TUTORIAL: HOVERPOD

PROBLEM STATEMENT:

The team has to build a manually controlled, wireless, hovercraft that has the capacity to move through a predefined path. The path will have varied terrain, having potholes, water and other kinds of terrains as specified in the sample arena below. The aim of the participant is to rake up the maximum points to win the task.

HOW TO APPROACH:

- Build the basic framework of a hovercraft.
- Setup the hovercraft controlling mechanism.

MATERIALS:

- Power source (LiPo battery)
- 2 Brush-less DC motors
- 2 Propellers (One for blowing air into the skirt and the other for orientation of the bot)
- Electronic Speed Controller (ESC) module
- Transmitter and Receiver
- Chassis (bot-base made of thermocol or any other light material easy to lift)
- Tarp or plastic curtain (for skirt)
- Perforated plastic (for rudder)

MECHANISMS:

1. Hover mechanism
    a. Locomotion
    b. Orientation

2. Manually controlled robot
    a. Speed controller

Hover Mechanism

Locomotion and orientation

The hovering mechanism of the hoverpod is based on the concept of air pressure. The BLDC motor and propeller combined would tend to constantly direct air into the skirt and fill more and more space inside it. At a certain point, the pressure force exerted by air molecules on the base of the hoverpod exceeds the force of gravity and as a result the hoverpod hovers above ground. So as to prevent the skirt from bursting due to high pressure, sufficient number of holes are made beneath the skirt to direct the air molecules outside the skirt.

For locomotion of the hoverpod a BLDC motor and propeller are connected in such a way that the propeller pushes air back and sufficient thrust is developed so as to move forward. And for providing orientation to the bot perforated/ corrugated plastic sheets are used to make rudders and direct the air flow.

Since we are using 2 BLDC motors torque has an important role to play. To prevent the hoverpod from rotating we need to design the hoverpod in such a manner that the total angular momentum of the bot is zero, hence no rotation.

As hoverpod is a light weight robot there is negligible friction between the skirt and the ground which makes it unstable and uneasy to handle. Hence, we need a little friction amongst the contact surfaces.

Manually Controlled Robot

As power source, Lithium Polymer (Li-Po) Batteries can be used which are lighter, smaller, can deliver huge currents, and have a very large capacity for their size.

Electronic Speed Controllers or ESCs switch power between the three combinations of two of the three poles of a brushless motor. It sends Pulse Position Modulated(PPM) signals to modulate the speed of the motors according to the PPM signal. The ESCs are in turn controlled by Rx-Tx (Receiver Transmitter) (Controller) which takes your commands and sends your receiver the commands for the servos and the motors.

Tips:

1. Heavy materials should be avoided because they add to extra payload.
2. Propeller for upward thrust should be at center of gravity to provide upward thrust equally in all directions.
3. Weight on the hull of the robot should be balanced.
4. Skirt should not be affected by water.
5. Torque should be balanced at upward and forward thrust state to avoid unnecessary rotation.
6. Unequal pressure force on the base invites the state of unequal frictional force with the ground which in turn rotates the hoverpod at forward movement command.

Useful link: http://www.instructables.com/id/How-to-make-a-RC-Hovercraft/

Model Hovercrafts.:

Image Source: http://www.gohover.com/rc/rc-hovercraft.html

Image Source: https://cdn.instructables.com/FXH/T51A/HE7D9KQA/FXHT51AHE7D9KQA.MEDIUM.jpg