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DESIGN & DEVELOPMENT OF SOLAR OPERATED MECHANISM TO COLLECT WASTE & CLEAN THE RIVER

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Abstract : Water pollution has been major cause of environmental concern. Most of the water bodies like rivers, lakes, streams, etc. are highly polluted. Floating waste is a major source of pollution. 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. In many cases, those water bodies turned into landfills and get wasted. The work has done looking at the current situation of our national rivers which are dump with crore liters of sewage and loaded with pollutants, toxic materials and floating solid waste etc.

By taking this into consideration, this project "Design & Development of Solar Operated Mechanism to Collect Waste & Clean the River" is to remove floating waste like garbage, debris and solid waste from water bodies and make it clean. 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 man power, time consumption for cleaning the river. In this project we have used Solar Panel it will supply Power for Machines operations and store the energy in the battery and used this energy for river cleaning with the help of a motor and chain drive arrangement.

I. INTRODUCTION

The "Design & Development of Solar Operated Mechanism to Collect Waste & Clean the River" used in that places where there is waste debris in the water body which are to be removed. This machine is consists of waterwheel driven conveyer mechanism which collect & remove the wastage, garbage & plastic waste from water bodies. This also reduce the difficulties which we face when collection of debris take place. A machine will lift the waste surface debris from 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 man power, time consumption for cleaning the river. It consists of chain drive mechanism which lifts the debris from the water surface.

The use of this project will be made in rivers, ponds, lakes and other water bodies for cleaning upper water waste debris. From this project we hope to clean the water surface debris. This invention relates to skimmer boats, i.e., work boats for collecting and disposing of floating solid waste materials in harbors and waterways. The invention is more specifically directed to highly maneuverable vessels equipped with means for picking up floating debris, means for storing the debris on the vessel, and means for discharging the debris from the vessel to a storage area.

In one typical trash skimmer design, one or more hydraulically powered open mesh conveyors are positioned between the pontoons of a catamaran-type twin-hull vessel. A main pickup conveyor extends off the front end, and extends into the water to catch the floatables, which it picks up and carries back to a main storage conveyor. When the storage conveyor is completely loaded, the boat is taken to a discharge position where the debris can be transferred to a truck or other facility. In some cases, a separate, on-shore conveyor can be used to pick up the trash discharged vessel.

II. PROBLEM STATEMENT

- The Central Pollution Control Board (CPCB) in 2018 identified 351 polluted river stretches in India.
- Every day, almost 40 million liters of wastewater enters rivers and other water bodies with only a tiny fraction adequately

treated.

- It's estimated that around 70% of surface water in India is unfit for consumption.
- Waste products, harmful chemicals, dumping of household waste, dumping of medical and other hazardous waste into the water results ultimately leads to loss of drinking water and even deaths of various life forms.
- Aquatic life forms mainly suffer because of water pollution because of loss of enough amount of fresh dissolved oxygen in water bodies due to raised volume of toxicity in water.
- Toxicity which is a result of water pollution leads to death of aquatic life forms.

III. OBJECTIVE

In the absence of garbage disposal facilities, the practice of dumping garbage into nearby Rivers has become quite common in recent years and has long-term negative impacts both on biodiversity of the area and as well as on the local environment. Below mentioned few objectives on our project is withstand.

- To reduce the pollution from water surface.
- To overcome the difficulty of removing waste particulate floating on water surface.
- To maintain the automation during working towards cleaning River.
- To perform the fast & reliable operation during cleaning River.
- Improve the water quality of a water stream or river.
- To work for society for clean up a section of a stream or river.
- To remove garbage from the waterway & give solutions to locals, to provide better environment to aquatic animals and human life.

IV. MATERIAL SELECTION & METHODOLOGY

The proper selection of material for the different part of a machine is the main objective. In the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

1. Availability of the materials.
2. Suitability of materials for the working condition in service.
3. The cost of materials.
4. Physical and chemical properties of material.
5. Mechanical properties of material.

