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ECO-AQUA CLEAN: WATER POLLUTION SOLUTION

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Abstract:

Water contamination has long been a source of worry in the environmental community. Most bodies of water, such as rivers, lakes, and streams, are extremely contaminated. Floating wastes are a significant cause of pollution. To remove the floating garbage, machines have been devised. Any such machine may necessitate the use of some form of power, which is once again uneconomical. As a result, we decided to design a machine that would be simple and inexpensive, as well as not require any external power source. Given that a moving river or stream creates water heads at various points along its route of flow, it was determined to employ the available heads to generate hydropower that could be used to power a suitably built machine. The requirement for human labor to remove garbage might endanger the individual. As a result, a robot that cleans garbage from the water independently can have a substantial influence on pollution control. However, properly developing such a robot is a difficult challenge. The design and analysis of a river cleaning robot are presented in this work. The mechanism is intended to perform various functions such as collecting floating garbage, underwater inspection, and so on. The robot is made up of a frame, a cylinder hull, thrusters, and large waste disposal arms.

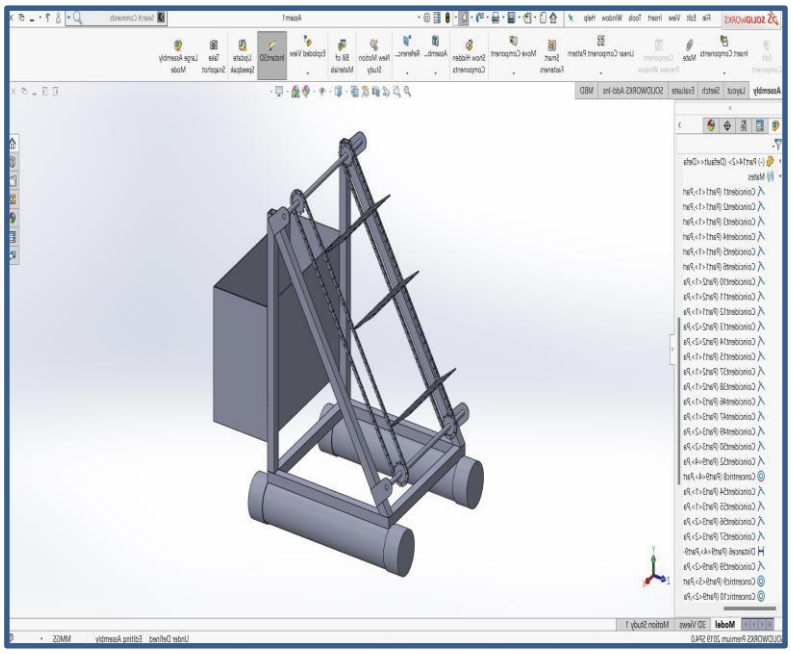
INTRODUCTION:

India is a country with stunning and diverse landscapes, abundant natural resources, and a popular tourist destination. The country is currently confronted with the terrible problem of large-scale environmental degradation, such as water pollution. Three rivers on the Indian subcontinent, the Ganga, the Brahmaputra, and the Indus, account for 90% of the plastic trash being drained into the sea globally. While the Ganga and Brahmaputra discharge the sixth greatest volume of untreated plastic trash into the sea, the Indus alone transports the second most.

Garbage contamination on the water surface of domestic lakes and urban rivers has become increasingly severe in recent years, threatening the biological equilibrium of the waterways. Parks and other recreational lakes and ponds frequently contain leaves, plastic bags, floating bodies, and other surface waste, harming the scenery and polluting the ecology. There are several surface garbage cleaning boats on the market at the moment, which are typically powered by fuel oil, have air pollution, noise pollution, and oil pollution issues, and are enormous in volume, making them unsuitable for small water surface garbage cleaning tasks. The garbage robot should be able to travel in eight different directions: front, back, left, right, left front, right front, left back, and right back. The collector's interior should be able to spin and gather heavy floating garbage. The

