DRISHTI

A Revolutionary Concept

LAKE CLEANER

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AIM OF THE PROJECT:

The main aim of the project is to clean the polluting water bodies with the help of a cleaning bot which is controlled wirelessly and further can be made autonomous.

The bot has to perform the functions of collecting the solid trash present in the water bodies like plastic bags,plastic bottles,small objects,etc… Further it should also be able to cut the small plants and weeds growing on the water surface and also collect them in the trash pit. After this process, it should empty this trash into a disposable pit.

MOTIVATION:

Nowadays, a lot of manual labour is being is employed in the cleaning of the rivers, lake and other local water bodies. A large amount of time and money is wasted by the government in this task to reduce the river contamination.

Hence to provide a Technical Solution for a Time and Cost Effective method to reduce the manual labour, we thought of making an automatic bot which can efficiently do all the chores in less time. This is the basic motive behind our “River Cleaning Bot”.

DESIGNING SOFTWARE USED:

SolidWorks

ANALYSIS SOFTWARE USED:

Ansys

WORKING PRINCIPLE:

The different mechanisms used in the different parts of the bot are as follows:

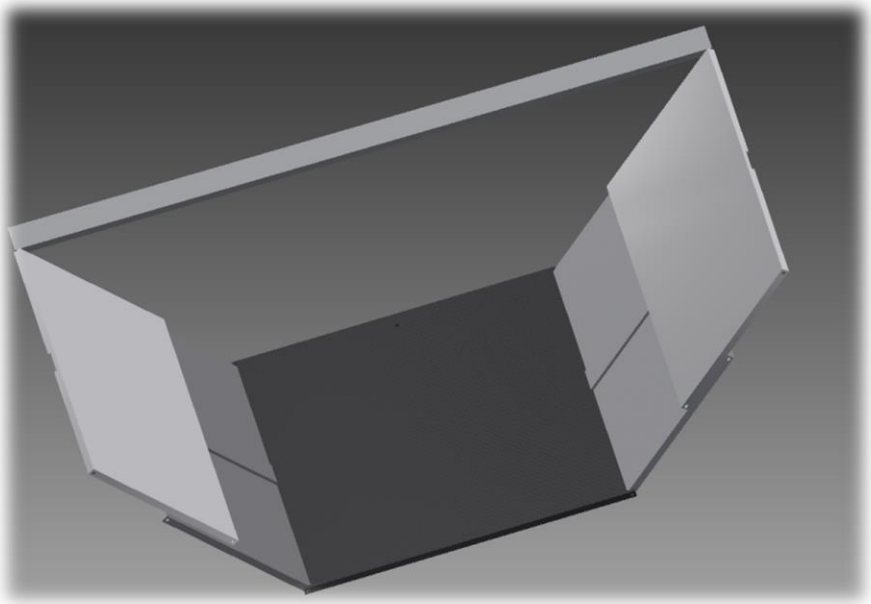
(A) Trash Collection Mechanisms:

(i) PNEUMATICS:

Pneumatics is a type of linear actuator which uses air pressure as the actuating force.

We thought of using the pneumatics to lift the collecting plates to a certain level and we would use four link mechanism to lift this whole assembly to dump this collected trash in our dumper container.

We made a SolidWorks Model for our mechanism and manufactured it.



