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An Innovative Design Thinking and Modelling Approach of Unmanned Surface Vehicle (USV) for Coastal Surveillance

Mr.C.Manivel, Mr.N.Gopalsamy

Abstract— *The purpose of this paper is to design and fabricate an unmanned surface vehicle (USV) for the coastal surveillance for the maritime of India. It aims to monitor territorial waters on a round-the-clock basis and allows the intelligence to take appropriate action to prevent terrorism, illegal smuggling and human trafficking as the continuous use of an aircraft for surveillance is prohibitively expensive along the Indian coastline which is a massive stretch measuring 7,517km.In this paper an Air Cushioned Vehicle (ACV) popularly known as a Hovercraft is chosen for surveillance as it has the ability to traverse any surface compared to other coastguard vessels thereby earning the title of amphibious boats. Its ability to access 75% of littoral allows them to come on shore during emergencies unlike conventional coastguards that have only 5% littoral access and cannot enter shallow water. Another major advantage of using this surface vehicle is it is easy to operate and noiseless compared to conventional vessels that generate wakes at high speeds unlike the ACV. The Hovercraft are fitted with a variety of sensors for intelligent monitoring and surveillance. The 360 degree SODAR that combines SONAR and RADAR is used for monitoring by using ultrasonic pulses to detect vessels. A wireless camera on board provides visuals for a more efficient surveillance and through wireless transmission networking real time imaging is achieved using Ground Control System (GCS). It permits the operator at the onshore station to control the (USV) and analyze its capabilities. The GPS system is incorporated to navigate the vehicle without human assistance. This paper aims to provide an affordable and efficient autonomous monitoring of the coastlines.*

Keywords— *USV, ACV, littoral, SODAR, Wireless Camera, Wireless Transmission, GCS, GPS*

I. 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.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.In simple words “Hovercraft is craft capable of moving over water or land on a cushion of air created by jet engines.RC means Conveyance that transports people or objects Operated and guided by radioAir cushion means The trapped air that supports a hovercraft a short distance above the water or ground.

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II. OVERVIEW OF HOVERCRAFTS.

A. Classification of Air Cushion Vehicles (ACV)

Fluid cushioned vehicles which are suspended a slight distance above an underlying ground or water surface by pressurized fluid flow output beneath such vehicles are known as an air-cushion vehicle, also known as a ground-effect machine (GEM) or a Hovercraft. These devices are also known as surface effect machines, ground effect vehicles and airborne surface vehicles. One type having a flexible or partially flexible skirt to contain lifting air, which leaks out under the skirt and can be controlled to some extent for balance and steering. Usually the propulsion and directional control are obtained by separate means, such as propellers and rudders, on top of the vehicle.

The other basic type has rigid side walls surrounding an air chamber, the walls being immersed in or in sliding contact with the supporting surface to minimize air leakage. The supporting air can be used for propulsion, since the energy is well contained, but additional propulsion means is often used.

B. What Laws Of Motion Are Used In Hovercrafts?

A hovercraft is a versatile boat that you can ride up to the shore. Riding on a hovercraft is like gliding along on a cushion of air. Hovercrafts are also known as air- cushion vehicles. Air currents underneath the base of the hovercraft allow it to travel on land or water. Low-pressurized air is ejected downward against the surface below, whether land or sea, causing the boat to float on the air. Newton's three laws of motion further explain how hovercrafts operate.

Newton's First Law: This law is also referred to as "the law of inertia." It states, "An object at rest will remain at rest unless acted on by an external force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an external force." Simply

stated, objects tend to maintain their position or direction unless another force or object interferes. Friction is tension between two objects that are touching. A hovercraft in motion will eventually come to rest because of friction and Newton's First Law. Once the hovercraft is no longer powered and comes to a stop, it will simply float on the water.

Newton's Second Law: According to Newton's second law of motion, "Acceleration is produced when a force acts on a mass. The greater the mass [of the object being accelerated], the greater the amount of force needed [to accelerate the object]." Newton's second law explains the force that accelerates the hovercraft. Some hovercrafts, such as homemade ones, can be steered simply by shifting your weight inside the vehicle. Leaning to the left will push more air to the right side. This will move the hovercraft toward the left. Leaning forward will add velocity by blowing air out the back of the vehicle.