The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should with stand it. Another criterion for selection of metal depends upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load.
Selection of the material depends upon factor of safety, which in turn depends upon the following factors.
Reliabilities of properties

1. Reliability of applied load
2. The certainty as to exact mode of failure
3. The extent of simplifying assumptions
4. The extent of localized
5. The extent of initial stresses set up during manufacturing
6. The extent loss of life if failure occurs
7. The extent of loss of property if failure occurs

V. LITERATURE REVIEW

1. DESIGN AND FABRICATION OF REMOTE CONTROLLED SEWAGE CLEANING MACHINE

- M. Mohamed Idhris, M. Elamparthi, C. Manoj Kumar, Dr.N. Nithyavathy, Mr. K. Suganeswaran, Mr.S. Arun kumar
The motive of the project is to automate the sewage cleaning process in drainage, to reduce the spreading of diseases to human. The black water cleaning process helps to prevent pest infestations by reducing the residues that can attract and support pests. It also improves the shelf life and sensory quality of food products. In the proposed system, the machine is operated with remote control to clean the sewage. Hence, this system avoids the impacts from the sewage waste and its harmful gases. This helps to prevent the mosquito generation from the wastage. The system has a wiper motor that starts running as soon as the set-up is switched on. Two power window motors are connected to the wheel and it is driven with the help of the remote control set-up. The process starts collecting the sewage wastes by using the arm and it throws back the waste into the bin fixed in the

machine at the bottom. An arm is used to lift the sewage and in turn a bucket is used to collect them. The set-up runs even in sewage area with water (limited to a particular amount) so that the wastages which floats on the water surface also gets collected. The garbage which affects the drainage is also picked up and removed. This system has limited human intervention in the process of cleaning and in turn reduces spreading of diseases to mankind. Modern services are becoming polarized.

2. DESIGN & FABRICATION OF RIVER CLEANING SYSTEM

- Mr.Abhijeet. M.Ballade, Mr. Vishal S. Garde, Mr.Akash S. Lahane and Mr.Pranav.V.Boob

India is holy country & during lots of festival like Ganesh visarjan, navratri durga puja & mainly Siahnsth kumbhmela there is lots of water pollution of Godavari River at Nashik. The water pollution is very important problem in rivers, ponds and water bodies near Godavari River at Nashik. 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. Similarly sometimes the aquatic animal tends to eats surface waste debris considering it as a food; which ultimately cause the death of animals. Due to polluted water many skin diseases to human kind are observed. So that to reduce the water pollution we are trying to make river cleanup machine. "River cleanup machine" a machine which involves the removing the waste debris from water surface and safely dispose from the water body. The river cleanup machine works on hydropower to extract waste water debris, plastics & garbage from Godavari river at Nashik

- **METHODOLOGY**

In this section, we provide a detailed description about proposed approaches to outlier detection. Methodology & steps to solve the problem given below flow chart shows the sequential operation/steps that will be performed during the project process.
Methodology shows systematic way to do work. It is standard process of describing process, how it is done in simplest manner. Design consists of application of scientific principle, technical information, and imagination for development of new mechanism to perform specific function the total design work has been split into two parts.

1. System design
2. Mechanical design

- **CONSTRUCTION**

1. Component used for the construction of River Cleanup Machine are as follows:
2. Water wheel- The waterwheels are rotate by using hydropower & this converted the kinetic energy of the water to mechanical energy to drive shaft to conveyer
3. Shaft: - The shaft is the main rotating component on which the conveyor is to be mounted.
4. Pedestal Bearings:- The pedestal bearing is made in use to give rotary motion & to support the shaft. The pedestal bearing are mounted on M.S angle frame.
5. Belt drive: - Belt drive is a transmission system of the water cleanup machine. Here we had use two belt system. First is cross belt & another is open belt Drive.
6. Conveyor:-The conveyor is mounted on the two shafts such a way that it collects the waste debris to be lifted upwards and collect inside the machine.
7. Bevel Gear:- Which transfer the power from waterwheel to second garbage handling conveyer.
8. M.S Angle Frame: - The M.S angle is made in use to form the main body of the machine. It supports all the components of the system.

- **WORKING**

In this project the main aim of this machine is to lift the waste debris from the water surface and dispose them in the tray. It consist arrangement of the conveyor which is placed on the shaft & bearings support; the shaft is coupled to the pedestal bearing and bearing is mounted on the M.S angle frame, the frame is welded and resembles the shape of slope facing machine part. Due to hydropower waterwheels are rotate; this power is transmitted to conveyer system by means of belt drives. As the conveyer is move, it collects the water debris, waste garbage &plastics from water bodies. As the machine is placed in the water the waste debris in water will get lifted and it moves in upward direction. As the waste debris reaches the upper extreme position it will get dropped in the tray. Hence this will result in cleaning of water surface and safe collection of waste debris from water. After collection of all wastage debris the second conveyer is convey it out of the river. The River Cleanup Machine utilizes long floating barriers which is being at an angle capture the plastic, making mechanical extraction possible.Fig.4 shows the Concept drawing of river cleanup system.