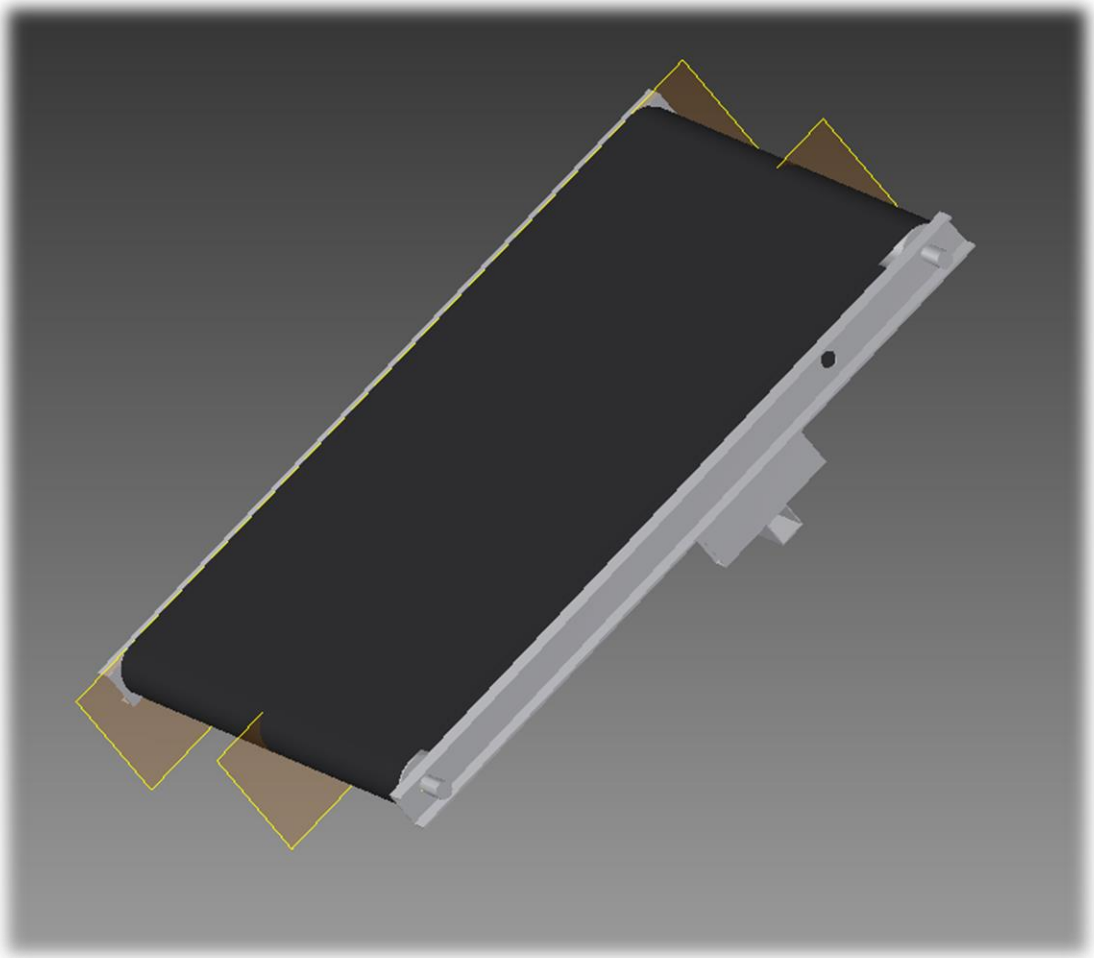
Errors in the Mechanism:

1) The air pressure was not able to bear enough weight. Appropriate amount of the air pressure required was not being generated in the cylinders. This reduced the amount of garbage that the bot can carry at a time.
2) The air pressure in the cylinder would reduce at a faster rate. So while in operation, the cylinders will have to be refilled many times in quick succession. This will increase the cost of operation and also it is not feasible to again and again fill the cylinders.
3) We would have to install a pressure regulator to maintain the air pressure at a constant value.

So, we had to switch over to some other alternative mechanism.

(ii) CONVEYER BELT MECHANISM:

This mechanism uses a Conveyer belt to collect the solid waste from the water body and transfer it to our dumper container. The conveyer belt is mounted at an inclination to the chassis. As the cylinders over which the conveyer belt slides roll, the belt moves in the anti- clockwise direction so that the solid waste gets stuck in the projections made in the conveyer belt. Just below the conveyer belt assembly is kept our dumper container. When the dumper is full, our four link mechanism lifts this dumper and disposes off trash out of the bot on the ground.