Newton's Third Law: Newton coined, "For every action, there is an equal and opposite reaction." This means that actions are interrelated. Further, actions and reactions occur in pairs. This law is true whether the forces are in equilibrium, moving, stationary or accelerating. For instance, the opposite of push is pull, and the opposite of up is down. Newton's Third Law explains the forces of lift and thrust in a hovercraft. The hovercraft is lifted off the ground by its air cushion -- the difference in air pressure above and below the hovercraft -- causing a lifting force. The fan of the hovercraft pushes air behind the vehicle, which propels it forward.

The Hovercraft Principle: How Does A Hovercraft Work?

The principle of working of a Hovercraft is to lift the craft by a cushion of air to propel it using propellers. The idea of supporting the vehicle on a cushion of air developed from the idea to increase the speed of boat by feeding air beneath them. The air beneath the hull would lubricate the surface and reduce the water drag on boat and so increasing its speed through water. The air sucked in through a port by large lifting fans which are fitted to the primary structure of the craft. They are powered by gas turbine or diesel engine. The air is pushed to the underside of the craft. On the way apportion of air from the lift fan is used to inflate the skirt and rest is ducted down under the craft to fill area enclosed by the skirt.

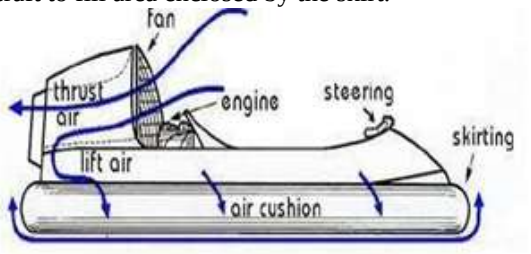


Figure 1 Sketch of Working Principle of Hovercraft

III. REVIEW OF LITERATURE

Literature has been collected from various journals, books, papers etc. & has been reviewed as follows-When designing a hovercraft it is important to have a clear set of client needs and target specifications to refer to throughout the design process. The client needs are used to evaluate preliminary design concepts to select the most feasible for each functional component of the hovercraft, while the target specifications are used to further refine the selected design components.

- Safe for use indoors in the presence of spectators
- Light weight
- Cost effective
- Easy to manufacture
- Should move in a straight line
- Should move fast
- Portable
- Aesthetically pleasing (Fit and Finish)

A. Hovercraft Essentials

The following section will present an introduction to hovercraft features, as well as the engineering concepts associated with each feature and function.

1) General Overview / Features

A hovercraft has several major components - the hull/body, the lift fan(s), the thrust fan(s) and the skirt.

Table 1 Response Table & Various Concepts of Body Style for Designing Hovercraft

Concept of Body Style	Safe	Durable	Light Weight	Cost Effective	Easy to Manufacture	Move in Straight Line	Portable
Ellipse	+	+	+	+	+	0	+
Square	+	+	+	+	+	+	+
Car Look-Alike	+	+	+	-	-	+	+
Box	+	+	+	+	+	+	+
Triangle	+	+	+	+	+	+	+
Circular	+	+	+	+	+	+	+
Cylindrical	+	+	+	+	-	+	+

*Note: +, 0 or - was assigned to indicate positive response a neutral response and negative response respectively w.r.t various features of Hovercraft designs.

Table 2 Response Table & Various Concepts of Body Material for Designing Hovercraft

Concept Of Body Material	Safe	Durable	Light Weight	Cost Effective	Easy To Manufacture	Move In Straight Line	Portable
Carbon Fiber	+	+	+	-	-	+	0
Cardboard	+	-	+	+	+	+	0
Aluminum	+	+	+	-	0	+	0
Fiber ass	+	+	0	0	+	+	0
Glass	+	+	0	-	-	+	0
Paper	+	-	+	+	+	+	0
Steel	+	+	-	-	0	+	0

Table 3 Response Table & Various Concepts of Lift Mechanism for Designing Hovercraft

Concept Of Lift Mechanism	Safe	Durable	Light Weight	Cost Effective	Easy To Manufacture	Move In Straight Line	Portable
Single Fan	+	+	+	+	+	+	+
Double Fan	+	+	+	+	+	+	+
Compress Air	+	-	+	0	+	+	+
Leaf Blower	+	+	0	-	0	+	-
Flying Wing	+	0	-	-	-	0	+
Vacuum Cleaner	+	+	0	-	+	+	-
Balloons	+	-	+	+	+	0	+

Table 4 Response Table & Various Concepts of Propulsion or Thrust for Designing Hovercraft

