Semi-Autonomous River Cleaning Prototype

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***Abstract*— Our proposed project uses chain drive system, D.C motor, D.C battery, bearing, shaft, conveyor system, ultrasonic sensor ,IR sensor ,inductive sensor, capacitive sensors and Garbage waste storage box (Tank) equipment's to work as Automatic River cleaning system.In this project we are proposing river cleaning machine using a mechanism proposed to overcome the real time problems for the floating waste which constitute to major problems regarding pollution. The machine consists of simple mechanism of chain sprocket attached to a pallet to lift the waste and dump it in the tank. And automatic plastic bottle and cans sorting system equipped with inductive and capacitive sensors and ultrasonic sensor for detection.**

***Keywords*— PLC programming, river cleaning, wire mesh conveyors, surface debris, inductive sensors.**

I. INTRODUCTION

This machine is consist of waterwheel driven conveyor mechanism which collect & remove the wastage, garbage & plastic wastage mainly plastic bottles and cans 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 design bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. It consists of belt drive mechanism which lifts the debris from the water. The use of this project will be made in rivers, ponds, lakes and other water bodies for to clean the surface water debris from bodies.

The project consists of a motor operated water wheel to run the project. It has four DC Motor of. 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.

II. SYSTEM DESCRIPTION

The prototype consists of a stable floating on which belt conveying system is mounted along with sorting mechanism. The mechanism is powered by four paddle mechanisms .powered by four motors. The direction of the motion is controlled by supplying power from either of the two motors to move the paddle in forward or reverse direction as per the requirement. This is controlled by PLC. A flapper-like arrangement is placed in front of conveyors. A proximity sensor is placed on the flappers. When the floating debris comes in contact with the sensor the sensor will sense the present and it close the flappers and it will start the conveyor. The flappers will collect the debris and conveyor will lift the debris and convey it on a platform where the sorting mechanism is fitted. The whole operation is guided by PLC programming. The sensors involved are all inputs of the ladder diagram and the motors involved in the operation that are used to drive the conveyor as well as direct the motion of the body ar the outputs of the diagram .The whole programming is done and stored in the PLC memory.

The sorting mechanism consists of Capacitive and inductive sensors for detecting metallic and non metallic objects and a small conveyor for throwing objects in the separate bins. This conveyor can convey in both left and right sides. When the collected waste comes on the board of sorting mechanism the inductive and capacitive are placed which will distinguish between metallic and non - metallic waste. An arrangement is done to start the conveyor in a particular direction based on the type of plastic. When the debris is metallic, inductive sensor goes ON and it starts a motor so that a conveyor moves in one

direction, say Left and that waste is collected in a bin placed in that direction and vice versa. An arrangement is also made to account for filling of bins. When the bins are fill it will start a red light to indicate that the bins are full.

A metallic wire mesh will be used for conveyor belt as water can be drained easily and it is flexible Wire Mesh Belt Conveyorsare used in industries such as heat treating, forging, foundry, food processing, snack food, baking, ceramics, glass, automotive and more. Wire mesh belt conveyors are suitable for any application like, including closed wire mesh belts for flexibility and conveying small parts, belts which having large opening for easy flow of water or air and for cleaning of products and smooth surface belts for easy and accurate transfer. Wire mesh belt conveyor is designed to interface with existing conveyor systems and is custom engineered from standard components. Easy to clean and immune to chemical reaction, wire mesh belt is ideal for diverse applications from metal working to food and clean room medical.

