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River Weed Cleaning Machine

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Abstract **Due to increase in water pollution in the form to waste debris, it is hampering the life of aquatic animal and make their life in danger. A machine will lift the waste debris from the surface of the water bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. The main aim of the project is to reduce the manpower, time consumption for cleaning the river. In this project we have stored energy in the battery and use this energy for river cleaning with the help of a motor drive arrangement.**

Keywords — Archimedes' principle, Buoyancy, water wheel, weed, lift, Conveyors etc

I. INTRODUCTION

The majority of developing nation's lakes and ponds are in poor condition. The government and private companies spend a lot of money and work on maintaining and cleaning them on a daily basis. The goal of this research is to create a multi-robot system of automatic aquatic vehicles that can execute different activities necessary for the cleaning and maintenance of ponds, lakes, and reservoirs.

Among the several goals, it was determined to develop a model that would be successful in gathering aquatic weeds while also serving as a garbage collector. This design has combination of characteristics strongly supports the objective of developing a potentially sustainable solution for the restoration of ecological activities.

The "UNMANNED RIVER WEED CLEANING MACHINE" is a mechanical harvesting method used in areas where invasive weeds must be removed from the waterbodies. This equipment is made up of a water wheel-driven floating barge and a conveyer system that removes and accumulates weeds, waste, trash, and plastic waste from waterbodies. This lowers the challenges we experience when gathering weeds and waste. It is made out of a conveyor system that pulls the weeds out of the water. The machine will also remove waste debris from the waterbodies, resulting in less water pollution and, finally, fewer aquatic animal deaths as a result of these issues. The project will be used in rivers ponds and lakes to clean the debris floating on the water surface.

II. PROBLEM DEFINITION, PRINCIPLES & METHODOLOGY

A. Problem definition

India is a vast country where garbage disposal facilities are absent in remote areas. Dumping of garbage and plastic wastes into water bodies has become a major cause for the water pollution and threatening the aquatic and human lifestyle. To remove weeds, waste debris, plastic waste and garbage from the waterbodies.

B. Principles used

Archimedes' principle used to determine the buoyancy of a body that is partially or completely submerged in a fluid. The weight of the item acts as a downward force. The buoyant force on the body is described in Archimedes' principle. The difference between the orders of magnitude of the buoyant force as well as the object's weight is therefore the net force on the body. The object floats if the net force is positive, if the object sinks then the net force is negative and if the net force is zero then the object is neutrally buoyant, means it does neither raise nor sink.

The upward force generated by a fluid against the weight of a submerged object is known as buoyancy or up thrust. As a result, an object with overall weight is higher than the fluid where it is immersed likely to sink. If the object's weight is lower than that of the liquid, the force will hold it floating.

Newton's third law of motion, As the law states, every action has an equal and opposite reaction. This rule is quite helpful in figuring out how a ship travels through water. The propellers are primarily responsible for the machine forward motion, as seen in When the propellers turn, they push the water backwards, pushing the machine ahead.

C. Methodology

- We have carried out literature survey mechanical river weed cleaning machine
- Detail design – Design calculations, different principle involved
- Fabrication – Fabrication of base frame, drum, water wheel, conveyor belt, collecting bin and assembly of all the components. Selection of motor and coupling it to water wheel to give motion for forward motion

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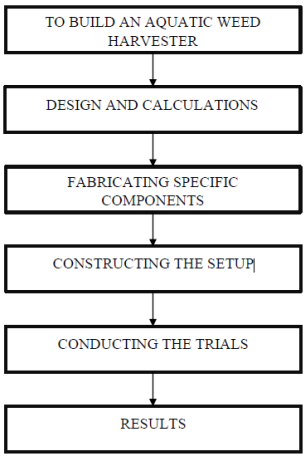

Fig.1:Methodology

III. LITERATURE SURVEY

[1] G.G. Rathod worked on a river cleaning machine design and manufacturing project. India during festivals like Ganesh visarjan and Navratri. The poisoning of water in streams, lakes, and other bodies of water around the Godavari River is a serious problem. The raise in water contamination in the structure to squander waste is causing problem for amphibian creatures and putting their lives in danger. The team is seeking to create waterway clean-up equipment to reduce water contamination. River clean-up machine is a machine that eliminates waste flotsam from the water's surface and secures it from the body.