direction is controlled by two DC motors, and the propeller rotation direction of the hull propulsion structure is controlled by the positive and negative rotation of the motor, according to the robot's characteristics.
When the robot travels too far, the user cannot clearly see the location of the waste, necessitating the usage of a display device. A camera plus a display screen comprise the display device. A camera plus a display screen comprise the display device. The camera at the front end of the robot records the real-time water condition, which is then transferred to the display screen on the remote control via the image transmission module, allowing the operator to view the position of the rubbish more intuitively and ease operation. India is a country with stunning and diverse landscapes, abundant natural resources, and a popular tourist destination. The country is currently confronted with the terrible problem of large-scale environmental degradation, such as water pollution. The Ganga, Brahmaputra, and Indus rivers are three of the ten rivers that account for 90% of the plastic garbage that is discharged into the sea globally. While the Ganga and Brahmaputra discharge the sixth greatest volume of untreated plastic trash into the sea, the Indus alone transports the second most.
The garbage cleaning robot should move in eight directions: front, back, left, right, left front, right front, left back and right back. The collector should be able to rotate and collect heavy floating waste into its interior. According to the characteristics of the robot, the direction is controlled by two DC motors, and the propeller rotation direction of the hull propulsion structure is controlled by the positive and negative rotation of the motor. When the robot travels too far, the user cannot clearly see the location of the garbage, and the display device is needed. The display device is composed of a camera and a display screen. The real-time water condition is recorded by the camera at the front end of the robot, and transmitted to the display screen on the remote control through the image transmission module, so that the user can see the location of the garbage more intuitively and facilitate operation.

Water is the source of life. Though 70% of the earth is covered with water, about 97% of it is in the form of oceans and hence not fit for human consumption. The remaining 3% is stored in various sources like glaciers, rivers, lakes and under-ground aquifers. Rivers and lakes which are found on the earth’s surface are very much essential for the mankind. River water is used for irrigation which in return gives food to the people. Rivers also maintain the ecology of the region and bring in prosperity. Unfortunately, most of the rivers and lakes are getting polluted. This is due to human actions like letting domestic and industrial wastes into such water bodies. Thus, rivers like Ganges, Yamuna and Narmada have become highly polluted. Even the South Indian River Kaveri is affected by pollution. Solid waste which floats on the river surface is a cause of serious concern. Disposal of solid waste is the first step towards minimizing surface water pollution. Some machines have been developed to clear the solid waste found on the surface of the water bodies.
Controlling the water pollution is very important in order to save the river and other living things. In India some projects are set up for reducing pollution, The National Mission for Clean Ganga was one of the projects set up in 2016. There are lots of researches carried out to control water pollution. One of the best methods is implement an autonomous system for waste disposal from the river effectively.



NEED:

- Environmental Preservation: To protect aquatic ecosystems and marine life.
- Human Health: To reduce the risks posed by waterborne diseases.
- Aesthetic Appeal: To maintain the aesthetic beauty of water bodies.
- Compliance: To meet environmental regulations and international commitments

OBJECTIVE:

- The primary objective is to efficiently and effectively remove floating waste and garbage from the water surface to reduce water pollution.
- Minimize the impact of plastic waste, and pollutants on aquatic ecosystems and wildlife.
- Improve the overall water quality by removing organic and inorganic contaminants that can degrade aquatic habitats and threaten public health.
- Allow for remote operation and control to maximize efficiency and ensure safety, even in hard-to-reach or hazardous areas.
- Develop cost-effective solutions for garbage collection, including maintenance and disposal of collected waste.