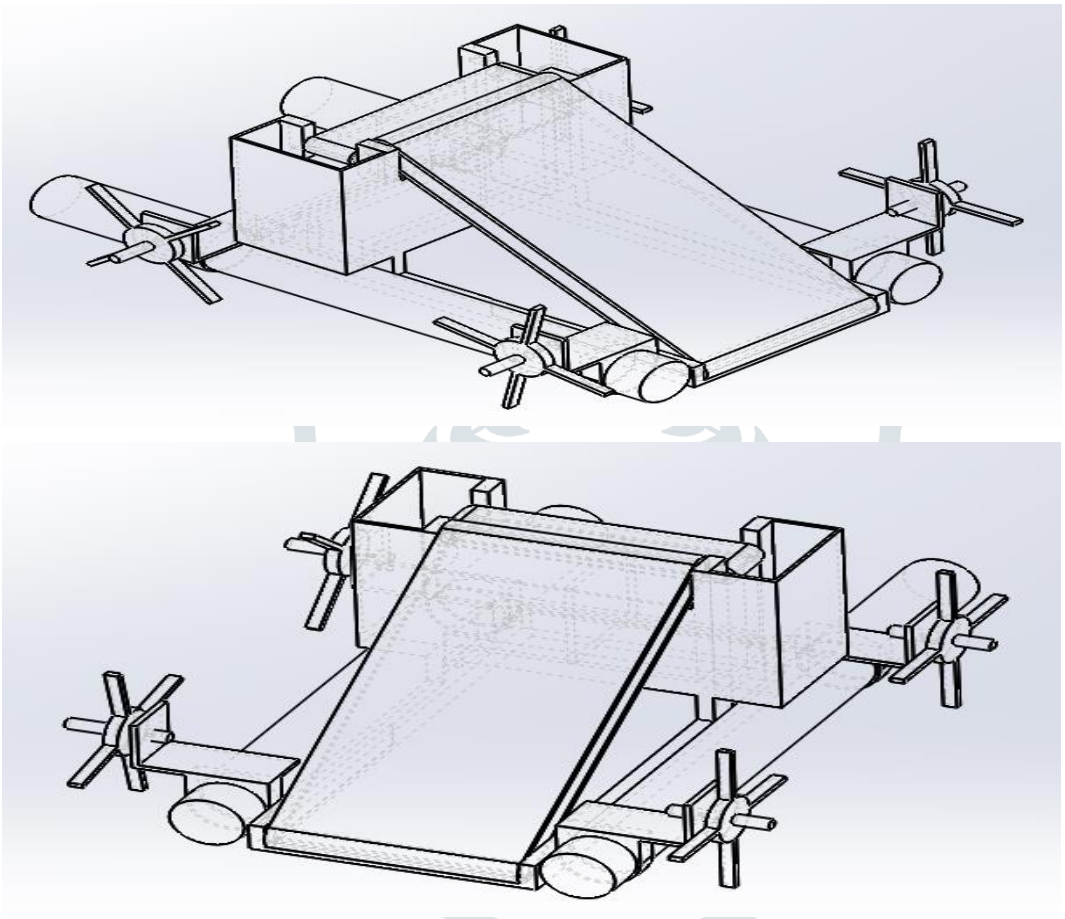

Fig: CAD model of the proto

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III. CALCULATIONS

Floatation Calculation:

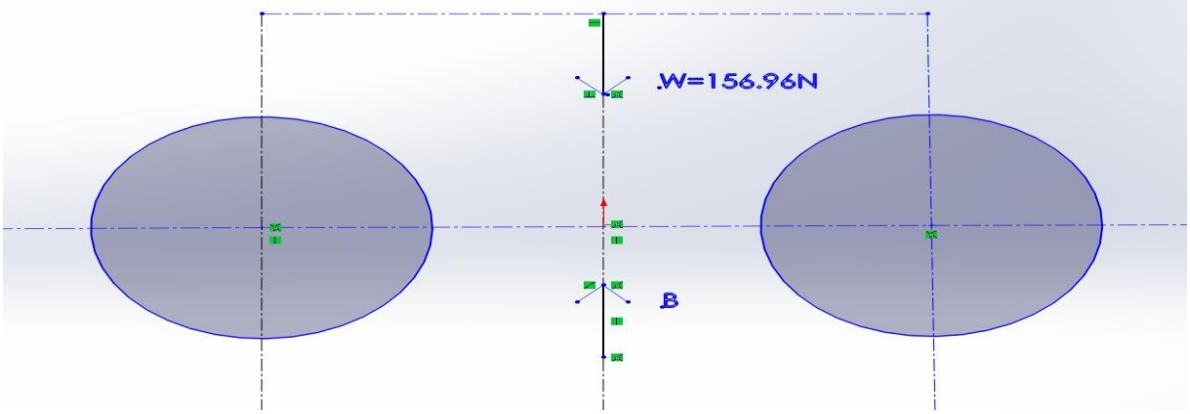

Fig.2 Schematic diagram of front view of pipes

The gross weight is considered by taking weight as 15kg. M=15 kg

L=1.2 m.(Reference)