[2] Nurlansa tested AGATOR experimentally. The environmental issue of trash and rubbish from various locations arranged into streams, which arises year after year and remains unsolved. Those stray items can clog up water channels, causing the water to become filthy, rotting, and overflowing, resulting in impact floods. This investigation aims to design and build AGATOR (Automatic Garbage Collector), a rotor robot model that acts as a programmed junk jockey to prevent rubbish from accumulating in the stream. The robot fills the trash can till it reaches a weight of 5 kg. The robot's normal speed is 0.26 m/s.

[3] Jogi , worked on Efficient Lake Garbage Collector by Using Pedal Operated Boat was the subject of a project, Because of the large amount of rubbish present in the lake water, towns all throughout India that are connected to small and large lakes, as well as the most remote towns, do not use the lake water for agriculture. The main idea is to use a pedal-operated pontoon to clean the lake water. The vessel is powered by a pedal mechanism and is used to remove garbage from the lake. The transports gather the garbage in the lake in this pontoon and then place it in a box-like structure on the lower side of the vessel.

[4] Padwa reviewed on Fabrication of Manually Controlled Drainage Cleaning System is presented, Because of the recurring trends in our current situation, the subject of flooding and environmental change has turned out to be insane. This project is primarily concerned with the automation of drainage cleaning systems. There is a problem with variety and space; to solve this problem, automation of the framework is essential.

[5] Dharmesh et al. A journal on the design and construction of river cleaning mechanisms was published. This technique strives to achieve its social goal of cleaning rivers and other bodies of water. Manual or by boat, for example, are the traditional and widely used methods of cleaning or more precisely collecting floating garbage, which are placed near the river's shore. However, these methods are dangerous, expensive, time consuming, and necessitate a large crew. The remote operated river cleaning equipment was designed and built with all of the factors in mind, and it aids in river surface cleaning in an effective, efficient, and environmentally friendly manner.

IV. DESIGN AND CALCULATIONS

A. Description of components

Main Frame: The main frame serves as the machine's primary body. All the system's components are supported by it. It can also be used as a floatation device.

Plastic Drums: It is used to provide net upward force i.e., buoyancy force for the floating platform

Conveyor: The waste material is collected by the conveyor, which is placed on the two shafts in such a way that it is hoisted upwards and collected inside the machine.

Collecting Bin: The gathered weeds are stored in the Collecting bin.

Motor: A 12V DC motor is selected. The motor is connected to water wheel which helps in the movement of the machine.

B. Design calculations

Base Frame:

- Length = 1215 mm
- Width = 615 mm
- Height = 15 mm
- Thickness = 2 mm
- Main frame – Square pipe of 15 mm

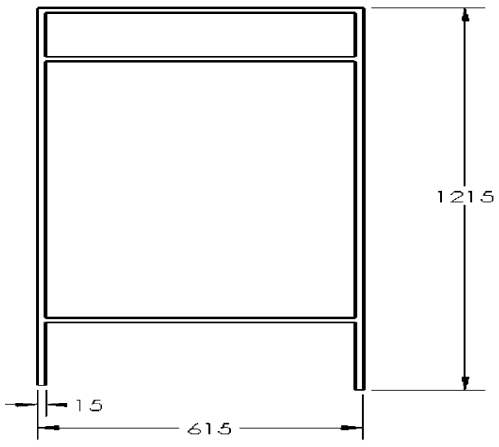

Fig.2: Main Frame Dimensions

Drum Dimensions

- Diameter of the drum 1, D_1=125 mm

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- Height of the drum 1, H =1100 mm