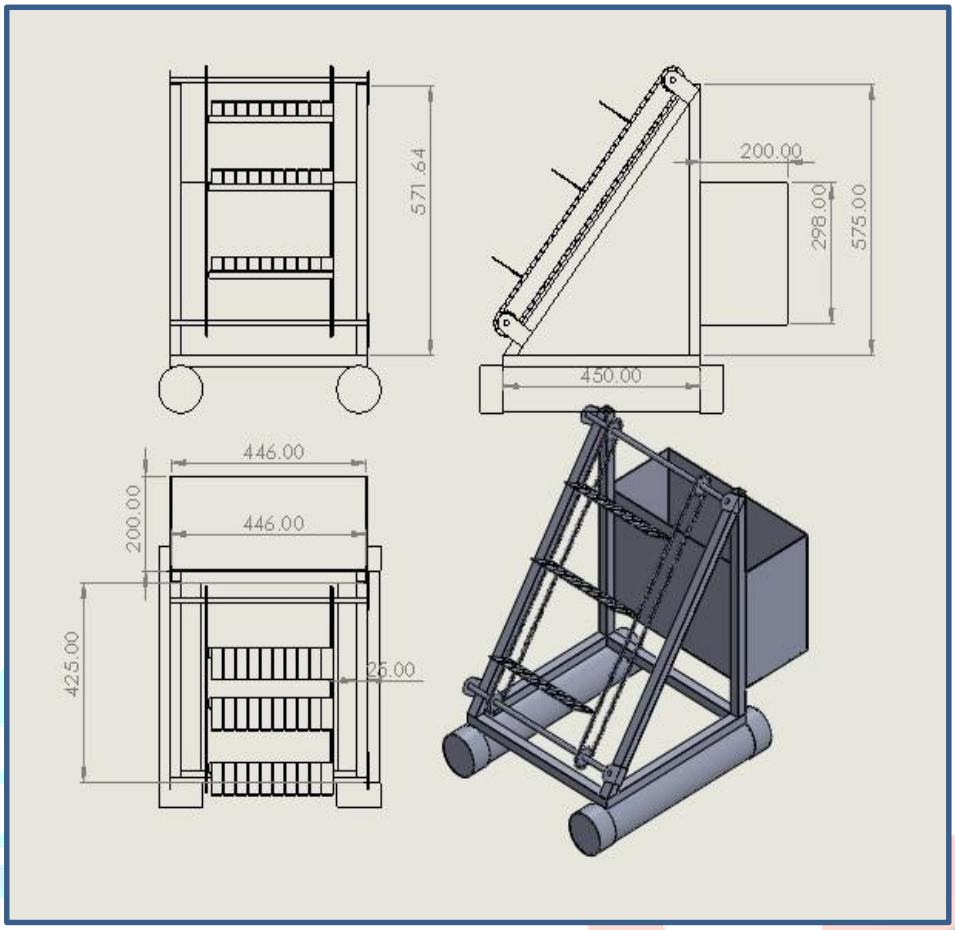
PROBLEM STATEMENT:

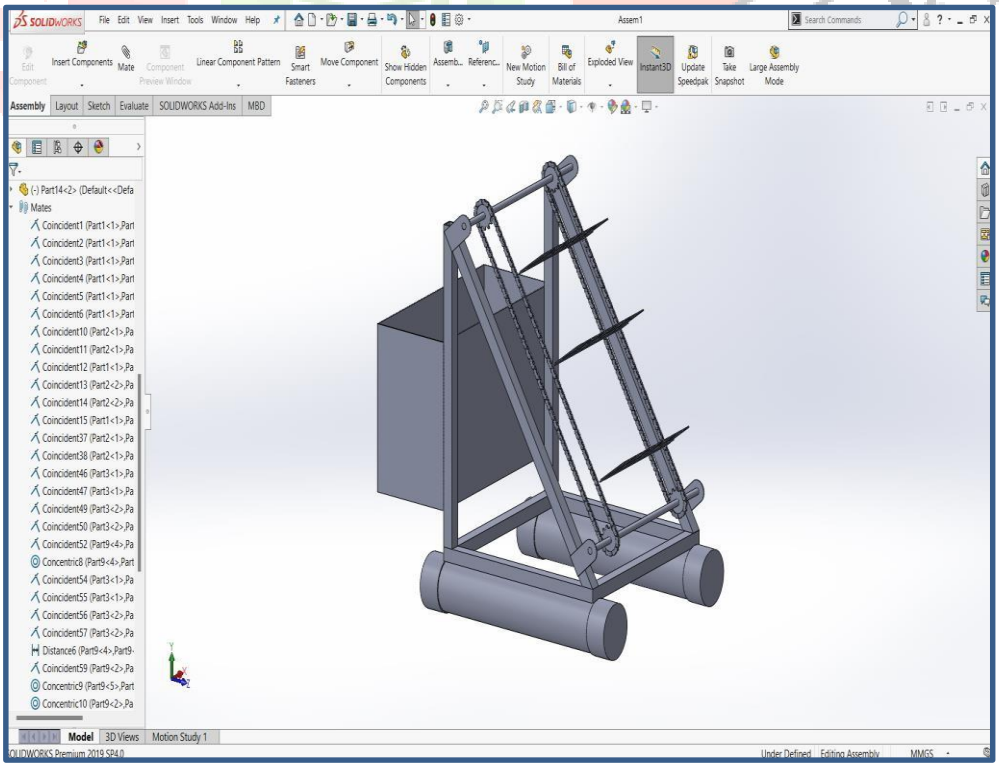
The problem lies in the accumulation of waste garbage in water bodies, leading to environmental degradation. Current methods of waste collection are inefficient and labor-intensive. There is a pressing need for an automated solution to collect and manage waterborne waste.

