Abstract

In this study we have mainly focused on analysis and procedure of designing and making of a RC Hovercraft along with GPS and Object detection. The designing parameters, the selection of the skirt, selection of motor, the weight of the hovercraft, the amount of thrust required are some of the parameters considered while constructing a RC hovercraft. Constructing an amphibious vehicle that can be operated over any surface was the primary goal of this project.

1. Introduction

Hovercraft is an air cushion vehicle that is capable to travel over land as well as water. The hovercraft designed by us works with the help of three motors, two among which are brushless DC motors whereas the other is servo motor. One of the BLDC (Brushless DC) motor is used to lift the hovercraft whereas the other is used to provide the forward thrust. The servo motor is used to provide the directions to the hovercraft. The BLDC motors used are controlled with the help of ESC (Electronic Speed Control).

2. Working Principle of a hovercraft

Hovercrafts work on the two main principles of lift and propulsion. Lift is an important factor because it is that which allows the craft to ride on a cushion of air. This process begins by directing Airflow under the craft. In order to accumulate the air under the air cushion, a skirt is required. A fan is used to move the air for propulsion. Hovercrafts have minimal contact with the ground. The common skirt is known as a bag skirt. The skirt that we have is used is made up of polythene. It covers the bottom of the base and has holes in it to for air to escape and push the craft off the ground. Each part of the skirt inflates independently which makes troubleshooting much easier and improves stability. The more stable the skirt is, the slower the hovercraft will move.

Fig 1 Working principle of a Hovercraft
2.2 Block Diagram and explanation

The above circuit shows the block diagram of a hovercraft. We have used two BLDC motors, one for lifting and the other for propulsion. Both the motors, as shown in the figure are connected to the electronic speed control. The motors used are of 1550kv. The lift motor is connected to channel 1 of the receiver module & the propulsion motor is connected to channel 2. The hovercraft hull is made of foam and the skirt is made of Polyethylene tarp material. The Servo mechanism is connected to the channel 3 of the receiver module. We have provided a separate Arduino to display the co-ordinates of GPS on the serial monitor on a laptop. The object detection circuit is made up of using a simple IR LED & Photodiode.

2.3 GPS

The Global Positioning System is a satellite navigation system that provides location with the help of 4 geostationary satellites. The GPS system is used for military purposes, commercial purposes as well as for personal use for navigation. GPS devices may have capabilities such as:

- The current location of the use
- Directions for the destination
- Estimation of time
- Estimation of traffic information

The GPS that we have used is connected to Arduino board, which is then connected to a computer. The co-ordinates are obtained with the help of serial monitor placed in the tool box of Arduino software. The GPS that we have used has a separate antenna which and it necessary to keep it in open space for it to work.

2.4 Transmitter and receiver parameters

- Transmitter Parameter
  - Channels available: 6
  - Frequency Band: 2.4 GHz
  - Modulation Type: Frequency Modulation
  - Antenna Length: 26mm
  - RF Receiver sensitivity: -76db
  - Program Type: GFSK

Fig 2 Block Diagram

Fig 3 GPS Module

Fig 4 Transmitter Remote
2.5 Object Detection

It consists of an Infra-red LED, a photodiode, a potentiometer, an IC Operational amplifier and an LED.

IR LED emits infrared light which is then reflected from the object towards the Photodiode which detects the infrared light. An IC Operational Amplifier is used as a voltage comparator. According to the requirement of the sensor potentiometer is selected.

The resistance of the photo diode reduces by a considerable amount when light is fallen upon it. One of the inputs of the operational amplifiers at threshold value set by the potentiometer. The other input to the op-amp is from the photodiode’s series resistor. When the incident light is more on the photodiode, the voltage drop across the resistor will be high. In the IC, both the threshold voltage and the voltage across the resistor are compared. If the voltage across the resistor series to photodiode is more than that of the threshold voltage, the output of the IC Operational Amplifier is high. The output of the IC is connected to an LED, which lightens up. The threshold voltage can be adjusted by the potentiometer depending upon the environmental conditions.

When the IR LED is held directly in front of the receiver, this setup is called Direct Incidence. In this case, the entire radiation from the Infra-red LED will fall on the Infra-red receiver. Hence there is a line of sight communication between the infrared LED and the receiver. If an object falls in this line, it obstructs the radiation from reaching the receiver either by reflecting the radiation or absorbing the radiation.

3.1 Advantages

Advantages of hovercraft: It can be worked over water, land, and other smooth surfaces. It is more maneuverable than boats. It has equivalent operating cost to the conventional boats of the same speed and payload. It is effortless in design, manufacture and operation. It can also be used for transport purposes. It is suitable for Disaster Management and army research operations.

3.2 Applications

- High speed marine sub surface & ground scanning survey & detection.
- Transport, service & safety craft for river & low tide coastal work where 24-hour access is vital for staff safety.
- Distribution of famine or flood aid support Relief work.
- Remote mining access support vehicle.

3.3 Summary

The basic idea of our project is that it deals with a wirelessly controlled hover craft prototype. Usually for Disaster management and research work, the hovercraft is unmanned. It is difficult to receive real time information from the affected areas; hence, to increase the utility and efficiency of the hovercraft, we have added features like GPS and Object detection, thus making it most suitable for disaster management, army and research operations.

4. Result

Model of the hovercraft was lifted successfully and also propelled through the thrust system. It was able to handle 2 Kg weight and hovered with an adjustable lift air cushion. Proper operation was achieved with the steering system and successfully completed trial run on land terrain. Also, it could detect the nearby Objects using the IR Sensor. We could accurately locate the hovercraft with the help of the GPS.
5. Conclusion

The principles of the hovercraft have been demonstrated using suitable material and power sources. The design of the hovercraft has come up to the level of expectations and it has helped a lot in constructing the model. It is proved that it is capable as an amphibious vehicle that can be used on land after series of tests. The thrust and lifting systems gave excellent performance and steering system is very useful to achieve considerable good maneuverability.

6. Future Scope and Recommendation

We are planning to add a robotic arm mechanism that can hold different types of props like a small spy camera, land mine detectors etc. so it can be useful in such operations that are related to security issues. We have also planned to attach a small remote operated torch arrangement at front of the hovercraft, so that it can be operated during the night period and also in the areas where very low light is available. While the Object Detection works fine, its range can be improved by using high directivity IR LED’s. Also, it can be improvised by using a Camera and coding it with the MATLAB software, thus letting us see the objects along with its detection. The GPS Module used is a prototype, and it can be improved by using the latest GPS Chip which has an in built Antenna, which requires complex coding.

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8. References