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Review Paper On Illustration Of Hovercraft

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Abstract: The aim of this work is to create, balance, simulate, and operate a self-sufficient model of a compact hovercraft that can traverse any type of terrain. It is suggested to use a real-time layered fuzzy navigator for hovercrafts in dynamic environments. The system consists of a modified proportional navigation based fuzzy controller and a fuzzy motion planner of the Takagi-Sugano type. The system's design is influenced by how humans navigate through barriers by using visual cues, such as views to the right and left, to determine where to walk next in the open area in order to reach their destination. It deftly blends two behaviours to handle both approaching and avoiding obstacles.

A fascinating example of a mechatronic device that levitates over water and land is the hovercraft. This project aims to build, balance, simulate, and run a self-sufficient model of a small hovercraft capable of moving over any kind of terrain. For hovercrafts operating in the hovercraft is an intriguing mechatronic device that can levitate over both land and water. The dynamic situations, a real-time layered fuzzy navigator is recommended. The way people move past barriers and use visual cues, including views to the right and left, to figure out where to travel next in an open space to get where they're going, has an impact on the design of the system.

Keyword: Hovercraft, Rotar, Propeller

I. INTRODUCTION

Hovercrafts are preferred when it comes to movement and transportation in different inaccessible places because of their amphibian characteristics. However, their greatest advantage—almost completely being removed from the ground—comes at the expense of limited and challenging agility. The air thrust produced by the propulsion system facilitates all steering and stopping actions. An air propeller powers a hovercraft, which is supported by a skirt, also known as an air cushion kept inside a flexible structure. A lift fan retains the air inside the cushion, thus air from the surrounding atmosphere is drawn in by the fan and compressed into the air cushion.

An air propeller powers a hovercraft, which is also supported by a skirt, also known as an air cushion kept inside a flexible structure. A lift fan retains the air inside the cushion, so air from the surrounding environment is drawn in by the fan and compressed into the air cushion. The fan must generate enough air speed for the rudder to function as an effective control surface because the hovercraft is guided by a rudder mechanism.

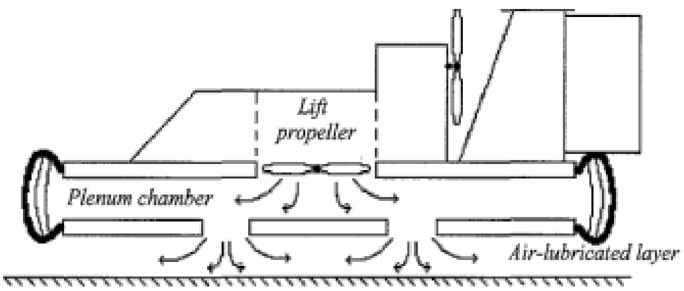

Fig.1 Twin engine Hovercraft

An amphibious hovercraft is one of the various varieties of hovercraft that exist. The suggested model hovercraft is also intended to be amphibious, meaning it has the ability to function both on land and on water.

To raise the hovercraft and make up for the air lost through the holes in the bottom plate, an ongoing supply of air is required. Additionally, the flow needs to be higher than the quantity of air escaping through the bottom plate's holes. Since it is impossible to guarantee that air escapes evenly around the hovercraft, the rate of air loss is not consistent. The engine and propeller must have adequate power to produce a high airflow rate into the chamber in order to maintain the lift as well. Because it lessens pressure loss around the propeller tube, a cylinder is positioned around the lift propeller to increase efficiency.

On the rear end of the hovercraft, the second propeller is powered by a separate motor. This engine, which creates a displacement forward, can only supply a steady speed to the propeller in opposition to the lift propeller. When there is no wind and the battery is completely charged, the propeller can produce a maximum force of 1,8 N. When all lift is generated and the rudder is in its default position, allowing the hovercraft to only move in a straight line, the highest speed this model hovercraft can achieve is 3 meters per second.

Hovercrafts, sometimes referred to as air cushions or air-powered vehicles, can move across mud, water, and other types of terrain. Cushion pressure is produced in this vehicle by continuously forcing high pressure air into the skirt. This procedure lessens surface and moving vehicle friction. They can traverse gradients up to 15 degrees, hover at heights between 250 and 650 mm over any surface, and function primarily at speeds exceeding 15 mph. The fundamental concepts of propulsion and lift underpin the operation of hovercrafts. Lift, however, is the primary factor since it facilitates the vehicle's riding.