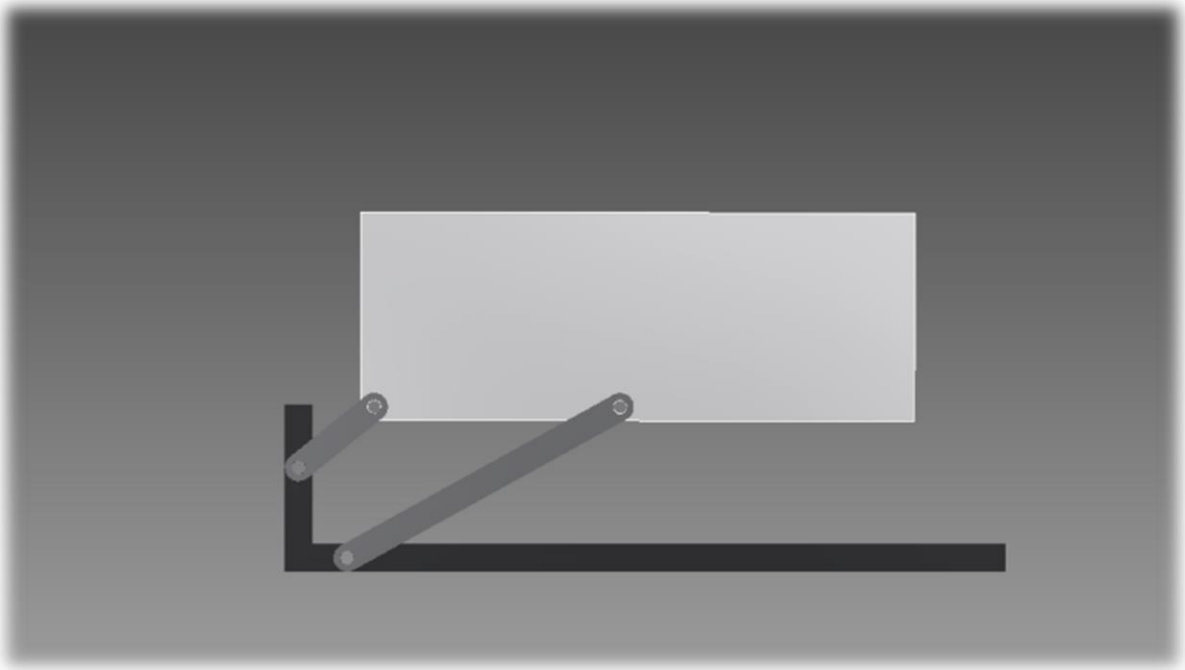


(B) Dumper Lifting Mechanisms:

(i) FOUR LINK MECHANISM:

We thought of various designs by the help of which we can lift the dumper upto such an elevation so that the trash can fall on the ground without any trash being left inside the dumper.

Our main aim was to give minimum rotation to the driver link and get maximum inclination of the dumper.



We finally arrived at the above design. Here the Inclination we get is the maximum.

(ii) LEAD SCREW MECHANISM:

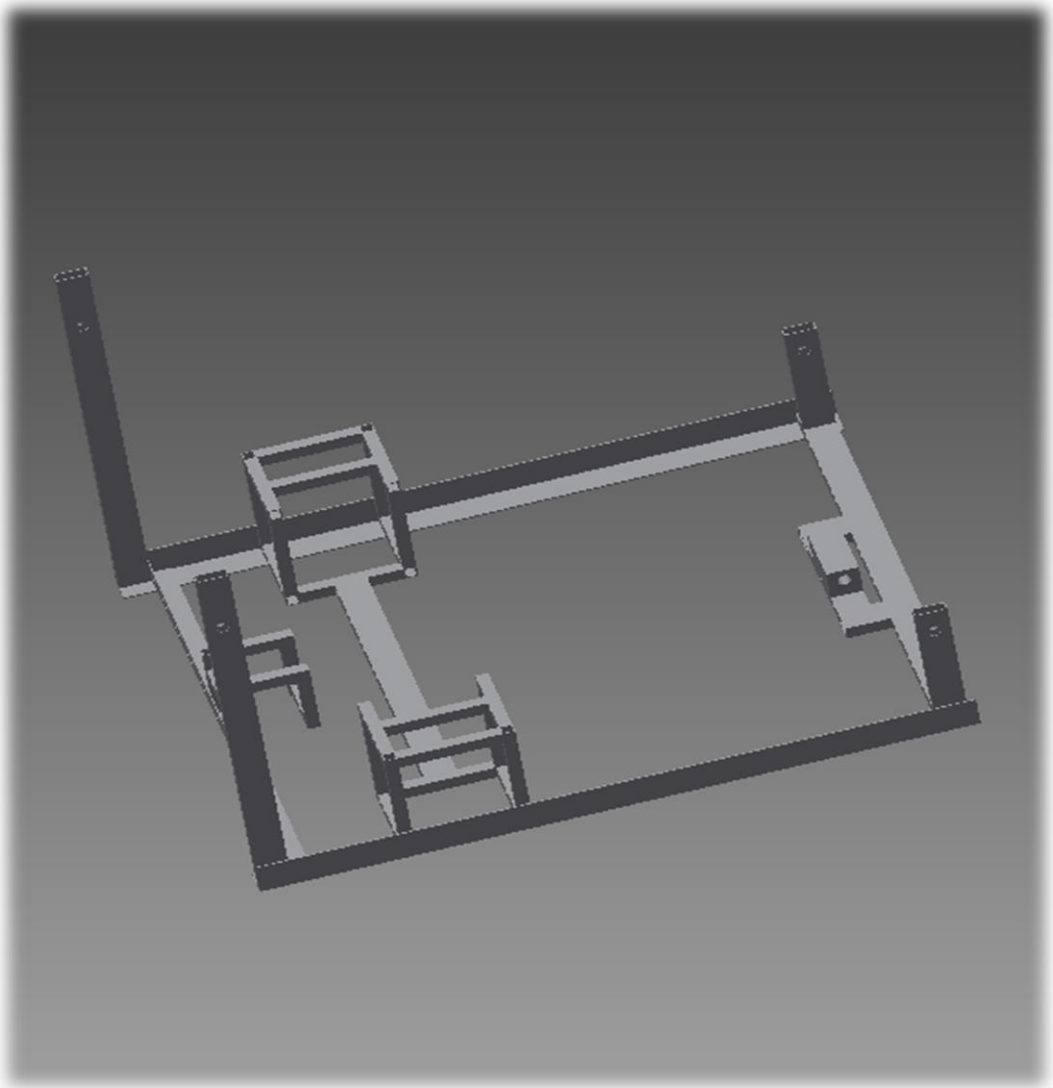
We are using a lead screw arrangement for the lifting of the dumper. The lead screw arrangement works as a linear actuator in our case.