Therefore,

- Volume of one drum (V_1) = $\pi R^2 H$ in m^3

Where, R – Radius of the drum, m

H – Height of the drum, m

$V_1 = \pi R^2 H$ $V_1 = \pi \times (62.5)^2 \times (1100)$

V_1= 13499030.93 mm^3

V_1= 13.499 litters

For safe design, consider volume of one drum,

V_1= 13.5 litters

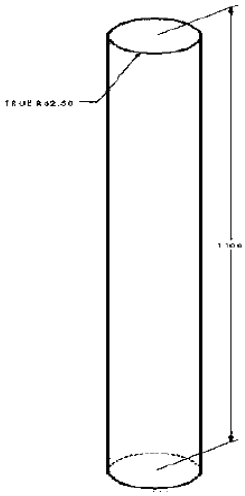

Fig.3: Drum Dimensions

Water Wheel

- Diameter of the water wheel, D = 240mm

Rpm of wheel, N = 60 rpm

- Velocity, V = ($\pi \times D \times N$) / 60 in m/s

V = ($\pi \times (0.24) \times 100$) / 60 V = 1.25 m/s

Eight pedalled water wheels are selected to obtain the required thrust. The pedals are separated at an angle of 45º

- L = 180 mm
- B = 50 mm

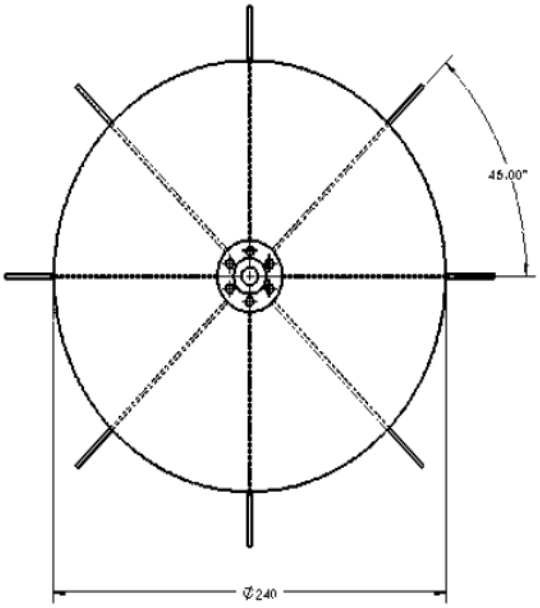

Fig.4: Water Wheel Dimensions

Battery

12v, 7amp battery is used for the motor to run Battery (12v, 7 amps)

Battery power (P) = V × I in watts

Where,

V = voltage in volts

I = current in amps Battery power (P) = 12 × 7 = 84 watts

Maximum Power: 84W at 60 rpm ± 10 rpm

Maximum Torque T (Nm)

T (Nm) = (9.554140127 × P (w)) / N (rpm)

Where,

T (Nm) = Maximum Torque

P (w) = power in watts

N (rpm) = speed of water wheel in rpm

T (Nm) = (9.554140127 × 84) / 60

T (Nm) = 13.37 Nm

Solar panel (18V, 10 Watt)

Panel watt (P) = 10 watt Two such solar panels are using, hence Panel watt = 10 ×2 = 20 watt Charging Time = (battery watt / panel watt) ×2 in hours

Charging Time = (84 / 20) ×2 Charging Time = 8.4 hour

Conveyor

The inclination of the conveyor can be varied as it is pivoted at a point on the frame.

Maximum suitable belt inclination (α)

$\alpha = \tan^{-1}[300/810]$ $\alpha = 20.323^o$

Table.1: Flowability factor for different inclinations

Inclination of Belt	A Flowability factor (K)
16º-20º	2.50×10^{-4}
21º-25º	2.35×10^{-4}
26º-30º	2.20×10^{-4}
30º-40º	2.00×10^{-4}

Mass capacity of the conveyor (M), M = ρ × k (0.9×B-0.05) ² × V in kg/sec[6]

Where,

ρ – Density of water hyacinth = 670 kg/m^3

k – Flowability factor = 2.50×10^{-4}

B – Belt width = 400 mm

V – Velocity of belt, m/sec

Diameter of the roller = 30mm

Velocity of the belt, V = ($\pi \times D \times N$) / 60 in m/s

V = ($\pi \times (0.03) \times 60$) / 60 V = 0.10 m/s

M = ρ k (0.9×B - 0.05) ² ×V in kg/sec

M= (670) × (2.50×10^{-4}) × (0.9 ×0.325-0.05) ² × 0.10 M = 1.3844×10^{-3} kg/sec Mass capacity of the conveyor per hour, M = (1.344×10^{-3}) × 3600 M = 4.9 kg/hr