First, a lot of air is directed under or within the skirt of the ship to begin the lifting process. Thrust force is produced by a propeller fan, which causes the body to move horizontally. To manoeuvre the vessel in the desired direction, steering capabilities must be included. Rudders can be used to do this. The form or style of the rudders is crucial for manoeuvring the vessel through the air.

2.1 HOVERCRAFT STRUCTURE AND DESIGN

A model hovercraft should have a sturdy and lightweight frame. Furthermore, a model needs to be buoyant and water resistant in order to function over water.

RC hovercrafts and RC aircraft have more characteristics because they both need to be lightweight, unlike boats.

Balsa building is the technology used in traditional aircraft modelling. This produces a robust and lightweight model, but it is exceedingly challenging to make this kind of construction waterproof. Furthermore, the model is not particularly sturdy, and as it operates and hits impediments, it frequently sustains knocks and scrapes. Other materials, more sturdy but yet very light, come in a range of gauges, such as plywood sheets and styrene.

These days, it's common to find high impact styrene sheets in many model stores. Furthermore, the model's size needs to be practical in order for it to be handled and kept in the lab with ease. Additionally, the model's mass has a significant impact on its design; a light model will be easier to operate, need less power from the motor, and have a longer-lasting battery.

2.2 Hovercraft Computer Aided Design (CAD) Model

CAD model is drawn using Solid Edged V20, and Fig.2 showing each part of the assembly drawing.

2.1.1The Hull

The hull of the hovercraft consists of a low-density balsa construction, with dimensions of 750mm*500mm*50mm, and wall thickness is 6 mm. The main forces that affect the hovercraft are the forces and moments exerted by the propulsion unit, the aerodynamic forces and moments exerted by the airflow (most notably, the drag) and finally the weight force.

2.1.2The Rotor Propellers

The propellers used in the physical model are ready made ones, therefore the model is not very accurate, the main forces of propeller are Rotation around the axis of the rotor, this is the main and most obvious motion, the aerodynamic forces and moments exerted by the airflow and finally the weight forces of the propeller which we neglected in our model because it weighs less than 7 grams.

2.1.3 Motor

The two DC brushless servo motors in the hovercraft model are used to raise (hover) the craft and to provide the thrust force needed to propel it ahead.

The propeller will be housed in this motor. Our propulsion system will consist of the DC motor and propeller working together. Since the motors we are utilizing can generate a lot more torque than they are small in size, a hub or basic gear box is not necessary.

2.1.4 The Mount

In order to prevent motor output power waste, the propeller is housed in a casing for safety reasons and to direct air flow in a single direction

2.1.5 Assembly Drawing

The only forces at work in the battery and electronic circuits will be weight. When examining the Simulink model of the hovercraft, Figure 3 depicts the model's assembly and the primary axes of direction are taken into consideration as positive directions.

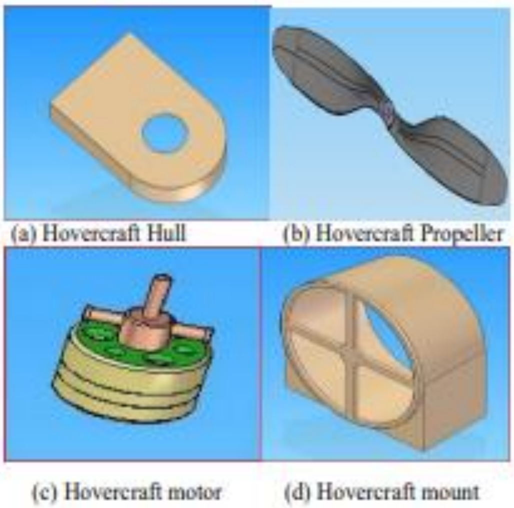

Fig.2 The parts of the assembly drawing.

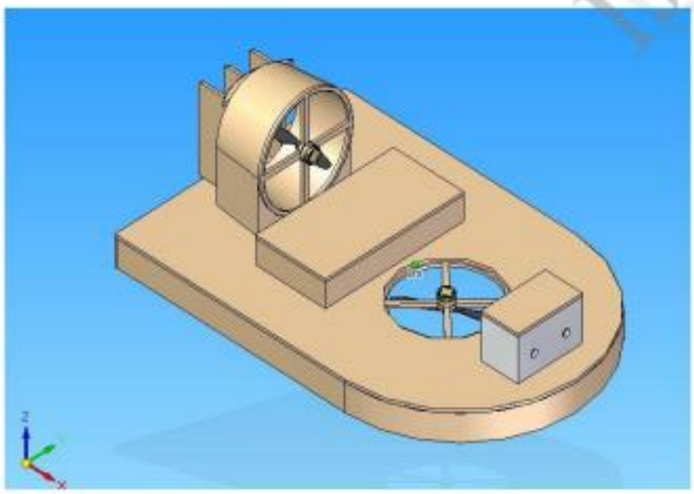
Fig.3 Hovercraft assembly drawing

2.1.6 Mass and inertial properties
2.1.6.1 Mass Properties
These properties were estimated using the inspection tool of Solid edge, the mass properties of each part are illustrated on table 1.