Concept Of Propulsion Or Thrust	Safe	Durable	Light Weight	Cost Effective	Easy To Manufacture	Move In Straight Line	Portable
Single Rocket	-	-	-	-	-	+	0
Double Rocket	-	-	-	-	-	+	0
Single Fan	+	+	+	+	+	+	+
Double Fan	+	+	+	+	+	+	+
Turbojet	-	+	-	-	-	+	-
Diesel Engine	0	+	-	-	0	+	0

Table 5 Response Table & Various Concepts of Power for Designing Hovercraft

Concept Of Power	Safe	Durable	Light Weight	Cost Effective	Easy To Manufacture	Move In Straight Line	Portable
Battery	+	+	+	+	+	+	+
Gravity	+	+	0	+	0	+	0
Chemical	-	-	+	-	-	+	-
Solar Power	+	-	+	-	-	+	+

Table 6 Response Table & Various Concepts of Skirts Material for Designing Hovercraft

Concept Of Skirts Material	Safe	Durable	Light Weight	Cost Effective	Easy To Manufacture	Move In Straight Line	Portable
Rubber	+	+	+	+	+	+	+
Plastic	+	0	+	+	+	+	+
Paper	+	-	+	+	+	+	+
No Skirt	+	-	+	+	+	+	+
Fiber	+	+	+	-	+	+	+
Nylon	+	+	+	+	+	+	+

IV. DESIGNS CONCEPTS

In this section we introduces various types of hover craft models from the literature study made up of different body style and body material .Each of the designs will be described and illustrated with the help of sketch.

Design 1 This design utilizes a double fan system for propulsion, a single fan to produce lift, has an ellipse shaped body made out of cardboard and a skirt made out of a plastic bag.

Design 2 This design utilizes a single fan system for propulsion, a double fan to produce lift, has a body style of a rectangle with rounded corners made out of recycled plastic with a solid skirt made out of foam.

Design 3 The design uses a combined lift and propulsion system with a single fan, has the body style of a circle, similar to a UFO made out of Styrofoam with no skirt.

Design 4 This design uses a double fan for propulsion, a single fan for life, has a body style of a circle similar to a UFO [unidentified flying object] made out of balsa wood with a monokote skin, and a skirt made out of polyethylene.

Design 5 This design uses a single fan for propulsion, a single fan for lift, has a body style of a rectangle with rounded corners made out of recycled plastic and a skirt made of polyethylene.

Design 6 This design has a double fan used for propulsion, a double fan used for lift, has the body style of a triangle made out of foam with a skirt made out of a plastic bag.

Design 7 This design utilizes a combined thrust and lift fan, with the body style of a rectangular box made out of recycled plastic, with a solid skirt made out of foam.

Design 8 This design uses a combined double fan and lift system, with the body shape of a car, made out of vacuum-formed plastic, with a skirt made out of rubber.

Design 9 This design uses a double fan for both lift and propulsion has the body style of a rounded corner rectangle made out of carbon fibre, with a skirt made out of plastic.

Design 10 This design has a single fan used for propulsion,

a single fan for lift, and a body style of a box made out of cardboard with no skirt.

1) Gap in Literature

From the literature review, It is observed that the utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out

of plastic have not been designed yet, so it's interesting to design utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic .All these aspects will be addressed in research work.

V.ENVIRONMENTAL IMPACT FROM HOVERCRAFTS

Do hovercrafts hurt the environment? No. The unique characteristics of the hovercraft make it one of the most environmentally friendly vehicles in the world. One of these characteristics is the hovercraft's low "footprint pressure."

Is a hovercraft good for our environment?

No Submarine Impact: While Move forward or under in a sliding motion there is no striking of one body against another takes place. Transference of propeller noise to marine life does not occur and does not have a negative impact on the submarine life.

No Discharge: There is no sudden giving off of energy .There is no discharge of diesel fuel, lubrication oil, gasoline or hot exhaust gases into the water.

No Wash: No Requirement of Cleaning with some chemical process. Some hovercrafts generate almost zero wash while Erosion is a major problem caused by conventional ferries and pleasure boats.

Reduction of Noise : Due to the past ten years development of propeller ducts with close propeller tip clearance, some Hovercrafts are not noisier than equivalent twin engine conventional high speed boats with inboard or outboard propulsions.

No toxic underwater surfaces: The hovercraft does not need any toxic underwater surfaces paint to keep the bottom clean from vegetation. Toxic bottom paint has become serious problems in the most sensitive areas.