We mount the lead screw onto the chassis of the bot. The nut traverses on the lead screw and pushes the dumper along with it.

So basically, there is one fixed link, two movable links and a lead screw. This completes our mechanism for the lifting of dumper container.

(C) CHASSIS:

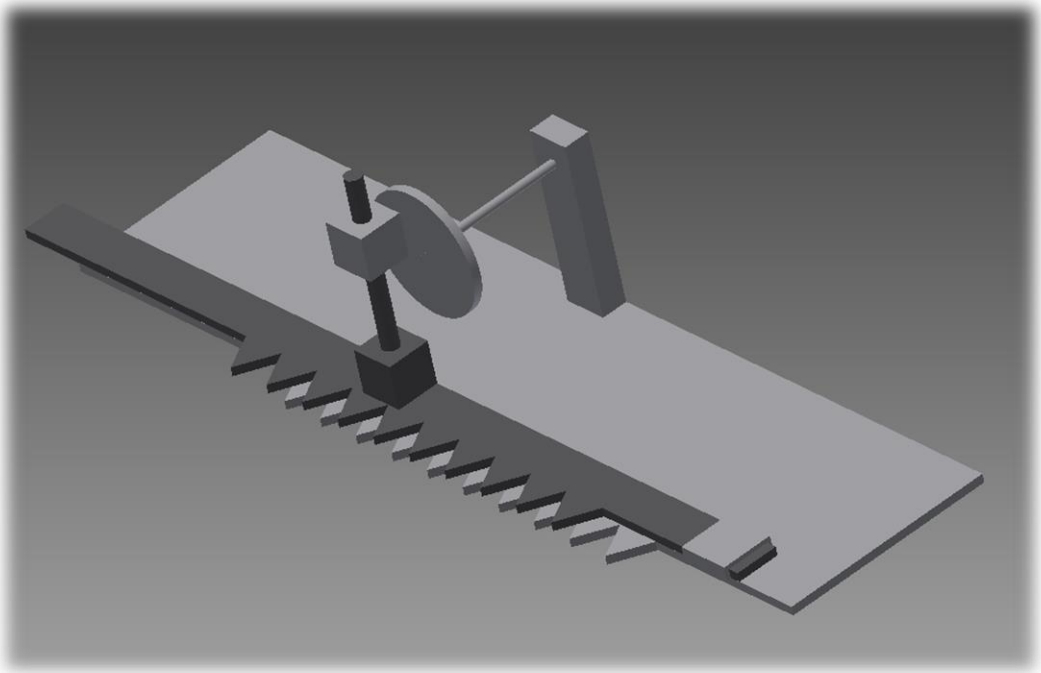
The chassis is designed so as to accommodate the wheels mountings, conveyer belt mechanism mounting, four link mechanism mounting and finally the chassis should sustain the weight of the (garbage + self-weight).