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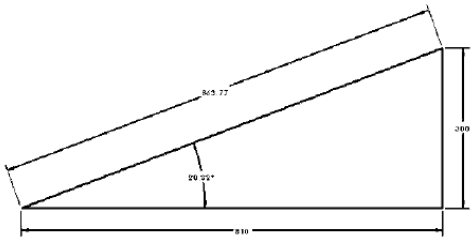

Fig.5: Conveyor Dimensions

IV. FABRICATION

Fabrication is the process of building machine, structures, and other equipment's by deploying various process and operations like cutting, forming, setup, full welding and assembling components made from raw material. A brief description of selection of raw material is given below.[1]

A. Process involved

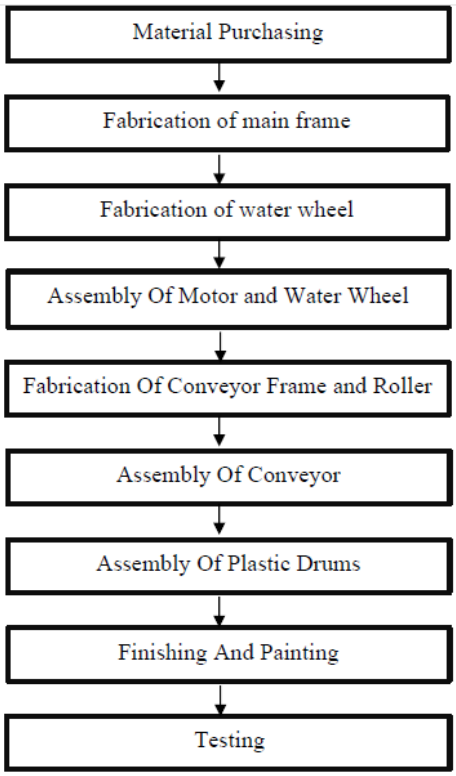

Fig.6: Flow Chart of Process Involved

B Components

Main Frame

The river weed cleaner's main frame is the skeletal structure on which all other components are mounted. The weight and strength of the material required for the frame are two design factors taken into account while determining the material required. Material used for the main frame is mild steel and the dimensions of the frame are 1215*615*15 mm.

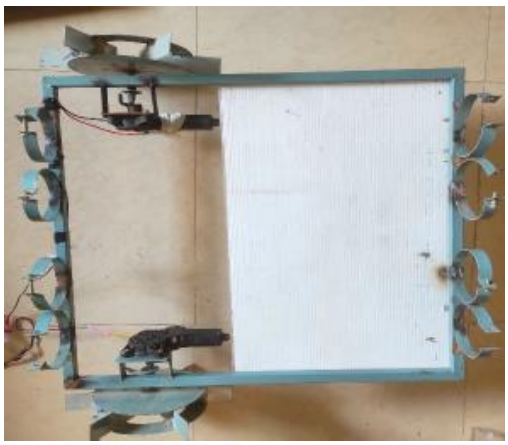

Fig.7: Main Base Frame

Water wheel

Water wheels with paddles are used to generate the necessary thrust. As the water wheels are rotated using motor the water flows backwards and as a reaction the platform moves forward. The diameter of the water wheel is 240mm and paddles are placed at an angle of 45 degree as displayed Material used for the water wheel is Aluminum

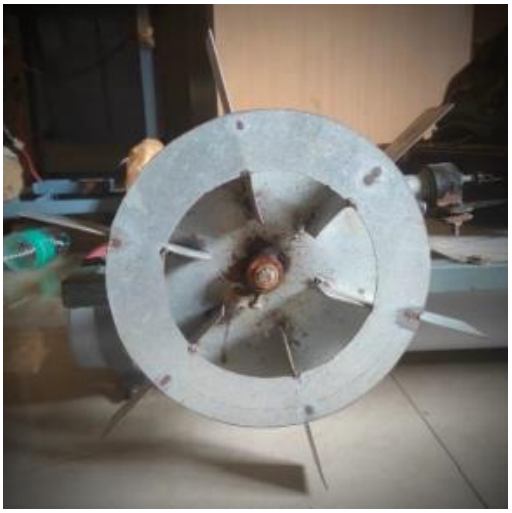

Fig.8: Water Wheel

Plastic drums

Plastic containers are used to displace water and generate buoyancy force. This keeps the platform floating. 4 plastic drums are used as a safety measure against failure. The openings are sealed and made airtight.

