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# DESIGN AND FABRICATION OF A MODEL OF REMOTE CONTROLLED HOVERCRAFT

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***Abstract***- *Nowadays, various mechanical, electrical systems or combination of both systems are used to help or ease human beings either during the daily life activity or during the worst condition faced by them. Unmanned hovercraft system is used throughout the world as a specialized transport in disaster relief, coastguard, military and survey applications as well as for sports and passenger services. It can move on the land surface and it is supported by cushion of high compressed air inside. This paper reports the design of a light weight hovercraft model with operational procedure. This model is capable of travelling over concrete, water and grass. Piduino Uno acts in this system as machine control unit. Remote controller is used here as a surveillance device.*

**Keywords:** Hovercraft, Light Weight, Piduino Uno, Remote Controller.

## 1. INTRODUCTION

A hovercraft, also known as an Air-Cushion Vehicle (ACV), is a craft capable of travelling over land, water, mud or ice and other surfaces with a certain speed. Its operated by creating a cushion of high pressure air between the hull of the vessel and the surface below. This pressure difference produces lift, which causes the hull to float above the running surface. With many crafts, this is generated by a separate engine from the one used to create the lift, but with some, the same engine is used for both. Typically this cushion is contained between a flexible skirt. Skirts are made of fabric, which allows a deep cushion. Cushion of air is generally maintained in a hovercraft by pumping steady supply of air. The design included several key components: the body, the propeller to provide propulsion and lift, the skirt to prevent too much air from escaping underneath the craft, and a scoop to redirect some air from the fan into the skirt as shown in Fig. 1.

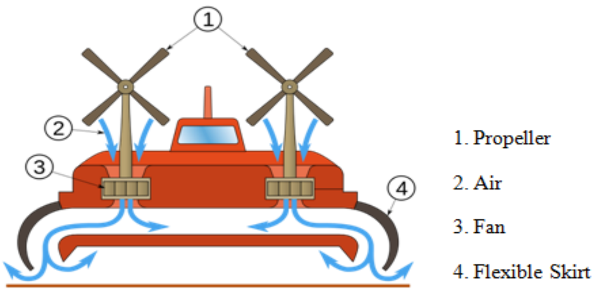


Fig. 1: Basic layout of a hovercraft

The controlling is accomplished through the use of a system of rudders behind the fan which is controlled by handlebars along up front direction. They typically hover at heights between 200 mm and 600 mm above any surface and can operate at speeds above 37 km per hour. They can clean gradient up to 20 degree [1]. The hovercraft gets about twice the fuel mileage of a boat with similar size and capacity [2]. It gives a smoother ride than a boat because it maneuvers above the water. It travels over water with no concern for depth or hidden obstacles. It will go against the current of river at the same ground speed as going along the current. The hovercraft also works very well in rapids or water where standing waves up to a meter high have been encountered for a medium scaled hovercraft [3].

The previous studies conducted by several researchers focused on a few types of hovercraft ranging from the human driven hovercraft till the remotely control hovercraft.

Fantoni [4] studied the vehicle used LCAC-1 Navy Assault Hovercraft which was designed to be used to transport U.S Marine fighting forces from naval ships off-shore to inland combat position. The system was developed in two different control strategies to stabilize the surge, sway and angular velocities with different controllers.

Aguiar et al. [5] focused on the hovercraft model namely as Caltech Multi-Vehicle Wireless Testbed (MVVT). The vehicle was equipped by two high powered ducted fans where each fans can produce up to 4.5 N of continuous thrust for forward motion. In addition, the Device Writer was used to send the signals to command the fan forces.

Marconett [6] developed a hovercraft consists of four propulsion motors and were mounted parallel to the ground in each translational direction for ensuring all directional movement. In the system, a microcontroller acquired inputs data from the sensors and provided outputs signals to vary the speed of each motor and proportional integral derivative (PID) controller was selected to control the hovercraft.

