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Design & Development of Water Bodies Cleaner

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***Abstract* - An increase in waste debris contamination of the water is endangering and putting the lives of aquatic species in peril. Despite the fact that more research has been done on the pollution caused by floating garbage and debris in rivers and other natural and man-made water bodies during the past ten years, including plastic, plants (Eutrophication), and other debris, there are still significant information gaps. The design and construction of the waste cleaning device for the water bodies are the focus of this project. Using a device called a "Water Bodies Cleaner," waste material from the water's surface is removed and properly disposed of in the body of water. The waste surface material from the water bodies will be lifted by a machine, which will ultimately lead to secondly, there will be less water pollution, and thirdly, fewer aquatic species will perish as a result of these issues.**

Given the significance, we developed a project/preposition for building a medium-sized cruiser called a "Water Body Cleaner" that will collect any trash or sewage that is present on the water's surface, down to a depth of around 2 to 3 feet. With the use of a conveyor belt, the trash and debris will be gathered in the Water Body Cleaner's dumpster. The Municipal Corporation will take the gathered rubbish out of the dumpster and send it for product recycling.

Keywords: Conveyor, River, wastage, garbage, pollution, Eutrophication, plastic pollution, the dumpster.

I. INTRODUCTION

The project's main goal is to at least somewhat repay Mother Nature for her assistance. The meagre water resources we do have must be protected since, as the saying goes, "Water is Life, Life is Water." We can't take use of the fact that 71% of the globe is covered in water for our own bad luck, lack of technical advancement, or inferiority. Only 3% of the world's total water resources which include rivers, lakes, ponds, wells, subterranean water sources, and glaciers can be used by humans. As far as humans are concerned, this 3% of water is the only source of life because it is the only amount, they can take to quench their thirst and stay alive. The other 97%, which is found in oceans and seas, is currently useless because to a lack of technological development.

Figure 1: Garbage Accumulation in River

It's not like our technology is so outdated that it can't make ocean and seawater drinkable, but the cost and investment are out of this world, and the efficiency is out of this world as well, making it incredibly inefficient. This technique will therefore need more study and development in order to turn ocean and seawater into consumables. It can be created and enhanced, but it won't be a reality for at least a few decades. But regrettably, during the past two to three decades, the quality of the water has rapidly declined. The fact that solid trash is dumped into rivers, turning them into dirt drains, is one of the main causes of this. The Ganga and Yamuna, the two most revered rivers in our nation, are no exception to this rule, and our use of the term "Mula Mutha River" is a prime illustration of this. Since only 3% of all water sources are suitable for human consumption and 97% of all water is stored in the seas, we can see that river sewage surface pollution is the biggest issue facing our planet today. Oceanic Plastic Waste is depicted in Fig.1.

Figure 2: Plastic Waste

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Therefore, we would like to present our creative concept for a sophisticated river surface cleaning system that uses an air tube guider mechanism that we refer to as "THE WATER BODY CLEANER." With this effort, we hope to make the achievable ideal of clean rivers a reality. Our goal is to protect the few water sources we do have; thus, we have created an advanced water body cleaner.

We must prevent plastic from entering the ocean through nearby water bodies, such rivers and lakes, if we want to cleanse the ocean of trash. Because of our issues with plastic waste, marine life suffers. As the plastic floats on the water's surface, solar UV radiation causes it to break down into tiny bits (less than 5mm), which marine life inadvertently ingests. In addition to various chemicals used in the manufacture of plastics being known to be carcinogenic and to interact with the body's endocrine, reproductive, and neurological systems, microplastics have been discovered in tap water.

II. DESIGN AND FABRICATION OF WATER BODY CLEANER

The Water Body Cleaner and its prototype's design and analysis are presented in this section. The classical procedures outlined in Raymer and Anderson's methodologies are the foundation of the design methodology. Choosing a mission profile and creating a list of needs are the initial steps in the technique. The prototype design process can start once the mission has been decided upon and the specifications established. Conceptual design makes up the first stage of the prototype, which is then followed by a preliminary design and a thorough design. Fabrication happens after the meticulous design. Using following geometrical values are used to develop the CAD model and is shown in Fig 3.

Density = 2.44$\frac{gm}{cm^3}$; Mass = 1556.34 grams; Volume = 1556341.39 m^3; Surface area = 988348.71 m^2

Center of mass: X = 1763.20; Y = 897.29

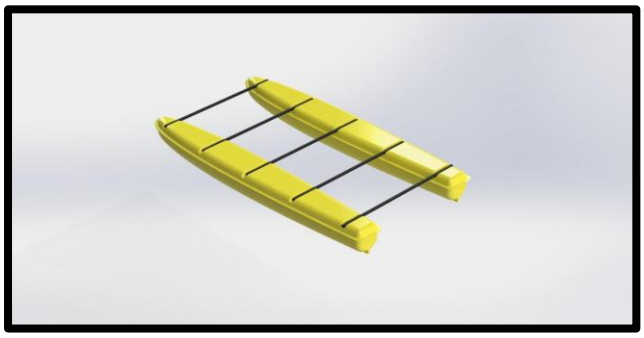

Figure 3: CAD model of hulls

2.1 Design requirement of hull

It is decided to create the design in accordance with the standard specifications. Since there are many different kinds of boat hulls, we decided to design one that would help us accomplish our goal, which is to collect the waste plastic debris that is floating on the water's surface. The catamaran boat hull is the most effective design for the water body cleaner. There are two hulls in this design, and there is more deck space between them. This space is used to accommodate the garbage collection tank and conveyor belt [5].