3. DESIGN AND FABRICATION OF RIVER WASTE CLEANING MACHINE

-Mr. P. M. Sirsat, Dr. I. A. Khan, Mr. P. V. Jadhav, Mr. P.T. Date

This paper emphasis on design and fabrication details of the river waste cleaning machine. The work has done looking at the current situation of our national rivers which are dump with crore liters of sewage and loaded with pollutants, toxic materials, debris etc. The government of India has taken charge to clean rivers and invest huge capital in many river cleaning projects like "Namami Gange", ''Narmada Bachao'' and many major and medium projects in various cities like Ahmadabad, Varanasi etc. By taking this into consideration, this machine has designed to clean river water surface. Conventional methods used for collection of floating waste are manual basis or by means of boat, thrash skimmers etc. And deposited near the shore of rivers. These methods are risky, costly and time consuming. By considering all the parameters of river surface cleaning systems and eliminating the drawback of the methods used earlier, the remote operated river cleaning machine has designed which

helps in river surface cleaning effectively, efficiently and eco-friendly. The "River waste cleaning machine" is used where there is waste debris in the water body which are to be removed. This machine consists of DC motors, RF transmitter and receiver, propeller, PVC pipes and chain drive with the conveyor attached to it for collecting wastage, garbage & plastic wastages from water bodies.

VI. SYSTEM DESIGN

In system design we mainly concentrate on the following parameter

1. System selection based on physical constraints

While selecting any m/c it must be checked whether it is going to be used in large scale or small scale industry in our care it is to be used in small scale industry so space is a major constrain .The system is to be very compact it can be adjusted to corner of a room. The mechanical design has direct norms with the system design hence the foremost job is to control the physical parameters so that the distinction obtained after mechanical design can be well fitted into that.

2. Arrangement of various component

Keeping into view the space restriction the components should be laid such that their easy removal or servicing is possible moreover every component should be easily seen & none should be hidden every possible space is utilized in component arrangement.

3. Components of system

As already stated system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact A compact system gives a better look & structure.

4. Man –Machine Interaction

The friendliness of m/c with the operation is an important criterion of design. It is application of anatomical
Following are some e.g. of this section

- Design of machine height
- Energy expenditure in hand operation
- Lighting condition of m/c

5. Chances of Failure

The losses incurred by owner in case of failure of a component are important criteria of design. Factor of safety while doing the mechanical design is kept high so that there are less chances of failure there over periodic maintenance is required to keep the m/c trouble free.

6. Servicing Facility

The layout of components should be such that easy servicing is possible especially those components which required frequent servicing can be easily disassembled.

7. Weight of machine

The total weight of m/c depends upon the selection of material components as well as dimension of components. A higher weighted m/c is difficult for transportation & in case of major break down it becomes difficult to repair.

VII. DESIGN CALCULATION

A trash skimmer work boat collects and discharges debris from the front. A storage conveyor positioned approximately amidships and along the center line, and is mounted on a slide or track arrangement that permits forward and reverse motion. A collection and discharge conveyor is mounted at the bow portion of the hull. The forward conveyor can be oriented in a trash collection position or in a trash discharge position.
The storage conveyor is brought sternward so that there is clearance for the proximal end of the forward conveyor to be raised or lowered, and then is brought back forward so that the storage conveyor is in position to receive debris or to discharge it. Auxiliary floats at the sides of the boat hull provide additional buoyant support for the front conveyor, and are detachable so they can be removed for road transport of the boat.

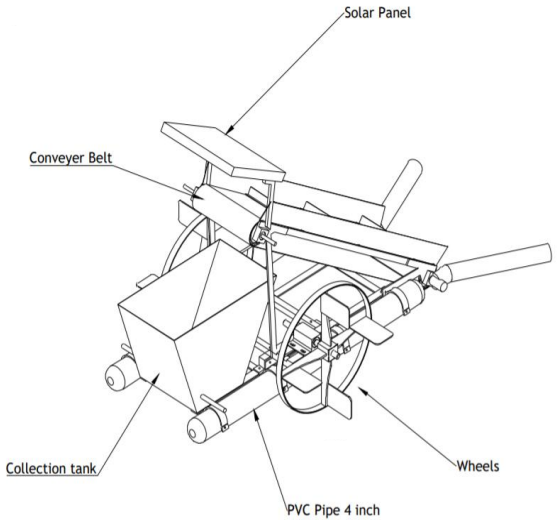


Fig 1 Design of Trash skimmer work boat

DESIGN METHODOLOGY-

The comprehensive methodology for the design is based on system engineering design and analysis approach. While giving due regard to the importance of the system design procedure, the methodology also draws on reliability study where the process will enhance the dependency on the system applied adequately in removing rubbish from inland waterway.