Hovercraft is without a doubt the most environmentally friendly way for ecosystems.

Disadvantages of Hovercrafts

1. They move a lot of air and can be relatively loud.
2. Potential of skirt damage.
3. More repairs.
4. Less capacity.
5. Control/stability is less as compared to other vehicles

Environmental Friendly Analysis: Are Thermocol Eco Friendly?

Thermocols (white colored soft material used for decoration and packing electronic items) eco friendly...i.e. do they bio degrade? No they are not Eco-friendly! They are made up of thermo soft plastic material and when they burn produces CloroFloro Carbon. Naturally dissolved thermocol may not be that harmful but burned one will be. It is the bane of waste recyclers. It neither burns nor does it reduce to invisible units, and if set alight, the result is a molten mess that solidifies when cool and gives off Strong and sharp vapors.

VI. MATERIALS AND METHODS

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.

Design & manufacturing of Radio controlled -Air cushion vehicle [RC-ACV [G- 1] 2015] by utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic

VII. DESIGN APPROACH

A. Step 1–Literature Analysis & Design Reviews

In this step we conduct a research survey about the air cushion vehicle that on which principle they are working, various parts & technical aspects of the working model, what their practical implementations, their advantages and limitations, more importantly selection of materials for design purpose. And technical aspects of manufacturing to make design safer, cost effective, to find alternative materials to make design lighter in weight, make design more aerodynamically and importantly more environmental friendly. We also finds various past development, future proposals, more important are they environmental friendly or not through this step. For that purpose to refer various types of air cushion models from the YouTube links for practical demonstration of their tips for manufacturing, materials used commonly, some alternative materials, cost of manufacturing, testing & their analysis. Literature survey is one the effective tool or approach for such observation to be carried out.

B. Step 2–Drafting of Design of RC-ACV [G-1] 2015

In this step we used Mechanical Cad software's 2D like Auto Cad for the objective of size specification. For the manufacturing we design a performance index RC-ACVPI [G-1] 2015.For the proper visualization of the model we used 3D software like Pro/E wireframe 4. Four main parts of design

- Base Design [Means Platform]

- Front Motor Mount Design [Lift Mechanism]
- Back Motor Mount Design [Propulsion or Thrust]
- Steering Design [The Act of Guiding or Showing the Way]

C. Step 3–Manufacturing Of RC-ACV [G-1] 2015
Manufacturing Objectives

- Build a working and autonomous RC hovercraft.
- Make the lightest and most cost efficient hovercraft possible.
- Offer a new & improved design of the existing hovercraft (based on self evaluation).
- Make the environment friendly Radio Controlled Air-cushion vehicle RC-ACV [G-1
] 2015

Stepwise Manufacturing of RC-ACV [G-1] 2015 with their objective function.

1. Preparation of Base [Means Platform & Skirt] By Selecting Appropriate Size & Material
- Design and build a durable and lightweight body and skirt.
- Find the best placement of parts.

2. Preparation of Front Motor Mount Design [Lift Mechanism]
- Choose the adequate placement of fans.
- Find powerful yet efficient fans to propel the hovercraft.

3. Preparation of Back Motor Mount Design [Propulsion or Thrust]
- Choose the adequate placement of fans.
- Find powerful yet efficient fans to propel the hovercraft.

4. Preparation of Steering Design [The act of guiding or showing the way]
- Determine the direction of travelling

In the end Assembly of all the utilities will be carried out with all the appropriate components.

D.Step 4– TESTING 0f RC-ACV [G-1] 2015 After Manufacturing

Testing parameters Such as
- Working conditions monitoring
- Speed control
- Lift mechanism [means Cause to move upwards], and
- Turning [means a movement in a new direction].

1) Design Procedure

E. Step 1–Drafting of Design of RC-ACV [G-1] 2015

1. Design Criteria –Specification of Size

In this step we used Mechanical Cad software's 2D like Auto Cad for the objective of
size specification.
- Base Design [means Platform] of RC-ACV [G-1] 2015
- Back Motor Mount Design [Propulsion or Thrust] of RC-ACV [G-1] 2015
- Front Motor Mount Design [Lift Mechanism] of RC-ACV [G-1] 2015

Part 1 Base Design Steps [Means Platform] Of RC-ACV [G-1] 2015 Utilities used: - Engineering scale, Cutter, Araldite, Pliers, Tape roll, Paint, Soldering Equipment, Keys, Marker, etc.