The main requirements for the structure of water bodies cleaner are:

- Catamaran Hull
- Light weight
- High buoyant property material
- High strength
- High stability
- Weight Distribution
- Easy to handle

2.2 Fabrication of Water Bodies Cleaner (WBC)

The sequence of process of fabrication WBC is described as follows. The broad steps are Fabrication of the Hull mold, Fabrication of the Hull, Fabrication of the Chassis, Fabrication of the conveyor mechanism, Assembly and Testing in river.

2.3 Fabrication of hull mold

The fundamental step in developing a mold is to begin manufacturing a fiber boat. This is the fabrication of the hull mold. The mold will be used to construct the final boat. Materials are used to support the mold until they become solid. There are two kinds of molding: male and female molds. Before being saturated with liquid catalyzed resin, the outer surface of a male mold is covered with a fiber mat. After the fiber mat is inserted into the female mold's interior, resin is used to fill it. A fiber mat is constructed in stages in both instances, and the solid portion can be removed from the mold once each layer of resin has hardened and cured. The male mold is used to apply the outermost layer last. After that, the exterior surface is polished to make it look beautiful and shiny. The laminate is applied from within. The top layer is inserted first in a female mold. The rough sandpaper is used to give the width a basic shape, and then we used fine sandpaper to grind it into a final shape. We started by laser cutting chart paper to get a rough cut of the foam blocks in accordance with the length and breadth of the hull. All of the necessary casting materials are arranged close together to avoid clusters and ensure a smooth and error-free process. The first step in the molding process is to cover the mold with the fiberglass

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sheets. The application of a coat of resin is the next step in molding. After beginning as a liquid, the resin solidifies when a catalyst or hardener is added. The addition of a mixture of hardener and cobalt to the resin solution initiates an exothermic reaction, making this a chemical reaction that cannot be initiated or stopped. After the resin coat has dried, the resin is combined with a catalyst and laminated. The proportion of the resin mixture used varies according to the size of the mold and the required casting. Layers of resin and fiber mat are applied to the mold and allowed to cure together for several hours. Compound hull forms are easier to make with fiberglass construction. For the compound structures, the castings are taken apart and chalk and resin paste are used to put them back together. Because we were attempting to create a male mold and the chemical reaction was generating a lot of heat and melting the mold inside, our team ran into problems during this procedure. We finally found the solution to this issue after conducting multiple tests. We did this by covering the mold with thick layers of commercial brown polyvinyl tape, which stopped the mold from leaking. The hull was finished well enough by us. Since the process was still in progress, we then added a second coat of resin, hardener, and cobalt to fill in the pours.

Figure 4: Molds for hull

2.4 Fabrication of hull

Fiberglass is a popular type of fiber-reinforced plastic made with glass fibers. The fibers can be distributed at random, rolled into a sheet (known as a chopped strand mat), or woven into a glass fabric. One possible type of plastic matrix is the thermoset polymer matrix, which frequently relies on thermosetting polymers like epoxy, polyester resin, vinyl ester resin, or a thermoplastic. Figure depicts an example of a fiberglass-constructed chassis design. It is cheaper and more malleable than carbon fiber, stronger by weight than many metals, non-magnetic, non-conductive, and electromagnetic radiation-resistant. Intricate designs can be sculpted into it, and it is frequently chemically inert.

Figure 5: Material testing of hull

2.5 Testing of Hull

For theoretical calculations involving that body, we frequently tend to represent a body by a point when studying forces, objects, and their interactions. While this is unquestionably an efficient method of representation, we are aware that very few people actually exist in real life who are the size of a point.

Simply put, if all of the body's mass were concentrated at a single location, where would that location be? The center of mass of the body is this fictitious point. We also know that, regardless of whether another force acts on a body, the force of gravity always does (keep in mind that we are not dealing with objects in space here; rather, we are dealing with things on Earth, so gravity is always present). The center of gravity of the body also refers to a point where the body's weight appears to be concentrated because even this force of gravity can be assumed to act at the center of mass.

Mathematically this can be expressed as follows,

$$CG = (m \times s)/M + m$$

Where “m” is the mass added (or removed), M is the original mass of the body, and “s” is the distance between the two centers of gravities of the separate bodies.