Particular attention is given to present design of boats since it is the most crucial phase in determining the overall configuration, and because of its added importance with the current emphasis of concurrent engineering. The information obtained can be further analyzed for improvised design of trash collecting system for rivers and canals.

Float Design For System Of Weight 25 Kg

According to the Archimedes principle, you need to displace the amount of water equal to the weight of the object plus the weight of the foam. Neglecting the weight of the foam, you need 25000 cm3 or 25 liters of foam to hold an object of 25000 g.

To account for the weight of the foam, you need to increase this amount slightly. The density of thermocol is about 40-75 times less than water, so you need to increase the volume by about 5% as the minimum, give or take. A third of a liter would do.

The equation would be to use the same amount of cubic centimeters of foam, as the number of grams in the object weight and then increase the result by at least 5%. This would position your object at the surface. To avoid the object getting wet, just slightly increase the amount of foam. So by increasing the foam size by 5% it comes to 26.25 Litre of thermocol is required to lift weight of 25 kg of Trash cleaning vehicle

DENSITY			
WATER	AIR	THERMOCOL	PVC
997 kg/m³	1.225 kg/m3	13 – 25 Kg/ m³	913 kg/m3

PVC pipe

Outer diameter – 100mm

Wall thick ness - 3 mm

Length 5 feet

Volume of air inside cylinder $=3.14*100^2*1500$

$=17678571.4286\ mm^3$

$=17.67$ Liter

Since we are using 2 hollow pvc pipes, So the net volume of thermocol that can be inserted inside the pvc is

Net volume = 17.67*2 = 35.24 liter

Thus it can lift the load of 35kg

Factor of safety = net capacity/ actual Load

=1.4094

FOS is 1.41

Hence our design for float selection is safe

4.1.2 DESIGN OF CONVEYER ROLLERS:

DRIVE PULLEY SHAFT DESIGN

Considering all the resistances (including wrap & bearing resistances), we get the torque from the following formula
Power of wiper motor 298.3 W

$$P = 2\pi NT/60$$

$$T = 60xP\ /2\pi N \quad \text{——}$$

T=95 Nm
Tension in the belt = T / r
= 95/0.385
=246.75 N
T_E=246.75 N
We have,
T_E = Carrying side belt tension

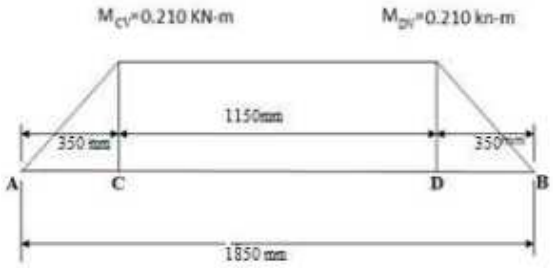
$$T_1 = T_E\ [\frac{\xi}{e^{\mu\theta}-1} + 1]$$

Where,
ξ = Drive coefficient = 1.66
θ = Angle of wrap= 210^0 = 210 x π/180= 3.66 rad
μ = Coefficient of friction between drive pulley and Belt = 0.35
T1 = 246.75{1.6 / [$e^{0.35x3.66}$-1] + 1}
=392.194 N
T2=T1-TE
=392.194-246.75
=145.44

Resolving horizontal and vertical components
FH = T1 cos10.360 + T2 cos19.64
=249.49 N

FV = T1 sin10.360- T2 sin19.640+ W
= (31.01 sin10.360) –(11.812 sin19.640) +7.3
= 29.63 N

