the higher pressure air below the hull and lower pressure ambient air above it produces lift, which causes the hull to float above the running surface. For stability reasons, the air is typically blown through slots or holes around the outside of a disk or oval shaped platform, giving most hovercraft a characteristic rounded-rectangle shape. Typically this cushion is contained within a flexible "skirt", which allows the vehicle to travel over small obstructions without damage. A Lithuanian Coast Guard hovercraft with engine off and skirt deflated. The first practical design for hovercraft derived from a British invention in the 1950s to 1960s. They are now used throughout the world as specialized transports in disaster relief, coastguard, military and survey applications as well as for sport or passenger service. Very large versions have been used to transport hundreds of people and vehicles across the English Channel whilst others have military applications used to transport tanks, soldiers and large equipment in hostile environments and terrain.

1.1 SPECIFICATION

BASE (HULL):

Material - Mf wood
Easily available in market.
Dimentions- Height – 18 mm (std.)
Width - 90 cm (36 inch)
length - 40 cm (16 inch)

HOLES:

No of holes – 9 hole
Diameter of each hole – 1.25 inch dia

BLOWER:

Name of manufacturer - Automach

Rated v(v)	Frequency(Hz)	Input power(W)	Wind pressure(Pa)	Wind pressure(M/min)	Rated speed(r/min)	Net Weight(Kg)
220 v	50 Hz	450 W	8000	2.5	16000	1.6
	50 Hz	550 W	8000	2.5	16000	1.5

PIPE:

Name of manufacturer - Ashirvad pipes Pvt. Ltd
Material – U PVC
Dimentions – Diameter – 1.25 inch (std)
Length - 8 feet
Bend - By 180°

PIPE BEND:

Easily available in market for size of pipe – 1.25 inch dia (std)
Material – PVC
Cost - Rs. 45

SKIRT:

Material – Parasuit cloth
Easily available in market in meter
Dimentions – Height – 1 mm
Width- 50 cm (20 inch)
Length – 110 cm (44 inch)
Area – 1371.325 sq. cm

MOTORS:
No of motors- 4 motors
RPM – 2000 rpm
Required voltage – 6 V
Cost of each motor(demo) – Rs. 100

BLADES:
No of blades – 4 blades for each motor
Cost of each blade – Rs. 60
Material- Plastic fiber

SILICON GLUE:
Easily available in the market
Cost- Rs. 50

CYCLE TUBE:
Cost- Rs. 70

2. LITERATURE REVIEW

2.1 History of Hovercraft

For centuries, there have been many attempts made to decrease friction between moving parts. Many ideas where experimented in the early 1900s until they came together by a man named Sir Christopher Cockerell.His job was actually an electronic engineer, but he sailed small boats, like a craft he had designed and built himself, in his leisurely time. He pondered the idea about drag on his hulls. He experimented with a variety of devices for introducing a film of air to reduce 'drag'. He had a theory which was originally tested in 1955 using an empty KiteKat cat food tin inside a coffee tin, an industrial air blower and a pair of kitchen scales. Christopher Cockerell's idea was to build a vehicle that would move over the water's surface, floating on a layer of air. This would reduce friction between the water and vehicle. To test his hypothesis, he put a smaller can inside a larger can and used a hairdryer to blow air into them. He had produced a 'skirt' of air capable of supporting a weight. He came up with the word 'lubrication' for this layer of air between hull and water. He made a working model with a boat-building friend, and tried it out on a dock near his house. His hovercraft designs led to the first hovercraft to be produced commercially, the SRN1. This was in 1956. Being treated with a great deal of disbelief, the Government of the day slapped a secrecy order on Cockerell's idea, eventually contracting Saunders-Roe to build a full sized hovercraft to test its feasibility. Cockerell also got the National Research Development Council, which fixed patents and rights, to protect the invention from being copied abroad. They also provided the necessary funds.

So the first hovercraft, the SR-N1 was flown from Calais to Dover in 2 hours on July 25th 1959. This craft, 30 feet in length with a 24 foot beam weighed 3½ tons. This gave the craft a 9 inch lift. SR-N4, a later hovercraft ferry (1968) carried 254 passengers and 30 cars - later stretched to carry 396 passengers and 53 cars. Later, hovercrafts were and still are sometimes used for military purposes also. This is all thanks to Christopher Cockerell.