(D) WEED CUTTING MECHANISM:

We thought about two types of cutting/ shearing mechanisms which are :

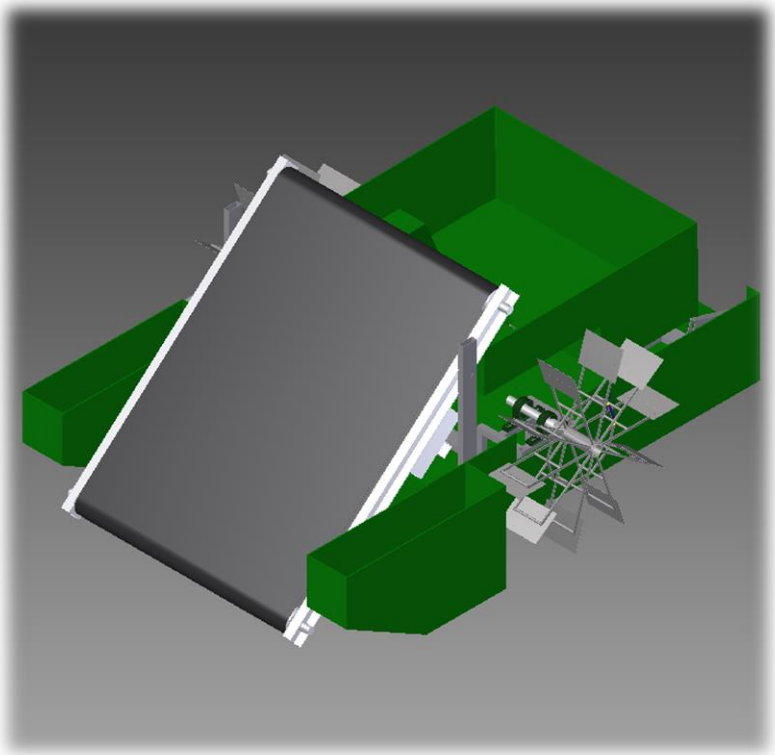
(i) Reciprocating Type Cutter

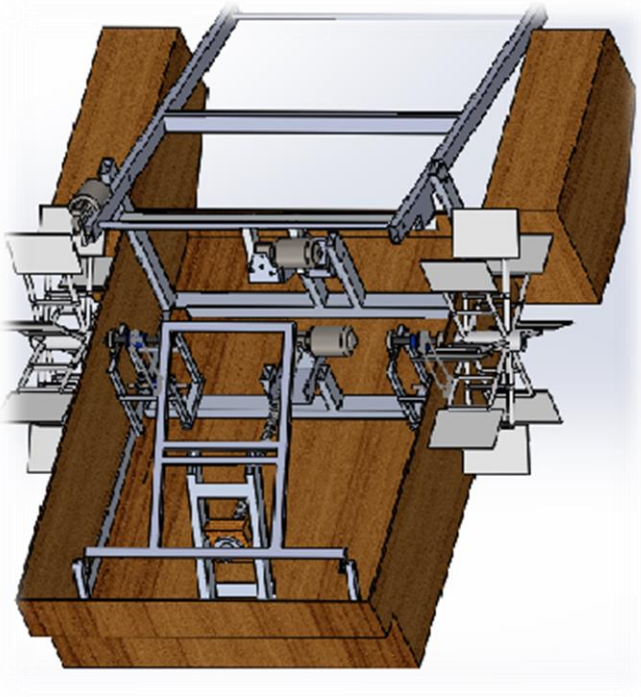


(ii) Rotating Type Cutter

In which the cutter roates and cuts the plants. The whole assembly is mounted on the arm which will have three degrees of freedom. By use of the arm we can adjust the depth of the cutter inside the water so that the cutting can be done at different depth.

CAD DESIGNS:





MANUFACTURING:

Materials Used:

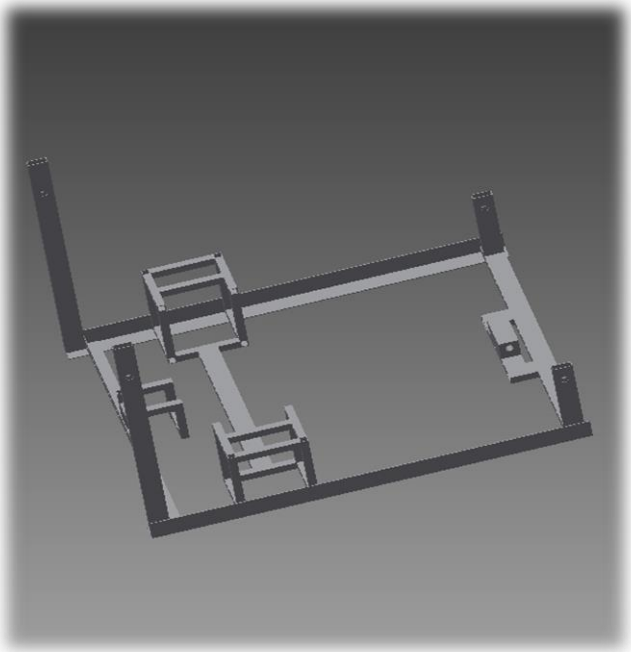
- Aluminium Sheets, Aluminium Box Sections
- Teak Wood
- Plywood
- FRP(For Body)
- Stainless Steel(For Propellers)

