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Hovercrafts and Its Affordability

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Abstract: Hovercraft prototype is designed and developed with complete hovercraft basic functions. The design process is very close to the boat and aircraft design process. In-depth research is conducted to evaluate basic functions of a hovercraft system, components, and its operating theory. Detailed design analysis is carried out to determine the size of the component parts and relevant standard requirements as applicable in the model of air cushion. An innovative method and design philosophy based on a flexible modular design that allows the construction of affordable hovercraft prefabricated modules are combined efficiently and sophisticatedly, enabling a dramatic reduction in manufacturing costs, providing one-size-fits all platforms that can accommodate a wide range of missions and applications. Hovercrafts have advanced vessel and their history more than half a century, as a popular marine vehicle. By introducing dynamic estimators for the disturbance and friction coefficients, the controller is made robust to constant external disturbances and uncertain model parameters. A projection operator is used to ensure that estimates remain within prescribed limits and are smooth enough to back step.

Keywords: Design, Functions, Hovercraft, Parts, Performance.

INTRODUCTION

Hovercraft is a vehicle hovers above the ground, over snow or water by a cushion of air. It is also known as an air cushion aircraft that capable of travelling over land, water or ice and other surfaces both speed and stationary. It works on a high pressure air cushion between the vessel's hull and the underlying surface[1]. The vehicle is fitted with one or two engines for the creation of an air cushion or lift force and for the development of a thrust in any direction. First engine is located at the back of the hovercraft for generating thrust which helps to push forward or backward, while the second engine is placed at the middle of the platform to create the Lift. Pressure chosen will reinforce the cushion and lift the weight. The air escapes from the bottom of the hovercraft produces the effect of hovering. Lifting or hovering of hovercraft pushes the air into the ground and thus creates pressure[2]. Its cushion is attached between flexible skirts. Hovercrafts are hybrid vessels run as an aircraft by a pilot rather than a captain as a marine vessel and float over any surface at heights from 210 mm to 610 mm and it runs at speeds of 38 km/h and clean up to 20 degrees of gradient. Due to natural phenomena, locations that are not easily accessible by landed vehicles are best suited for hovercrafts. It is commonly used in disaster relief, coastal military and survey applications as well as in sports and passenger services as specialized transportation. Its large versions are used in hostile environments and terrain to transport tanks, soldiers and large equipment. In riverine areas, there is a great need for a reliable, secure, quick, and low-cost transport system. It takes time to transfer the load from the landed vehicle to a boat.

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There is no need to transfer goods with hovercraft as it operates on both land and water[3].

A similar air cushion is maintained in a hovercraft by pumping in a steady supply of air in order to keep pace with the connection around the sides. There is always some leakage as the vessel has to be free to move, but the designers use different methods to keep the leakage as small as possible so that only limited power is needed to sustain the air supply. There are various ways to create air cushion and reduce leakage. The air pressure inside the skirt is moved when the fan rotates and to generate lift so that hovercraft is hovering almost without friction[4]. The table 1 portrays the components of hovercraft.

DESIGN CONCEPT

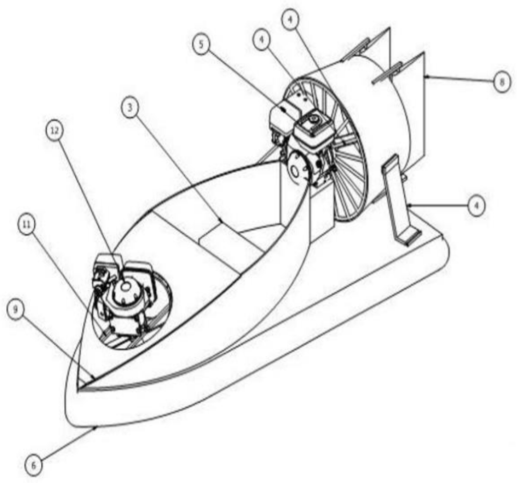

Figure 1: View of Hovercraft

Table 1: Components of the Hovercraft

Item	Description	Quantity
1	Hull Base	1
2	Lift Duct	1
3	Seat Assembly	1
4	Thrust Duct Assembly	1
5	Thrust Engine and Fan Assembly	1
6	Skirt	1
7	Stand	1
8	Rudder	2
9	Body Cover Front	1
10	Seat Assembly Main	1
11	Lift Engine Mount	1
12	Lift System	1

PRINCIPLE OF HOVERCRAFT

The hovercraft is floating on a cushion of air supplied by the lift fan above the ground surface. The air cushion is essentially frictionless to the hovercraft. Blower’s air is blown through a hole into the skirt as shown in Figure 2. The skirt inflates and the rising air pressure works on the hull base forcing unit up or lifting. Small holes under skirt prevent it from bursting and provide the necessary air cushion[5]. A blower installed in the thrust engine blows air backwards as soon as the assembly floats, which generates an equivalent response that allows the vehicle to push forward. Power is needed due to friction of the air cushion has been drastically reduced. By mounting rudders in the airflow from propeller due to this steering effect is achieved. A change in rudder direction shifts the air flow direction, resulting in a change in vehicle direction. Through connecting wire cables and pulleys to a handle, this will be done. The position of the rudders changes when the handle is pushed[6]. Fig 3 demonstrates the pressure distribution in skirt.