Vertical moments



Moment at C,
MCV = RCV x 0.35
= 0.602 x 0.35
= 0.210 kN-m

Moment at D,
MDV = RDV x 0.35
= 0.602 x 0.35 = 0.210 kN-m

Therefore, Resultant moment at

$$C = \sqrt{(M_{CV})^2 + (M_{CH})^2}$$

= 37.3 N-m

Resultant moment at D

$$D = \sqrt{(M_{DV})^2 + (M_{DH})^2}$$

= 37.3 N-m

Case-1: Based on moment We know

M = MCR = MDR = 37.3 N-m

Allowable bending stress

$$(\sigma_b) = \frac{32}{\pi d^3} \text{ x M x } K_b$$

(Gb)=
= 1.75 mm

Case-2: Based on Deflection method Deflection based diameter

$$d = \sqrt[4]{\frac{W_R \text{ x } a \text{ x } L \text{ x } 16000}{E \text{ x } \pi \text{ x } \alpha}}$$

Where,

W_R = resultant loading

$$= \sqrt{(R_{CH})^2 + (R_{cv})^2}$$

a = Bearing centre to hub distance (mm)
L = Hub spacing (mm)
E = Young's modulus for shaft (N/mm2)
α = Allowable deflection (radians) = 0.0015 rad to 0.0017 rad = 0.0017 rad (max.)

So, selected shaft size is 17 mm at bearing and 25 mm at hub

DESIGN OF FRAME -

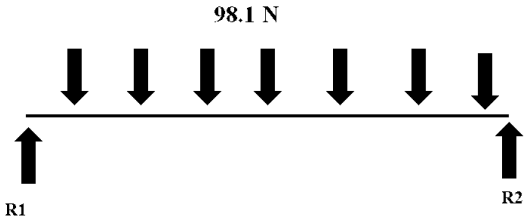
The Frame fabricated for our project which is made up of M.S. It is welded accordingly for arrangement of the system components. The Frame along with dimension is shown in figure below:

Frame Specification:

- Size of Frame: 250 x406mm
- Material of Frame: Mild Steel
- Unloaded Weight of Frame: 2.65 kg o
- Loaded weight of frame: 9.7 kg

FRAME DESIGN:

Assumptions:
Area of frame = 250 x 450 mm*)
Total load on frame is about 10 kg
F=10 x 9.81 = 98.1 N



Fig, this load is applied at the center as shown in fig.

From fig.
R1, R2 are the reaction forces,
R1 + R2 = F
And
$\sum M_{R1} = 0$

F x 250 - R2 x 406 = 0
98.1 x 250- R2 x 406 = 0
Therefore,
R2 = 60.40 N
RI + 60.40 = 98.1
RI = 37.7 N
Mb = 60.40 x 250
Mb = 3020
Y =b/2 (b= width of square pipe of frame)
= 15/2= 7.5mmm
I = bd^3/12=d^4/12 ……. (Since b = d)
=(15)^4/ 12
I = 4218.75

Stress on frame,

$$\sigma = M_b y / I$$

σ= (3020 x 7.5)/4218
σ = 5.369 N/ mm
σ = Syt / fos
Therefore,
Syt = σ x fos
= 5.369 x 3... (Assuming FOS = 10)
Syt = 16.2 N/ mm

Selecting material Mild Steel 15 mm Square tube having Tensile strength (min) = 150 N/ mm^2
For safer design considerations as 16.2 N/mm^2
Therefore all assumptions are in safer state.