Specification of components:-

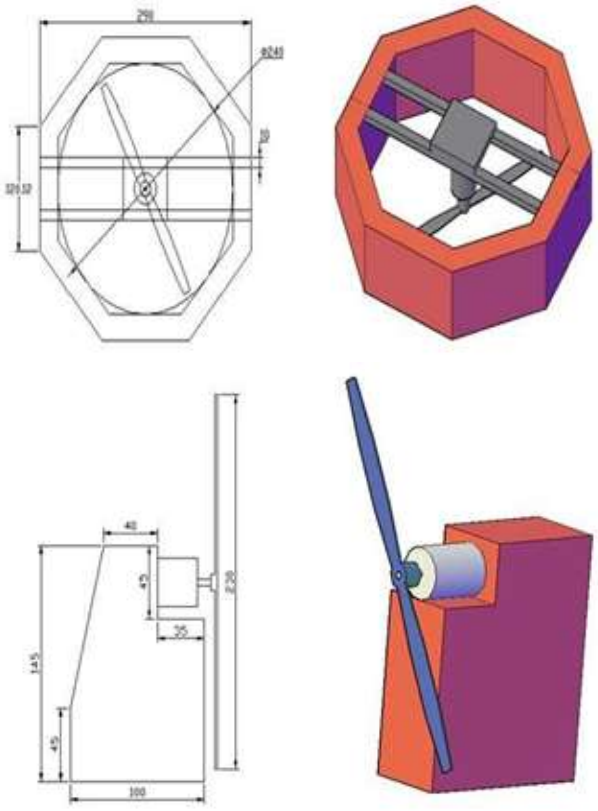
1) Thermocol (Thickness=22.5mm (2 sheet), 45mm (1 sheet)

Part 2:- Front Motor Mount Design [Lift Mechanism] Of RC-ACV [G-1] 2015

Specification of component:-

1. Thermocol (Thickness=22.5mm)
2. Wooden (one rectangular piece and two strips)
3. Brushless Motor (Out runner 1200KV, Thrust- 850gram)
4. Propeller 9x5 Standard & Counter Rotating

Part 3 Back Motor Mount Design [PROPULSION OR THRUST] OF RC-ACV [G-1] 2015



Material Used: Wooden

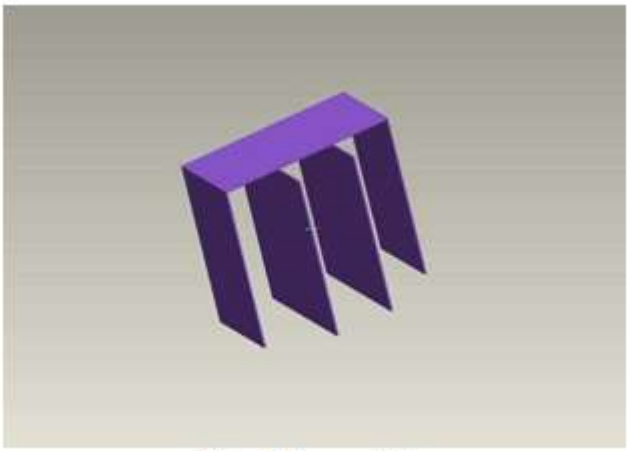
Specification of Components:

1. Wooden (150x100x40)
2. Brushless Motor (Out runner 1100KV, Thrust-1130gram)
3. Propeller (9x5)"

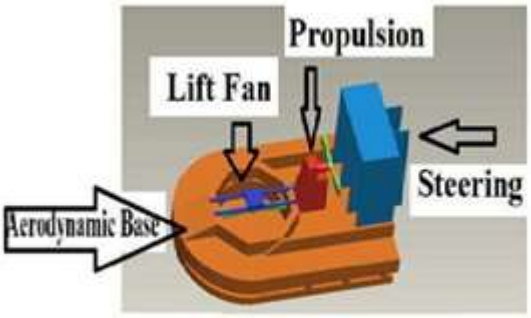
Part 4:- Steering Design [The Act of Guiding or Showing the Way] Of RC- ACV [G-1] 2015

Material Used: Cardboard

Specification of Components: 1) Servo Motor (Torque (Kg-cm): 0.8g, Operating Speed: 0.14sec)