2.2 How a Hovercraft Works

A hovercraft is a vehicle that can go on both land and water and is supported by a cushion of pressurized air. They are usually assumed to be a bizarre kind of transportation, but they are actually quite simple. Hovercrafts are air cushion vehicles (ACVs) or ground effect machines. They are the most unique among vehicles that are supported by pressurized air.

Hovercrafts float on a cushion of air that has been forced under the craft by a fan. This causes the craft to rise up. The amount of lift can range from 6" to 108", depending on the size of the craft. The amount of total weight that a hovercraft can raise is equal to cushion pressure multiplied by the area of the hovercraft. It is necessary to limit the cushion air from escaping. The air is contained by the use of what is called a skirt. Skirts are made of fabric, which allows a deep cushion. Once "lifted" or "on cushion", force must be created to move the hovercraft forward. With many crafts, this is generated by a separate engine from the one used to create the lift, but with some, the same engine is used for both.

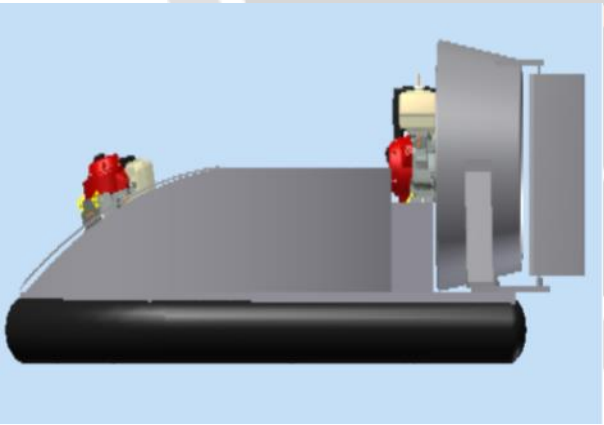
Now that the hovercraft has lift and thrust, it has to be steered. This is accomplished through the use of a system of rudders behind the fan, controlled by handlebars up front. Steering can also be controlled by the use of body weight displacement - a skill which is achieved after practice. Hovercrafts are used with the steering handlebars but also with out. The science part of hovercrafts is easy to understand.

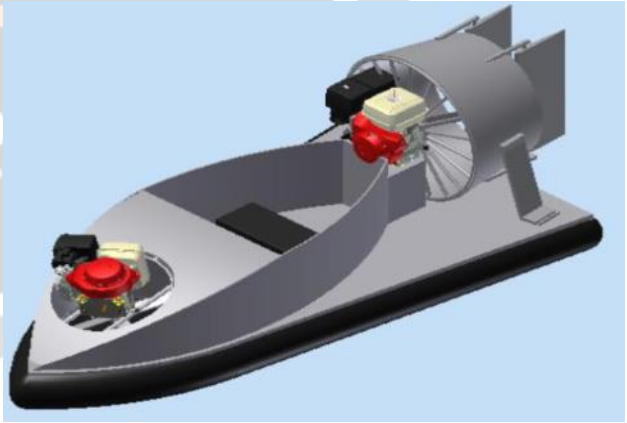
2.3 Manufacturing and Business of Hovercrafts

There are tons of companies out selling hovercrafts. You can find a lot of hovercrafts on the internet. Hovercrafts are sold in all sizes - 1-2 people hovercrafts all the way through 30 people and cargo hovercrafts. Kids like me even build hovercrafts for school projects or science fairs. Prices are in the thousands. They go from $10,000 to about $30,000. Many companies compete on the internet - hov pod and neoteric are manufacturers. There is demand for hovercrafts, so there is the supply. I think that hovercrafts will get popular in the future. They are good vehicles. You could make good money from selling hovercrafts.

3. PROJECTION

3.1 EXISTING DESIGN





1. The hovercraft works on air cushion.

2. Air cushion is provided through a blower which pumps air into the skirt thereby inflating the skirt.

3. The air pressure thus raises the craft up above the ground.

4. The vehicle has two engines; the rear and the front.

5. A stator fan is attached to the front or lift engine which directs air into the skirt to provide air pressure needed to lift the craft.