VIII. CONSTRUCTION

CONSTRUCTIONAL MODEL
Complete system is been designed in CATIA V5R20

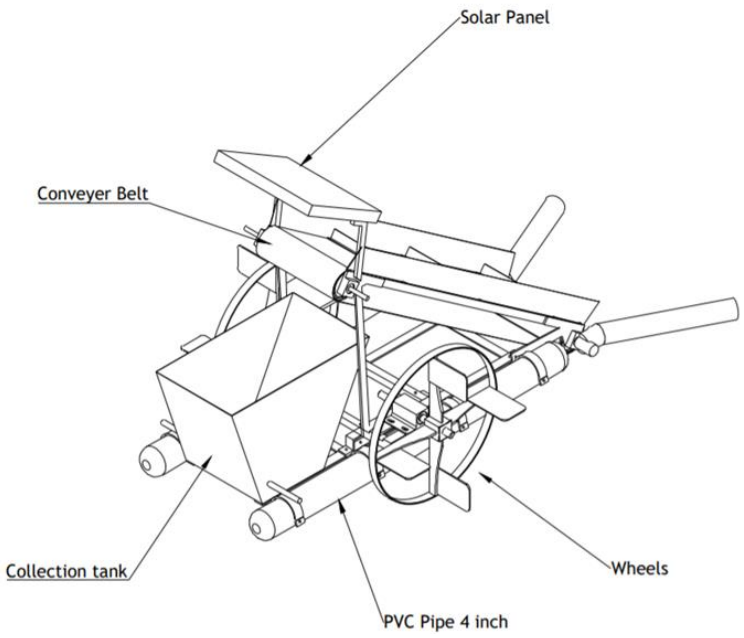


Fig 2 Constructional Model of Trash skimmer boat in Isometric view

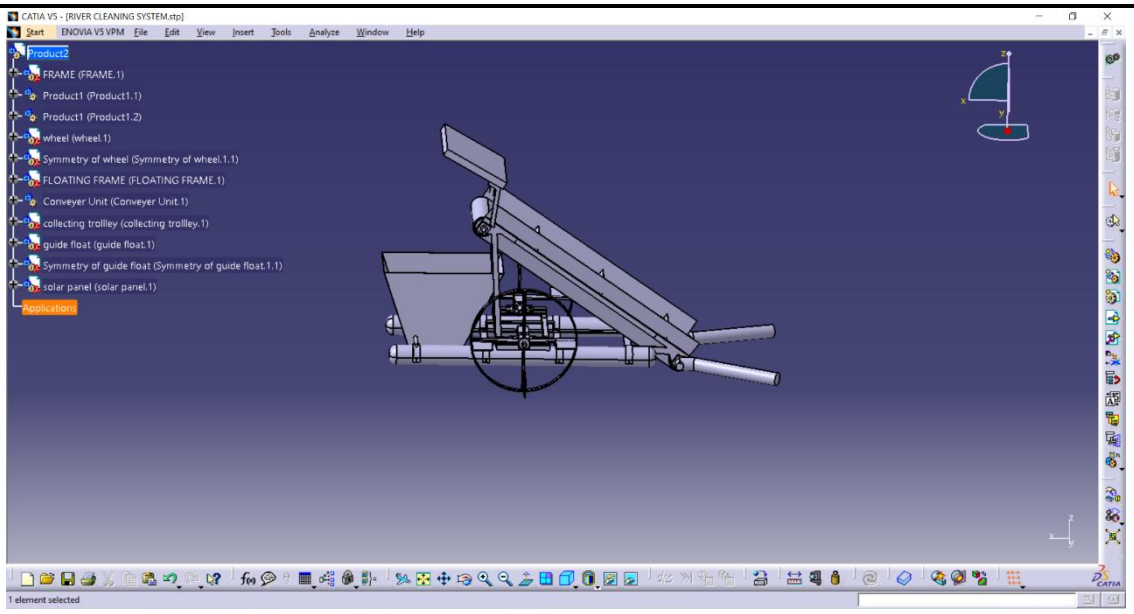


Fig 3 Isometric view of Trash skimmer boat

The project consists of a motor operated water wheel to run the project. It has four DC Motor of 12V, 7.6 Ampere. The device which is running the project is chain drive coupled having collecting plate. The project consists of two main shafts balancing and hoisting the sprocket of chain drive. The components are rest on frame serve as main body of the project. The steel pipe with pressurize air generates pressure head to run the project on water surface. The fabricated storage tank is used to store the waste fulfilling the purpose of the project.

IX. WORKING PRINCIPLE

In this project the main aim of this machine is to lift the waste debris from the water surface and dispose them in the tray. Here we are fabricating the remote operated river cleaning machine. The collecting plate and chain drives are rotating continuously by the motor. The collecting plate is coupled between the two chain drives for collect the waste materials from river. The collected wastages are thrown on the collecting tray with the help of conveyer. Our project is having propeller which is used to drive the machine on the river. The propeller is run with the help of two PMDC motor. The total electrical device is controlled by RF transmitter and receiver which use to control the machine remotely.

ASSEMBLY OF MACHINE (Parts to be fabricated)

- Base Frame
- L- Section 4
- Inclined Section 2
- T- section 2
- Collecting Mechanism
- Carrying Belt
- Skimming Water wheels
- U- section 2
- Connecting Link