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Fig.9: Plastic drums

Conveyor[6]

The loading conveyor is inclined at different positions, picking the weeds with angular metal called rakes riveted to it. The presence of the rakes as shown n fig 5.8 also prevents the weed from falling back. The harvested weeds are dropped onto the collecting bin by gravity. The conveyor is driven by a motor attached to the roller.

Fig.10:Conveyor

Collecting bin

Collecting bin / tank is used to store the harvested weeds

Fig.11: Collecting bin

Motor

A motor which converts electrical energy into mechanical work. In this project three such motors are used. The water wheel is driven by two motors and another motor is used for the conveyor mechanism. 12volts 17watt wiper motor as displayed in fig 5.10 is used for the rotation of water wheel and the conveyor

Fig 12:Motor

Battery

A battery is a device that stores the energy and provides direct current to the required components. For this model 12volts 7amp battery is used.

Fig 13:Battery

Controller[3]

The controller used in the project is Arduino nano, this controller helps in traction of machine in the desired directions using Bluetooth module connected to it[3]. This controller can be controlled using smartphones over Bluetooth.

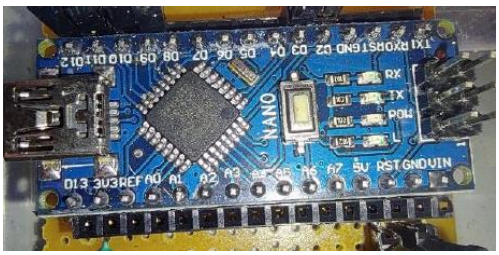

Fig 13: Controller

C Assembly

- To survive the model and its operation, the first step is to assemble the project's base frame using a hand cutting machine and an electric welding machine
- Plastic drums are assembled at the base frame. The function of these plastic drums is to float on water while bearing the entire weight as air is sealed in drums generating a differential pressure head, which causes the machine to float on water
- Inclined section is pivoted on base frame to support conveyor frame. Conveyor belt and roller are assembled on conveyor frame. Motor is mounted on the frame which drives the conveyor

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• The drive source of the project is motor, which are used to rotate the water wheels. The motor and shaft are mounted on the main base frame

• The water wheel is bolted to the base frame's shaft. The water wheel's purpose is to propel the system backward or forward on water

• Collecting bin is mounted on the frame so that the harvested weeds fall into it

Fig.14: Assembled Machine.

D Advantages

• Maintenance cost and initial is less

• It is beneficial for both small and large lakes with a lot of weeds

• It can also collect plastic wastes and other floating wastes

• Easy in operation

• Easy disposal of collected weeds

• Various parts can be easily replaced and installed

• Skilled workers are not required to operate the system

• System is environment friendly

V. CONCLUSION

• We have designed and fabricated a low-cost mechanical device to remove aquatic weeds, which has a storage capacity of 5kg. The mechanism made to collect weeds is also able to collect plastic wastes and other floating trash. On the basis of its design and cost expenditure, it is very less expensive compared to existing mechanical harvesters.

• It can be utilized to gather trash and reduce pollution in ponds, rivers, and oceans.

• Machine can gather dead fish and solid contaminants from waste water in fishing plants

• It is more effective, efficient, economical compared to manual harvesting method. It has 85-90% effective weed pulling. Due to mechanical control effective weed management is done. Thus, objective of the project is successfully achieved

• While concluding this report, during the production schedules of the working project model, I received a great deal of practical experience. I am pleased that this knowledge has been put to good use in the field of social welfare.

ACKNOWLEDGMENT

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