Item	Mass (grams)	Quantity	Total mass
battery	147	2	294
Control circuits	225	1	225
DC motor	39	2	78
ESC	15	2	30
receiver	40	1	40
propeller	7	2	14

Table 1 Mass Properties

2.6.1.2 Inertial properties
These properties were estimated using the inspection tool of Solid edge to be used in the Simulink model parameters, the inertial properties of each part are illustrated on Table 2.

Axis	M.M. Inertia	Radii of Gyration
X	0.098562 kg-m^2	240.333073 mm
Y	0.085518 kg-m^2	223.866049 mm
Z	0.016975 kg-m^2	99.738627 mm

Table 2 Inertial properties

3 Components
3.1 Arduino Uno R3
ATmega16U2 instead of the 8U2 found. This allows for faster USB transfer rates. No drivers needed for Linux or Mac.
The ability to have the Uno show up as a keyboard, mouse, joystick, etc. New SDA and SCL pins next to the AREF. this is a duplication of the Analog 4 and 5 pins. Two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes.
Reset button moved from centre of board to corner near USB connector, allowing resets when shields are connected. Larger heat sink copper area for the LM117 regulator.

Fig 4 Arduino Uno R3

3.2 Servo Motor

- Power Supply: Through External Adapter.
- Stable and Shock Proof • Connector Wire Length 300mm
- Operating Speed: 0.17sec / 60 degrees (4.8V no load)
- Operating Speed: 0.13sec / 60 degrees (6.0V no load)
- Stall Torque: 9 kg-cm (180.5 oz.-in) at 4.8V
- Stall Torque: 12 kg-cm (208.3 oz.-in) at 6V
- Operation Voltage: 4.8- 7.2Volts
- Gear Type: All Metal Gears
- Original box: NO
- Colour: Black
- Item size: 40*19* 43mm
- Servo weight: 55g
- Net weight: 66g (with accessories)
- Package weight: 75g

Fig 5 Servo Motor

3.3 Male-Female & Male-Male jumper wires

These are jumpers terminated as male to female. Use these to jumper from any male or female header on any board. It is very useful for breadboard and Arduino These are jumpers with male connectors on both ends. Use these to jumper from any female header on any board, to any other female header.

Combine these with our female to-female jumpers to create a male to female jumper. Single Port male to male Jumper Wire - Greatly used for breadboard and Arduino.

Fig 6 Male-Female & Male-Male jumper wires

3.4 Bluetooth Module HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default, the factory setting is SLAVE.

The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections.

Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project.

Fig 7 Bluetooth Module HC-05

3.5 ESC (Speed Controller for Brushless Motor)

- Weight: 25g
- 304 Brushless ESC
- Dimensions: 45 x 24 x 11mm
- Firmware: Hobby wing
- Power input: 5.6V-16.8V (2-3 cells Li-Poly, OR 5-12 cells Ni-MH Ni- MH/Ni-Cd battery)
- BEC: 2A Constant current: 30A (Max 40A less than 10 seconds)

Safe power function: regardless of the throttle stick in any position the motor will not start immediately Throttle Calibration function: Adapt to different remote throttle travel difference, improve throttle response linearity.

Fig 8 ESC (Speed Controller for Brushless Motor)

4.1 Software Implementation

The microcontroller has been programmed using a variety of software programs in order to effectively run our project. They are listed in the following order:

4.2 Keil Software

It is employed in the writing of project operation programs. Embedded software developers use Keil 8051 development tools to handle a variety of challenging problems. It provides file assembly and debugging capabilities and is available as an evaluation package. Compiler, linker, and assembler are examples of different development tools.

4.3Flash Magic

We burn the program in this software so that it compiles on a microcontroller. It supports NXP and Philips microcontrollers and is typically used to program hex code into an EEPROM. Because these controllers enable the in-system programming (ISP) functionality, programs written in hex code can be executed. The microcontroller's datasheet, which has all the specifics, can be used to determine whether or not it supports ISP.

5.1Calculations

5.1.2 Lift Calculation

Total weight: 6*9.81 = 58.86 N

Area of cushion: π r2 = 0.3318 m2

r = 0.325 m

Cushion pressure = Total weight / Area of cushion

Cushion pressure = 177.39 Pa.