METHODOLOGY:

- Project Start
- Feasibility Analysis
- Research & Information Gathering
- Conceptualize design
- Component selection
- Prototyping
- Testing & validation
- Refinement & optimization
- Final assembly
- Deployment & Field Testing
- Maintenance
- Project End

MODEL AND DESIGN:

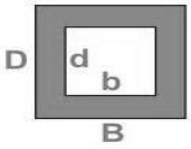




CALCULATIONS:

1. Frame

Load on frame considered P = 5 kg = 49.05 N y = D/2 = 20/2 = 10 mm D = 20 mm B = 20 mm t= 2 mm thickness



Hollow Sections obtained by subtraction

$= \frac{BD^3}{12} - \frac{bd^3}{12}$

Length of frame is 600 mm
Moment of inertia in x direction I = 7872 mm^4

Mb $= \frac{49.05*600}{4} = \frac{WL}{4}$ = 7357.5 N-mm

Bending stress of pipe

$\frac{Mb}{I} = \frac{\sigma b}{y}$

$\sigma b = \frac{7357.5 \times 10}{7872}$ = 9.34 N/mm2

Theoretical bending stress

$\sigma b(th) = \frac{Syt}{f.s} = \frac{310}{1}$ = 310 N/mm2

$\sigma b < \sigma b(th)$

Hence design is safe.

2. Shaft Design

A shaft is rotation member usually in cylindrical, which is used to transmit torque, power and motion between various elements such as electric motors and gear sets, pulleys or turbines. For this design work, a uniform solid shaft is used due to the following reasons:
To increase the life span of the shaft.
To allow efficient movement of the shaft through the support bearing.

RPM = 55
Design Power, Pd = 120 W
Length of Shaft = 400 mm
Allowable shear stress τ = 40 MPa (Considering the keyway effect)

Torque T = 20834 N mm From
Torsion equation, $T = \frac{\pi}{16} * \tau * d^3$

$20834 = \frac{\pi}{16} * 40 * d^3$

d =13.84
mm
so, we are selected 12 mm diameter shaft

3. Bearing Design

The deep groove ball bearing has been selected and on the basis of bore diameter up to 12 mm, Bearing no. 6001-2RS has been selected for design.

From design data book, Specific dynamic capacity C = 5100 N.

The life of bearing Lh = 9000 hrs

So, rated life of bearing L10 = 60xNxLh = 60 x 55 x 9000 = 29.7x 10^6 revolution

Equivalent load on bearing, $L_{10} = \left(\frac{C}{Fe}\right)^n * K_{rel}$

Assuming 90% reliability and n = 2 for ball bearing

$29.7*10^6 = \left(\frac{5100}{Fe}\right)^3 * 1$

F_e = 16.46 N

4. Moving frame calculation

The total weight of the frame without garbage is 4kg and the total weight of the frame with garbage is 5 kg we can used two motors for moving frame

So, each frame contains 2 kg without garbage and 2.5 kg with garbage

Force required for lifting 2 kg is

F1 = m*a

= 2*9.81

= 19.62N

Force required for 2.5 kg is

F1 = m*a

= 2.5*9.81

= 24.52N

Torque T1 is required to moving frame is
T1=F1*d

=19.62*150

=2.943 Nm

Torque T2 is required to moving frame is

T2=F2*d

=24.52*150

=3.678 Nm

We are selected the 10-rpm motor

Rpm = 10

Voltage =12 v

Power = 4.8W

Torque required for motor is

$p=\frac{2\pi NT}{60}$

$4.8=\frac{2\pi 10T}{60}$

T = 4.58Nm

T1, T2 < T

Hence selected motor is safe.

CONCLUSION:

In this era of technology, it is possible to construct and use this technology for the purpose of cleaning water reservoir. Thus, we are working to develop robot that will automatically detect the garbage and collect it this will help in every aspect in keeping the environment lean in the near future.

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