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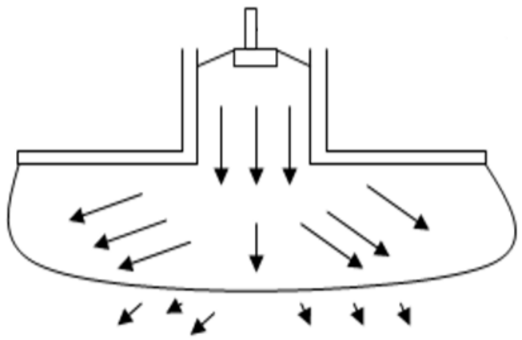

Figure 2: Blower or Skirt Arrangement

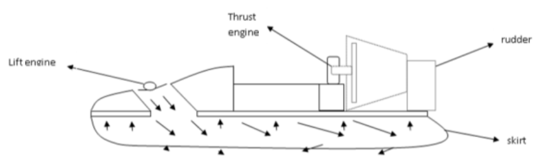

Figure 3: Pressure Distribution in the Skirt

Aircushion plays a vital in hovercraft. Air cushion is supplied by a blower that pumps air into the skirt and thus inflates the skirt. The air pressure lifts the craft above the deck. There are two engines in the vehicle; the rear and the front. To lift the craft, a stator fan is connected to the front or lift engine that guides air into the skirt. Propeller produces the thrust required to propel the craft which is attached to the rear or thrust engine. Propeller has a thrust duct that allows the air to be guided. Duct is bell-shaped in such a way that the velocity of air flowing through the duct increases. PVC-coated polyester skirt gives it more strength to maintain air pressure. It's made tight with air. Hull is a structure that holds the craft's entire weight and hole is made by which air enters the skirt[7].

HOVERCRAFTS AND ITS AFFORDABILITY

In recent years, catamarans have counterbalanced the main advantage of hovercrafts, which is their high speed; at least in the range of 38 km/h. Catamarans use more powerful marine propellers than air propellers, making them more reliable and economical. At the same time, they are closer to the means of aviation in terms of maintenance than marine vehicles. Hovercrafts work in such harsh environments like mixture of water, pebbles, salt, sand, etc., causes the propeller and the fan blades to become eroded, engine is required sophisticated filtration systems. In addition, skirt is made up of rubber increases maintenance costs as it occasionally requires the replacement of different parts. Reliability and availability cannot be compared with conventional displacement hulls, two parameters that are particularly important for military use[8]. It has less drag and requires less horsepower to move, a well-designed hovercraft has much improved performance than the normal boat. Hovercrafts are not considered affordable due to not entered in mass production.

1. *Legal Issues:*

Air cushion effect describes cark tablemat is keep on table cloth, so that it is completely silent. If the mat is dropped perfectly in horizontal direction, air is trapped and it stop guide. A similar air cushion is maintained in a hovercraft by pumping in a steady air supply. There is always some leakage because the craft needs to be free to more, but the designers use different methods to keep leakage as small as possible so that only minimal power is needed to maintain the air supply. The easiest method to produce air cushion and minimize leakage is like a bowl turned upside down and fitted with an engine and a propeller that pulls through a hole at the top into the hollow part. Increasing air pressure is pushing the bowl's sides. But the bowl is not elastic, and the air pressure forces the bowl off to the ground instead of forcing the rubber to stretch[9]. Fig 4 portrays the air cushion supply.

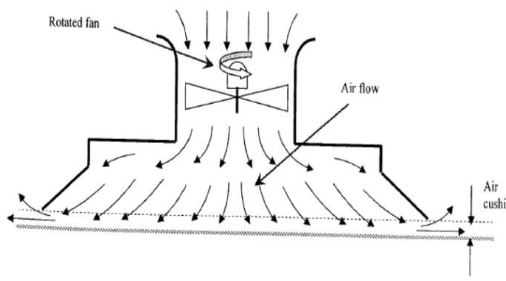

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Figure 4: Air Cushion Supply

2. Performance:

Performance is used as a general measure of quality to determine the effectiveness of different parameters. It has descriptive character than a quantitative form. Depending on the number of propulsion modules adopted, several options can be created in terms of speed. The Hovercraft 3.1 has one propulsion module and can reach a speed of 33 km/h while the Hover Craft 3.3 can reach 65 km/h with two propulsion modules. The bigger ships, like the Hovercraft 5.4, are on the low speed scale of the hovercraft, touching just 30 km/h. The weight of the craft is another important parameter that is also directly related to speed and overall performance. Aluminium is the main building material to be discussed for the dimensions of crafts, while composites are secondary option for smaller crafts. Hovercrafts are used for military use and also to carry heavy loads, and aluminium hull material. Prefabricated modules are complete structures and effect is double bulkheads on the side of the joint by combining two modules. This can result in extra weight, which is undesirable for high-speed crafts. To avoid extra material and weight, it is recommended that the thickness of the side plates is less than what it would have to be if the strength of the individual module was evaluated. All modules are fitted with ready-to-use piping, although not all modules will be used in the final craft. The result is increased weight and use of composite materials is recommended to counterbalance this difference in the superstructures of all crafts[10].

CONCLUSION

Craft principle is demonstrated using low-cost material and after series of test it is proved that a viable means of transportation on land and water. Propulsion and lifting systems delivered outstanding performance and manoeuvrability. An extraordinary innovation is not needed to achieve affordability. The approach in this paper is simple but promising and can be easily implemented by shipyards trying to drive down their production costs. It is a good basis for demonstrating the feasibility of a large-scale hovercraft. Depending on the design office or shipyard requirements, various modules and systems or specific module dimensions can be chosen to follow the theoretical concepts of design. The presented design covers a wide variety of missions while also minimizing the cost of manufacturing. The objective was to produce various but balanced crafts within acceptable limits of design. Every possible aspect cannot be optimized; output varies from one type of hovercraft to another. The large hovercraft has a lower skirt height to cushion beam value and thus better stability, while the small craft has a better total weight capacity as the cushion density is higher.

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