Final Assembly



Connection Circuit Diagram

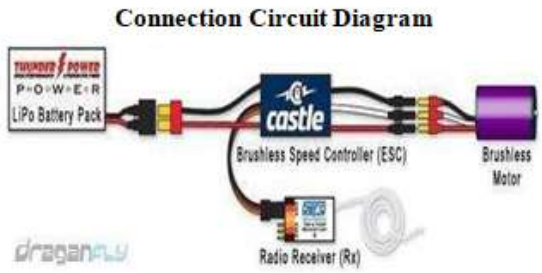


Figure 2 Connection of Brushless Motor, ESC &LiPo Battery

Radio Control Transmitter & Receiver

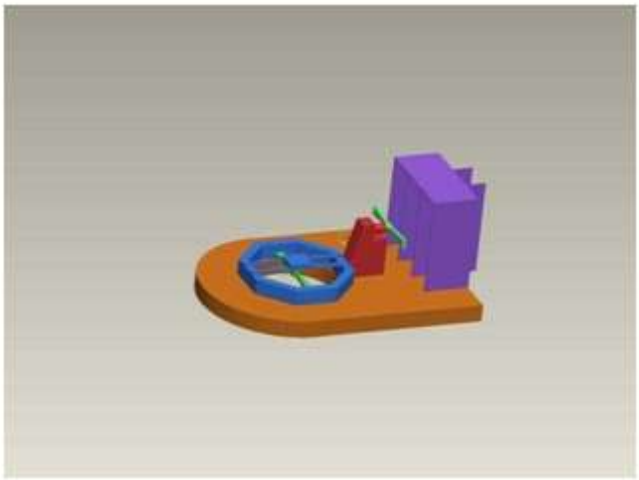
Channel 1 – For Steering Control Channel 2 – For Back Motor Control [Thrust or Propulsion]

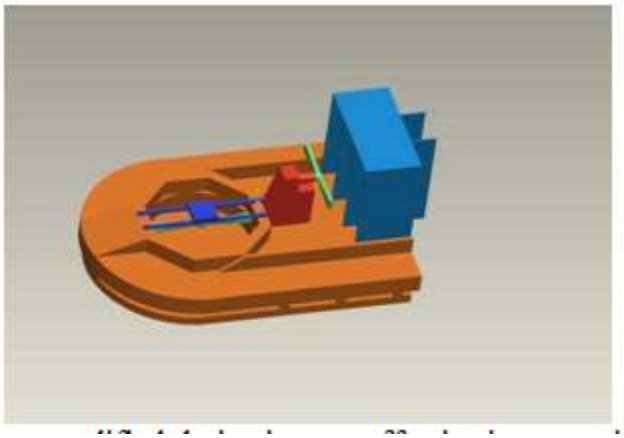
Channel 3– For Front Motor Control [Lift]

VIII. RESULTS & DISCUSSIONS

A. Material & Cost Effective Analysis

For the objective of material specification & their cost we construct a table for that Simplified Material Design Cost Matrix of RC-ACV [G-1] 2015&For the manufacturing we design a performance index RC-ACVPI [G-1] 2015.





B. Aerodynamic Design Modification:

Base Before Modification:- Before modification, hovercraft is unstable, handling is difficult, lift is more at front as compared to other portion, air is not properly distributed around the base.

Base after Modification: After modification, hovercraft is stable on the ground, handling is quite easy, and air is properly distributed around the base so that the lift of hovercraft is balanced.

We found that our modified design is more effective in comparison with old design considering the aerodynamic forces.

Base and Front Motor Mount Modification: - We are using the 1200KV brushless motor on the front motor mount which has the thrust capacity of 850kg. Base is made by thermocol sheets. First we fixed the motor on the base with wooden strip at define place at where the hole is provided for lift. During testing we find that the front portion of hovercraft is lift more than back portion. So we join one more sheet of thermocol without hole. This sheet are joined at some distance from the old base for the proper circulation of air between two sheet and air come out from the circumference of the sheet and lift is provided on the all corner. These modifications improve the controlling of hovercraft.

Back Motor Mount Modification: - We are using the 1100KV brushless motor on the back mount which has the thrust capacity of 1130kg. First of all we use thermocol

material for the back mount. But during testing of hovercraft they break into two pieces due to heavy vibration and resultant force produce by motor. So after this accident we take the decision to increase the strength of back mount. This time we use wooden material for back mount to increase strength and wooden also help in decreasing the vibration during running of motor. Again we test it and it runs properly without so much vibration.