Sanders [7] reported on Electro Cruiser, an amphibious hovercraft in his book. An electric motor was used to drive both propellers and another one of the propeller to provide lift by keeping a low pressure air cavity inside the skirt.

The paper done by Cheng-long et al. [8], consisting about an amphibious hovercraft to study the nonlinear control of the hovercraft. It introduced Multiple Model Approach (MMA) to acquire a linearized model of the hovercraft based on some work points of nonlinear process.

A simple triple hovercraft platform, equipped with fuzzy controller is described by Eddie et al. [9]. In the development, a triangular Styrofoam as the hovercraft's frame, three model size airplane motors, three light weight model size airplane propellers, two sensors and interfacing cables were used.

## 2. STRUCTURE DESIGN

Figure 2.1 shows the top and side view of the developed project. The model is 24 inch. in length, 15 inch. in width and 16 inch. in height. Designed structure with all of the 3D drawing components are shown in Figs. 2.2 to 2.4 with dimensions.

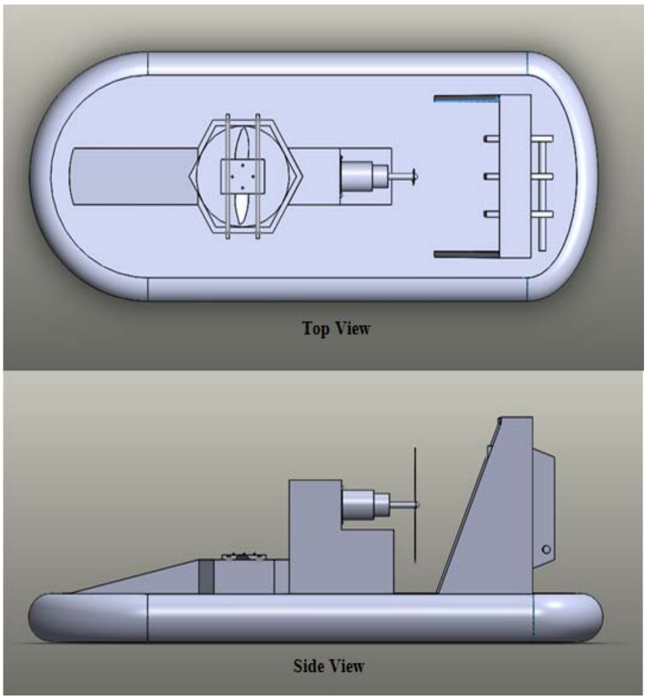


Fig. 2.1: Orthographic View of the Model

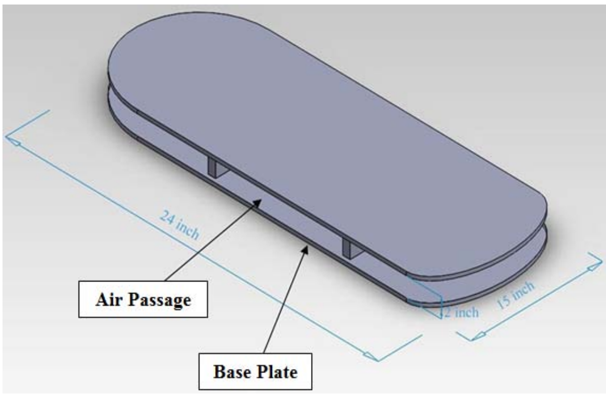


Fig. 2.2: Hull of the Hovercraft

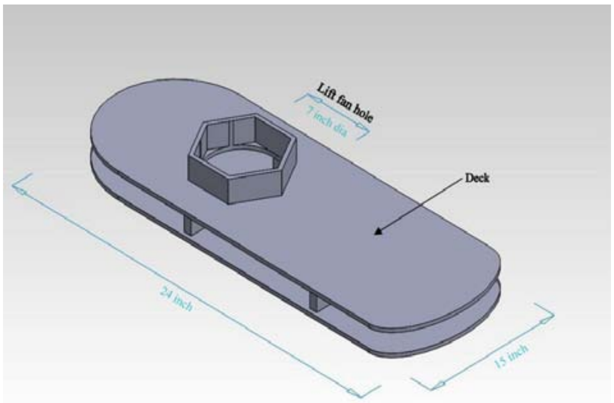


Fig. 2.3: Hull with Lift Fan Diameter

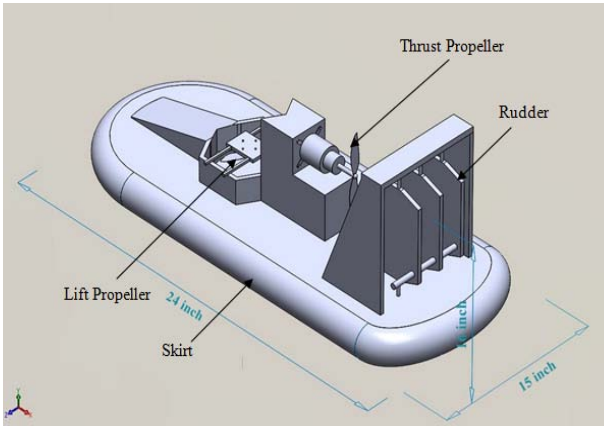


Fig. 2.4: A 3D View of the Model of Hovercraft

## 3. OPERATIONAL PROCEDURE

The hovercraft floats on a cushion of air supplied by the lift fan. The lifting fan is placed in the central location of the hovercraft to form an air gap between the hovercraft and the ground and to provide the force that required to lift the hovercraft. Figure 3.1 shows how pressure is developed in the skirt.

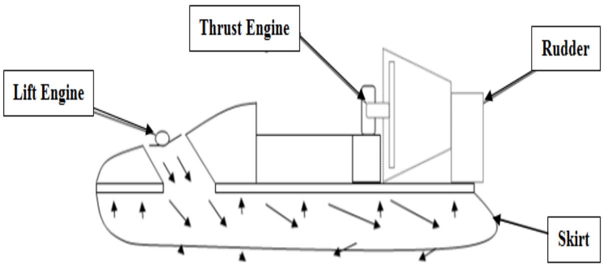