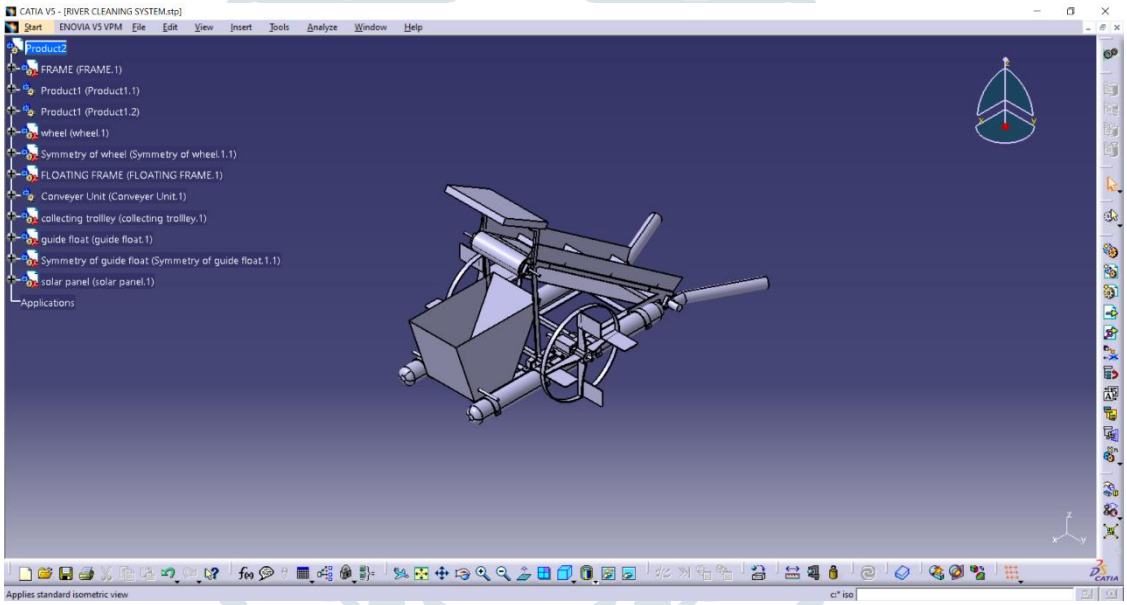
WORKING

In this project the main aim of this machine is to lift the waste debris from the water surface and dispose them in the tray. It consist arrangement of the conveyor which is placed on the shaft & bearings support; the shaft is coupled to the pedestal bearing and bearing is mounted on the M.S angle frame, the frame is welded and resembles the shape of slope facing machine part. Due to hydropower waterwheels are rotate; this power is transmitted to conveyer system by means of belt drives. As the conveyer is move, it collects the water debris, waste garbage &plastics from water bodies.

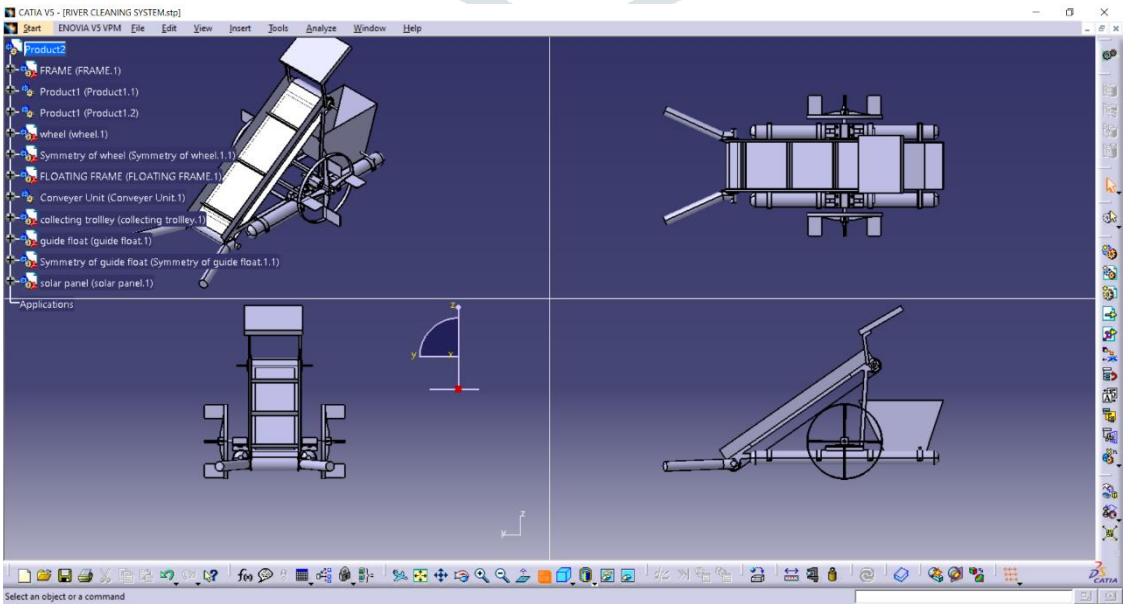
As the machine is placed in the water the waste debris in water will get lifted and it moves in upward direction. As the waste debris reaches the upper extreme position it will get dropped in the tray. Hence this will result in cleaning of water surface and safe collection of waste debris from water. After collection of all wastage debris the second conveyer is convey it out of the river. The River Cleanup Machine utilizes long floating barriers which is being at an angle capture the plastic, making mechanical extraction possible.Fig.4 shows the Concept drawing of river cleanup system.