C. Testing conditions

Testing parameters Such as

- Working conditions monitoring [means the act of observing something]
- Speed control [means A rate (usually rapid) at which something happens],
- Lift mechanism [means Cause to move upwards], and
- Turning [means a movement in a new direction].

Testing Condition are as following:

1) Working Condition: - Determining how well the hovercraft works consists of considering how well the craft performs as a whole and how well each component performs its task. The RCACV can hover and move forward on the plane ground surface. The RCACV was incapable of running on water. During testing we observe that all the components are working very well.

2) Speed Control Monitoring: - We carried out the speed control test on the plane floor surface. The speed of the hovercraft is depending upon the speed of motor. When we increase the speed of motor then hovercraft's speed is increase and vice versa. The speed of motor is control by the right sided joystick of remote control.

3) Lift mechanism: - Lift mechanism is used to reduce the friction between ground surface and hovercraft's base. We observe the main factor during testing are following: -

1. Enough lift (So friction between ground surface and hovercraft's base are less).
2. Proper balance (Provided lift is equally distributed on whole base and the skirt is strongly attached and air-tight).

4) Turning: - Now we consider the functioning of steering mechanism. During testing we observe the working of rudder. When rudders turn on right side then RCACV turn on right side, but the flow of air is in opposite direction as shown in fig. and vice versa.

D. Features of RCACV 2015

Feature of RCACV are as following:

1) Safe: - Our design is safe and environment friendly because we are using motor for lift and propulsion which does not create any pollution while running. There is no chance of fire or explosion, because no usage of fuel, so chance of accident is reduce and our design become safer.

2) Light Weight: - We are using thermocol as base material which are light in weight, so the overall weight of our design is less.

3) Cost Effective: - Our design is cost effective because we are used thermocol or cardboard for base and body which are low cost material.

4) Easy To Manufacture: - Manufacturing of our design is very easy. There is no need of any machining operation.

5) Capable of Moving Straight Line: - While testing we observe our design model will be capable to move in straight line.

6) Portable: - Our design is portable because of light weight. The weight of our design is near about 1.5kg, so we can easy carry the RCACV.

E. Implementation /Recommendations

This design utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic .

Implementation of for RC-ACV [G-1] 2015 for such application of working are as following :

1. Navigating shallow and narrow waterways that cannot be reached by boat.
2. Wildlife research and conservation.
3. Retrieving birds from tailings ponds at mining sites.
4. Survey work.

Final Design of Manufactured RC-ACVPI [G-1] 2015

This design utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic .

F. Further Future Design Modification

We can use the alternative material or more modification in design to increase the efficiency of hovercraft. We can improve the thrust and lift system. We can also improve the steering mechanism.

IX. CONCLUSION

Literature gap analysis conduction is found to be very useful approach for selection of material & design pattern.

From the literature review, It is observed that the utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic have not been designed yet, so it's interesting to design utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic .All these aspects will be addressed in research work.

This design utilize a combined single trust and lift system with a body shape of box made out of thermocol and with a skirt made out of plastic.

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We can use the alternative material or more modification in design to increase the efficiency of hovercraft. We can improve the thrust and lift system. We can also improve the steering mechanism.

A. Feature of RCACV are as following:

Our design is safe and environment friendly because we are using motor for lift and propulsion which does not create any pollution while running. There is no chance of fire or explosion, because no usage of fuel, so chance of accident is reduce and our design become safer. We are using thermocole as base material which are light in weight, so the overall weight of our design is less. Our design is cost effective because we are used thermocole or cardboard for base and body which are low cost material. Manufacturing of our design is very easy. There is no need of any machining operation. While testing we observe our design model will be capable to move in straight line. Our design is portable because of light weight. The weight of our design is near about 1.5kg, so we can easy carry the RCACV.

B. The Future of the Hovercraft

The history of the hovercraft continues to be written. Today and in the future, however, that history is being written not only by inventors, engineers and movie studios. The history of the hovercraft is now being written by your neighbors building a hovercraft in their garage; by your local fire department performing rescues; by your child building a hovercraft at school; and by you. The opportunities may be slim for you to go down in history as the inventor of a new vehicle or as an Olympics winner. In contrast, hovercraft today and tomorrow are very much an equal opportunity, available to everyone. If you've ever wanted to fly, if you've ever wanted to race, if you've ever wanted to become a part of history, now is your time.

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