6. The propeller attached to the rear or thrust engine develops the thrust needed to propel the craft.

7. The propeller is enclosed by the thrust duct which makes it possible to direct the air.

8. The duct is bell-shaped such that it increases the velocity of air escaping the duct.

9. The polyester skirt is PVC coated which gives it more strength to sustain the air pressure.

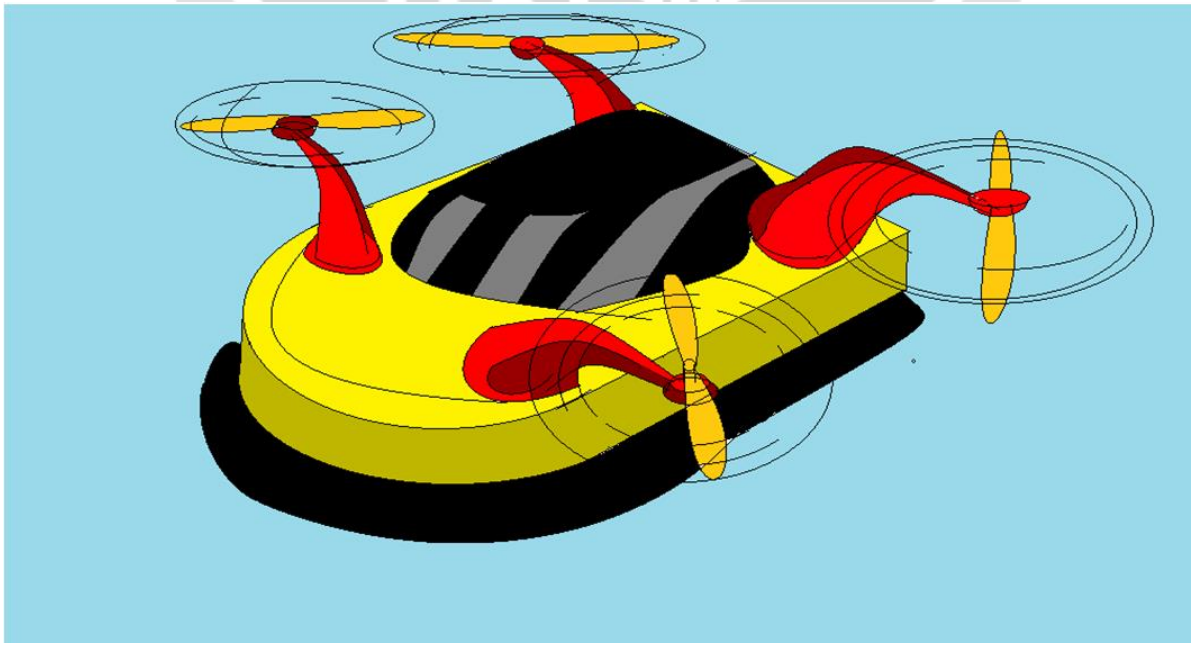
10. It is made air tight.

11. The hull is a platform which sustains the entire weight of the craft.

12. A hole is made on the hull through which air enters the skirt.

3.2 PROPOSED DESIGN

The Proposed Model works with the combination of both electric motor as well as air cushion. The modification provided on this project are, the four electric motor that makes it a Hovercraft cum Quadricopter. A hovercraft can run on both land as well as water surface, so with this modification, it can also fly efficiently in the air, thus making it a total utility vehicle.
The hovercraft works on air cushion. Air cushion is provided through a blower which pumps air into the skirt thereby inflating the skirt. The air pressure thus raises the craft up above the ground. While the four motors lifts the object in the air, thus enables it to fly efficiently. By providing a common control circuit, both the hover work and flying facility can be controlled from one place, according to the requirement. This type of vehicle defines the future vehicle, which exhibits all the facilities packed in one vehicle.



4. CONSTRUCTION

4.1 The Hull

For demonstration purposes, let the craft be designed to carry one person of weight 70kg + 15% of 70kg = 80.5kg
Let length of hull = 90 cm (36 inch)
Width of hull = 40 cm (16 inch)

If width =40 cm (16 inch); length =90 cm (36 inch); Surface Area = 40 cm . * 90 cm = 3600 cm².