COMPONENT DETAIL & BILL OF MATERIAL

Sr. No.	Material	Quantity
1	DC 12 volt Wiper motor	1
2	Skimming wheels (to be fabricate)	2
3	Circular Pipe Pvc 4inch Od 1500mm Long	2
4	Bearing	4
5	Solar Panel	1
6	Battery 12 volt 7amp	1
7	Johnson Dc Motor	2
8	Steel conveyer Belt	1
9	M6 Nut Bolts	15
10	Metal steel 0.6 Mm	1



Isometric Side View



ADVANTAGES

1. It is a non-conventional river cleanup system.
2. It's initial & maintenance cost is low.
3. Skill Worker not required to drive the system self-propel.
4. Proper timing of mechanical control operations can improve control and reduce the spread of propagates.
5. Environment friendly system.

FEATURES OF PROJECT

1. No operating cost.
2. For operating trained operator not required.
3. No maintenance cost.
4. Simple working.
5. High load carrying capacity.
6. Portable unit.

DRAWBACKS OF PROJECT

- High initial Investment
- Currently suitable for minimum work load

APPLICATION

1. It is applicable to reduce water pollution in rivers, ponds, oceans.
2. It is useful to reduce the environmental marine pollution at Godavari River, Nashik.
3. It is useful in small ponds, artificial water storage, and Small lakes.

X. CONCLUSION

While concluding this report, we feel fulfill lots of practical experience during the manufacturing schedules of the working project model. We are happy that our knowledge has been used for social welfare. The project "Design & Development of Solar Operated Mechanism to Collect Waste & Clean the River" has designed which is very much economical, easy to operate and helpful for water cleaning and it can be modified with more cleaning capacity and efficiency.

This project design is fabricated in accordance so it can provide flexibility in operation. On the basis of it design and estimating cost and availability it is very cheap and very useful for the society. Although the design criterions with problems definitions which, however were overcome by using references & teachers guidelines. The choice of raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. We will do efforts during machining, fabrication and assembly work of the project model to fulfill the need of project.

XI. REFERENCES

[1] DESIGN AND FABRICATION OF REMOTE CONTROLLED SEWAGE CLEANING MACHINE
- M. Mohamed Idhris, M. Elamparthi, C. Manoj Kumar, Dr.N. Nithyavathy, Mr. K. Suganeswaran, Mr.S. Arun kumar

[2] DESIGN & FABRICATION OF RIVER CLEANING SYSTEM
- Mr.Abhijeet. M.Ballade, Mr. Vishal S. Garde, Mr.Akash S. Lahane and Mr.Pranav.V.Boob

[3] DESIGN AND FABRICATION OF RIVER WASTE CLEANING MACHINE
- Mr. P. M. Sirsat, Dr. I. A. Khan, Mr. P. V. Jadhav, Mr. P.T. Date

[4] REVIEW ON ADVANCE RIVER CLEANER
- Pankaj Singh Sirohi, Rahul Dev, Shubham Gautam, Vinay Kumar Singh, Saroj Kumar

[5] DESIGN AND FABRICATION OF RIVER CLEANING MACHINE
- Sheikh Md Shahid Md Rafique1, Dr. Akash Langde, Dept of Mechanical Engineering Anjuman college of Engineering and Technology Nagpur

[6] REVIEW PAPER ON DRAINAGE WATER CLEANER MACHINE
- Ganesh S. Patil, Rahul A. Pawar, Manish D. Borole, Shubham G. Ahire, Ajay L. Krishnani, Amit H. Karwande

[7] STUDY OF RIVER HARVESTING & TRASH CLEANING MACHINE
- Rajendra Patil , Rahul Itnare, Sagar Ahirrao, Amol Jadhav, Ajay Dhumal , B.E. Scholar BVCOE&RI Nashik (Pune University) Assistant Professor BVCOE&RI Nashik