Now,

Weight of body =Weight of water displaced

$M*g = 2*\dot{\rho}_w *V_w *9.81$

$15 = 2*1000*A_w * L_w$

$15 = 2000 *1.2*A_w$

$A_w = 6.25*0.001 (m^2)$ ….1

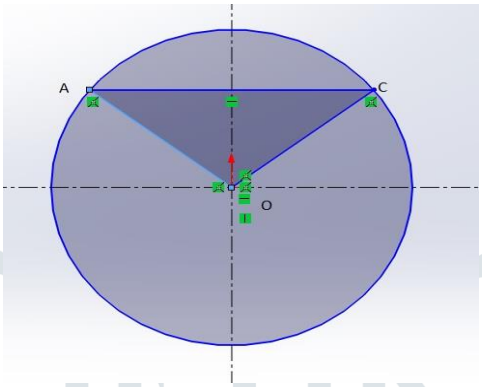

Fig.3 Geometry

Cos Ø =r/2/2

Now,

A_w = arc ABCOA + Δ AOC

$A_w = \pi*r^2 ((360-2* Ø)/360) + 0.5*r* Cos Ø *r* Sin Ø$

On substituting the values,

$A_w = 2.3095*r^2$ …..2

From 1,

$2.3095*r^2 = 6.25*0.001$

R=52.02 mm.

On considering safety, R=55mm. Thus, D=110 mm.

Belt Conveyor Calculation

Taking standard width of belt as 400mm,

For the conveyor we are using Johnson motors with specifications

Speed=10 rpm, Torque=84 kg-cm; diameter as 30 mm.

Power developed by motor P = T*w

$P = 84/10*9.81*2* \pi *10/60$

P = 8.62 watt

Now, mass carrying capacity = density of plastics * volume carrying capacity (Q)

Now, the value of Q is given as Q = K * B^2 * v

K= 2.35*10^-4

Q = 2.35*10^-4* (0.9 *b-0.05)*15.7/1000

Q = 11.43 kg/hr

M=1360*11.43

Mass carrying capacity = 5.606 kg/hr

The maximum lift that can be used to carry the mass is given by,

$$P = C*L*3.5/1000$$

Where C is mass carrying capacity

On substituting the values, L = 0.45 m

But for safety we take L=0.4 m

The length of chain drive is given as Length = L/Sin (inclination angle)*2 +(diameter* π*2)

$$\text{Length} = 0.4/\text{Sin } 30^{o} *2 + 40 * 2* \pi$$

$$\text{Length} = 1788.2 \text{ mm}$$

IV. Literature Review

Design And Fabrication Of River Cleaning Machine Sheikh Md Shahid Md Rafique1, Dr. Akash Langde[2017] 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. The purpose of water wheel is to move the machine forward or backward on water. Motor is used to rotate the water wheel with the help of chain drive mechanism.

Mr. P. M. Sirsat, Dr. I. A. Khan, Mr. P. V. Jadhav, Mr. P.T. Date Design and fabrication of River Waste Cleaning Machine [2] This paper emphasis on design and fabrication details of the river waste cleaning machine. 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.

Anna Grincova, Miriam Andrejiova, Daniela Marasova, Samer Khouri (2018) [3] They studied and carried measurement and determination of the Absorbed Impact Energy for Conveyor Belts of Various Structures under Impact Loading. The effect of impact loading at the transfer point is often manifested by mechanical damage to a conveyor belt. To describe the phenomena related to the conveyor belt damage caused by the impact of the material, it is important to monitor the amount of the absorbed impact energy. Therefore, the focus of the present article is on the identification of the effect of the conveyor belt's structure (textile or steel conveyor belt carcass), as well as the strength, the material's drop height and the drop weight on the relative amount of impact energy absorbed by a conveyor belt.

1Mohammed Rafeeq, 2Ateequrahman, 3Sanjar Alam, 4Mikdad 1-4Department of Electronics and Communication Engineering [2016] When the waste is segregated into basic streams. The metallic waste could be reused or recycled. Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the waste [3]. The occupational hazard for waste workers is reduced. Also, the segregated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant then to the recycling plant. Currently there is no system of segregation of glass, plastic and metallic wastes at an industry. J.S. Bajaj has suggested that a least cost, most appropriate technological option for safe management should be developed. The purpose of this project is the realization of a compact, low cost and user friendly segregation system for urban households to streamline the waste management process.

V. Conclusion

Thus our project attempts to minimise human intervention in surface water cleaning. When the device is completed, small water bodies such as lakes, ponds, small river can be cleaned where huge cleaning machines cannot be reached.Also the plastic segregation makes it more time efficient and that plastic can be recycled. We can also replace battery with solar panels and make it completely work on solar energy. The product right now is manually controlled but through automation techniques

such as remote controlled technology, it can be made self-automated. With better advancements, variety of objects that can be segregated can be increased.

VI. REFRENCES

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