Fig. 3.1: Pressure Distribution in the Skirt [1]

The propeller is located at the rear part of the hovercraft to generate the thrust action, which pushes the hovercraft forward. The propeller is enclosed by the thrust duct which makes it possible to direct the air. Components used to fabricate this model are insulation foam, Neoprene fabric, Plastic, Plywood, etc. The two Servo motors (Model No.: A2208/12) are used to create that lift and thrust force. Neoprene fabric is used to make the skirt. Fabricated hovercraft is shown in Fig. 3.2.

Fig. 3.2: The Complete View of the Hovercraft

Steering effect is achieved by mounting rudders in the airflow from the propeller. A change in direction of the rudders changes the direction of air flow thereby resulting in a change in direction of the vehicle. The connecting link between the rudders is controlled by the servo motor. Thus servo motor guides the motion of the hovercraft. The Lipo battery supplies the power to the electrical components.

## 4. CONTROL STRATEGY

Once the model was fabricated, the next target is to control it. The control system is developed with the use of components like Piduino Uno (Model: ATmega328P), Voltage regulator (7805), Resistor, Capacitor, Crystal (20 MHz), Breadboard, Diode, etc. The main job for controlling the motor or servo speed is done by the Piduino. A microcontroller based program is developed for this purpose. When the switch creates a pulse, it received by Piduino. Piduino modifies the output pulse after analyzing the input and initialize the motor. This program can be edited as requirement. The entire system is controlled by a remote controller. Circuitry for the remote controller is equipped on a bread board. Circuit diagram of Encoder, Transmitter, Decoder and Receiver are shown in Fig. 4.1 and 4.2 respectively.