Width =40 cm (16 inch); length = 90 cm (36 inch) MATERIAL OF CONSTRUCTION IS MF WOOD

4.2 Holes

9 no of holes are made near the periphery of the base at appropriate distance.
Diameter of each hole (d) = 3.125 cm (1.25 inch)
The area of each hole is = $\pi/4*(d)^2$ i.e. $\Pi/4*(3.125)^2$ =7.66 cm²
Therefore total area of 9 holes is = 9*7.66 cm² =69.029 cm²

Diameter of each hole(d) = 3.125 cm (1.25 inch) Total area of holes=69.029 cm²

4.3 U PVC Pipe

Take a pipe of 8 feet length having diameter of 3.125 cm (1.25 inch).
Mark its centre.
Then bend the pipe from its centre, in the shape of "U" at 180°.
This u shaped pipe is connected with 9 holes in the hull, with the help of connectors of
Diameter=3.125 cm (1.25 inch).
Length =7.5 cm (3 inch)

Diameter of pipe = 3.125 cm(1.25inch) , length of pipe = 8 feet Diameter of connector = 3.125 cm(1.25 inch), Length of connector =7.5 cm (3 inch)

In order to avoid air leakage, all joints are sealed by using a special silicon glue.

4.4 Attachment of air blower

Air blower supplies the working medium i.e. air at high pressure to provide the lift required to hover the object.
The blower that is required has following specifications:

Rated v(v)	Frequency (Hz)	Input power(W)	Wind pressure(Pa)	Wind pressure(M/min)	Rated speed(r/min)	Net Weight(Kg)
220 v	50 Hz	450 W	8000	2.5	16000	1.6
	50 Hz	550 W	8000	2.5	16000	1.5

The outlet of the blower is connected to the end of u pipe, with the help of a pipe bend available in the market for the size of 3.125 cm (1.25 inch).
In order to avoid air leakage, this joint is then permanently sealed by using silicon glue as mentioned above.

Design of skirt

The skirt must be able to sustain the pressure needed and also push the craft.

The cushion pressure = 694.8 N/m 2

In order to make skirt for hovercraft, take a Para suit cloth of following dimensions:

Dimentions – Height – 1 mm
Width- 50 cm (20 inch)
Length – 110 cm (44 inch)

Area of skirt = Cushion area = 1371.325 sq. cm; Height of lift = 1 cm

Thus, Volume of skirt = Area x height of lift == 1371.325 sq. cm*1cm = 1371.325cm³

Area of skirt = Cushion area = 1371.325 sq. cm , Height of lift = 1 cm,

Volume of skirt =1371.325cm³.

The skirt is then fixed beneath the hull and its boundary is pasted around the periphery of the hull with the help of silicon glue, to avoid air leakage from skirt.

4.5 Demo modification

Four electric motors fixed to represent the modification in the project. Suitable no of high torque engines may be used to provide the project with flying abilities.
Specification of demo motors are:

No. of motors- 4 motors
RPM – 2000 rpm
Required voltage – 6 V

No of motors- 4 motors, RPM – 2000 rpm, required voltage – 6 V

4.6 Rubber tube

A rubber tube is used to avoid ram with any substance which is fixed at the periphery of the hull (base).

5. WORKING

1. First provide the supply to the blower, which will provides high pressure air from its outlet, at the pressure of 2.5 m/min.

2. The air discharged from the blower, will enter into the pipe connections.

3. This air flows from pipe connections and comes out from ends of pipe connection that are fixed to the holes made in the hull.

4. The air from the holes then flows into the skirt and inflates it.

5. As soon as the skirt gets inflated with the air, the holes provided on the skirt enables the air from skirt to come out and get packed beneath the skirt.

6. The air coming out from the hole of skirt exerts pressure on the air already trapped in space beneath skirt, which results into the formation of air cushion between the bottom of hovercraft and floor.

7. This air cushion lifts the hovercraft and acts as the working medium for it.

8. According to the modification in the project, in order to make the project fly a proper coordination can be established between engines attached to the hovercraft as shown in fig. above, with the help of control circuit.

9. This coordination helps to formulate an efficient flight in the air.

10. In this way both the method can be used to make the project –fly, float, and also run on the surface without friction.

6. CONCLUSION

6.1 Performance Test

Classical method was used to establish the speed of the craft.

Distance covered=100m; Speed of craft=100/16.1=6.21 m/s

Designed speed = 9m/s; Efficiency= (6.21/9) x 100 = 69%

6.2 Result

The hovercraft was lifted and was propelled by the thrust system. It was able to carry weight 20kg and hovered with an air cushion of 0.5 inch.

6.3 Conclusion

The craft principle has been demonstrated using low cost material and has proved capable as a viable means of transport both on land after series of tests. The propulsion and lifting systems gave excellent performance and with good maneuverability.

6.4 Recommendation

More research is recommended to improve on the efficiency of the hovercraft and to enable it with flying ability. The skirt has to be air-tight without leakage.

7. REFRENCE

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