Corollary: another thing that can be concluded from the above equation is that if the mass is neither removed nor added but only moved from one position to another on the parent body, the new center of gravity is given by the same equation except that M remains unchanged, therefore

$$CG = (m \times s)/M$$

This is how we calculated the Centre of gravity (cg) of our hulls

Formula:

$$CG = (m \times s)/M$$

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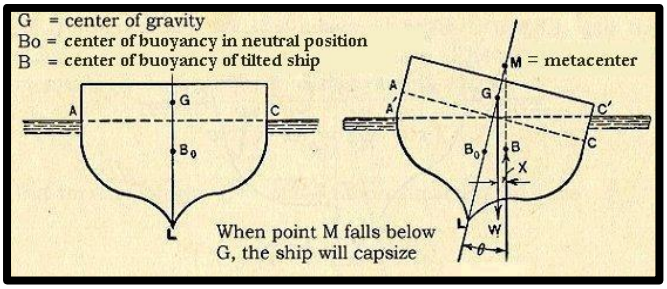

Figure 6: CG of hull

Various errors and inaccuracies are evaluated right from the very beginning of boat hull design and construction by performing tests and precautions at each step.

A brief list of the purpose of model testing:

An estimation of the hull form, form parameters, and basic curvature.

- Main dimensions on a reduced scale
- Stability test on a rough scale
- Powering the machine
- Buoyancy test
- Weight test

Figure 7: Testing of hulls

2.6 Materials and Components of Conveyor Mechanism

- *The frame:* The system's framework holds all of the moving parts together for safe and secure operation.
- *The belt:* A long stretch of thick, durable material upon which materials are transported from one place to another.
- *The conveyor belt support:* Rollers assist the belt to stay on course and swiftly maintain movement. Rollers keep objects in place and prevent the belt from sagging.
- *The driving unit:* Motors may use either variable or constant speed-reduction gears to power the conveyor belt. An efficient driving unit must continually assist the belt with continuous running, smooth reversing and repeatedly adjusting direction.
- *The pulleys:* The conveyor belt should loop over two or more strategically positioned pulleys. The pulley controls the belt's movement and performs critical functions such as driving, redirecting, turning, tensioning and tracking the belt.
- *The clamping straps:* Clamping straps are used on various machines to hold down fixtures and work components.
- *Add-on modules:* Most additional parts are installed for further reinforcement. While rollers support the belt from within the system, stands and lateral guides support the outer framework.

Conveyor belt is the most important part of the machine which consists of critical sub parts for the functioning of the belt. In conveyor belt the angle of inclination, power, and smooth running is the most important. We have used UPVC pipes as rollers and industry standard shaft and roller bearings.

The conveyor mechanism is completed by the assembly of these subparts. A DC motor is installed for conveyor system. Additionally, the waste is collected in the collection bin at the back of the machine using the buckets on the belt, which are used to remove it from the water's surface.

III. DEVELOPMENT OF WIRELESS REMOTE-CONTROL DEVICE

The PCB used for the etching and engraving procedure was developed by using standard electronic components. It was started by taking a Zero PCB, which was afterwards spray painted; any desired colour may be utilized. Moving on to the cutting phase, the laser cutter was given the design command once we had designed the PCB on MATLAB. In accordance with the instructions, the laser cutter carved pads and tracks on the Zero PCB. The PCB is then put into the Copper Sulphate solution and agitated until the copper on its surface dissolves in the solution. The copper that is already in the rails and pads doesn't change. Acetone was used to clean the PCB surface and remove extra paint from the tracks, pads, and even the PCB surface. Drilling holes in the PCB was the final step in the PCB's creation.

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Figure 8: RC Remote Controller

IV. CONCLUSIONS

We had many obstacles during the project study, and these obstacles enabled us to identify the problem's root cause and come up with a solution. In the beginning, we began by defining the issue that has an impact on the community and society, with a burning desire to take action. This led us to discover the expanding issue of garbage dumping in freshwater sources. We therefore designed the project that would solve this problem with a strong sense of commitment. We carried out the various tasks while doing so, which included thorough research on the current state of rivers in India. To be more specific, we chose a river called the "Mula-Mutha River." The next step was cleaning the freshwater resources using technology, which is what our project was created for. Therefore, the solution to the issue is quite straightforward: first, stop the ugly mentality of environmental pollution; second, stop the pollution itself on the physical level by taking appropriate measures; and third, clean the already polluted freshwater resources in a more technologically advanced manner. Finally, this project places an emphasis on supply flexibility in daily operations. This is frequently simple to use and requires little maintenance. In order to eliminate water pollutants including plastics, rashes, and water debris that are floating on river and pond surfaces, the project "Design & Development of Water Bodies Cleaner" is typically developed to create a system that is remarkably affordable and useful. This is primarily highly helpful for preserving human health and lengthening the lives of aquatic creatures.

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