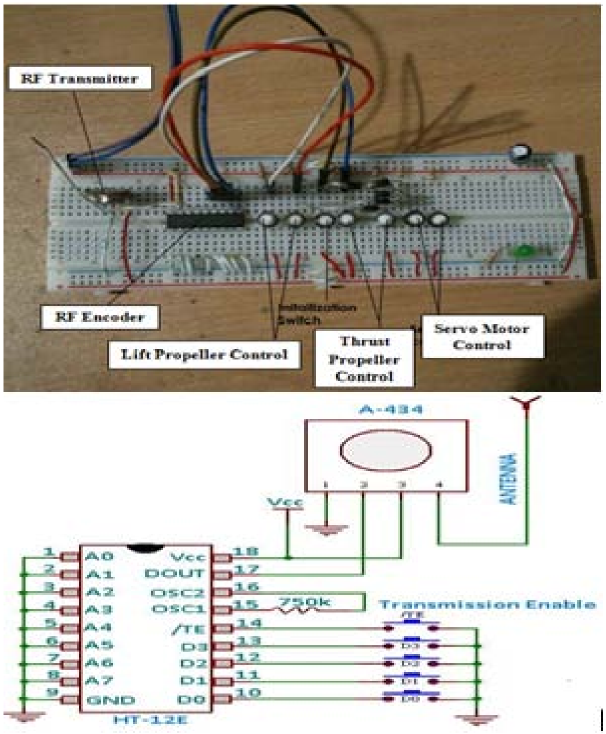


Fig. 4.1: Circuitry of Encoder and Transmitter

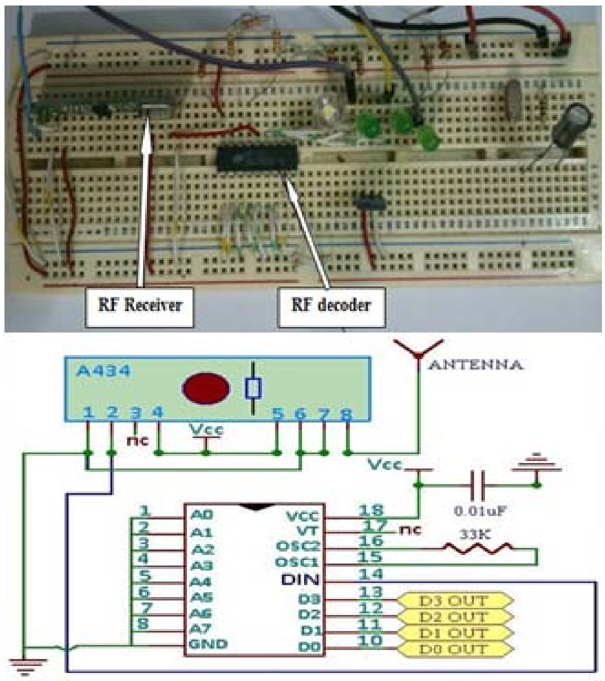


Fig. 4.2: Circuitry of Decoder and Receiver

The RF encoder-decoder and the transmitter-receiver are the four main components of the system. There are eight buttons in the circuit. Two of those are for thrust propeller control, two are for lift propeller control, one for the initialization of the motors, one for rudder positioning upto 90 degree and the rest two are used to move the rudder left or right. The system is programmed is such a way that with each press of the button, speed of the motors changes by 5 rpm. The rudders can move to maximum 30 degree from its initial position. When the buttons are pressed the encoder receives the digital input or electronic pulses and encodes it. This encoded data then are transmitted through the transmitter. The receiver of the second circuit receives this data and the decoder decode it. This decoded input is then passed to the microcontroller board (piduino uno) for further processing. The microcontroller then controls the motors and servo as per requirements. The whole circuit requires +5 volt.

## 5. RESULT

The craft principle has been demonstrated using low cost material and has proved capable as a viable means of transport both on land, concrete and water after series of tests. The propulsion and lifting systems gave excellent performance and with good maneuverability. It gives an air cushion of 3mm and the average speed of 3.7592 m/s is found.

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