Air pressure blown in skirt through fan is

Pf = 105000 Pa

atmospheric air pressure Patm = 101325 Pa

therefore, Pf – Patm = 3675 Pa.

Considering 6 holes on the skirt through which air can escape and produce require thrust for uplift (hole diameter = 2cm.) = 6 * 0.0628 = 0.377 m.

Now hovercraft is designed to lift 3 mm off the floor, the total area through which the air will escape (Ae) = (.377* .003) = 1.131 * 10-3 m2

.By calculating Velocity pressure

(Pv2) = ½ ρ V2 = 177.38 Pa

ρ =density = 1.22 kg/m3

Therefore, V = velocity = 17.05 m/s.

This is the escape velocity (Ve) of the air from where it escapes through the gap at a given cushion Pressure (Pc)

The Volume of air lost (V) = Escape Velocity

(Ve) x Escape Area (Ae) = 17.05 * 1.131*10-3 = 0.019283 m3/sec.

Power = ρ*Ae* Ve3

= 1.22 * 1.131* 10-3 * 17.053

=6.83 W.

5.1.3 Thrust calculation:

The basic equation for Gross thrust is given by: -

Tg = m * Vd

Where:

Tag = Gross thrust

Vd = Discharge velocity (Efflux velocity) and

m = mass flow rate = ρ * A * Vd

Where:

Duct Diameter = 1000mm (Area (A) = 0.785m2)

Discharge Velocity Vd = 10 m/sec

Density of air ρ = 1.22 kg / m3

Power required:

P = Tn * V = 95.77 * 0.1

= 9.577 W.

Total power req = 2 * 9.577 = 19.154 W

6.1 Result and Discussion

Thus, we designed RC controlled hovercraft. In this project we used microcontroller so as to control the International Journal of Scientific Research in Science, Engineering and Technology (ijsrset.com) 712 operations of project. RF modules are made used so as to control the body from a distant (wireless). In below figure, we have shown some of our parts of project. In figure 9, we have shown our receiver parts. Similarly, in figure 10, transmitter has been shown.

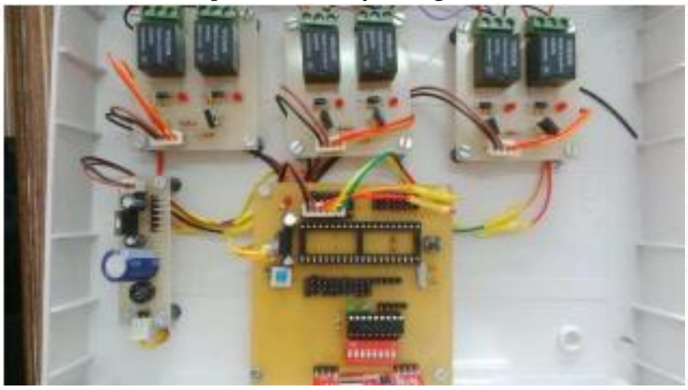

Fig 9 Receiver

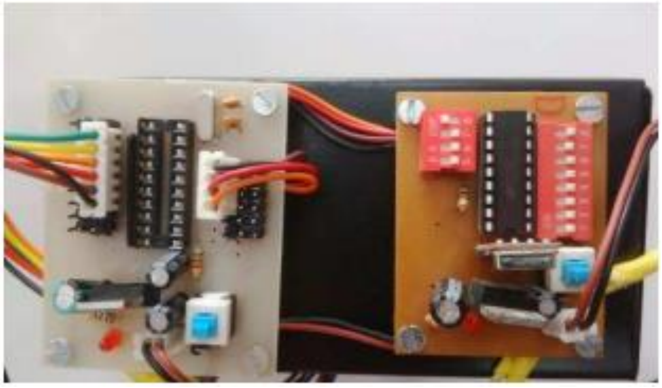

Fig 10 Transmitter

7.1Conclusion

Although hovercrafts theoretically seem like simple mechanisms, their actualization requires a very challenging technique. There are many issues that must be resolved in order to steer the hovercraft in a stable path. Every calculation and plan need to be precise and faultless. To avoid instability and subpar performance, we must take into account the weight and shape of each component. Several variables and issues are taken into account when building and designing the ship. When all procedures are followed precisely, this machine can rotate smoothly, eliminating friction. However, because of the difficulties in maintaining consistent operation, its uses are confined to those of the military or transportation industry. Also, the overall cost is another great hurdle for the widespread use of this vehicle.

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