Motors Used:

- Viper Motors (100 kgcm , 50 rpm)

CHASSIS:

The Chassis Design is as shown below:



LEAD SCREWS:

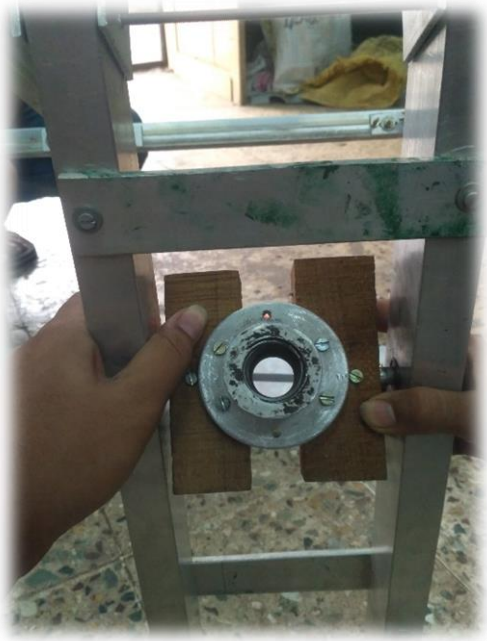
The motor mountings for the Lead Screws were manufactured with aluminium. Two of these were made. One for the garbage dumper and other for the adjustment of the inclination of the conveyer belt in the water.

The pillars for the hinging of the lead screw were also made and fixed exactly at the center of the middle link.

The problems faced with this was that:-

- The lead screw was wobbling very much even after properly connecting the coupler. We made the whole motor mounting twice but still the lead screw was wobbling about its axis. Due to this, the lead screw could not properly propagate on the nut and whole assembly was encountering jerks again and again. After checking each and every component in the mounting, we finally found that the coupler was not perfect. The holes which were connecting the lead screw with the coupler were not straight. Hence we made new holes and thus the problem was solved.
- The holes in the two pillars for hinging had to be exactly co-axial.

- The extension of the lead screw was hitting the bot as it was progressing further. Also the height of hinging was decided on the factor that the extension of the screw should not hit the bot. We had to cut some portion of the screw to reduce its length.



WHEELS:

We cut cylindrical hollow rods of lengths 95cms and 230cms from long steel rods. Also 20 aluminium plates were cut. These were welded in the desired orientation to make the wheels which were finally coupled with the motor to make things work. The shape of the wheels is shown below.

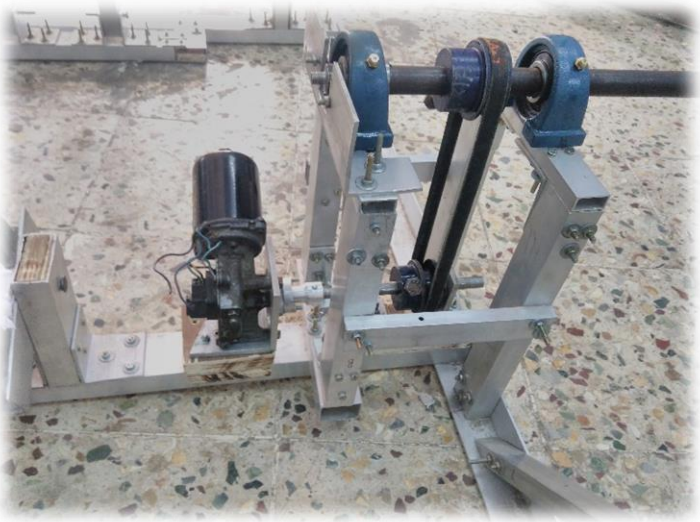
We welded the wheels by Electric Arc Welding Machine.

The motor was mounted on the base of the bot itself because it would be difficult to mount the motor in air as then the clamp would have to bear high

load to hold it. The motor was connected to a pulley which would transfer the power to the axis of the wheel through a belt-drive pulley system.

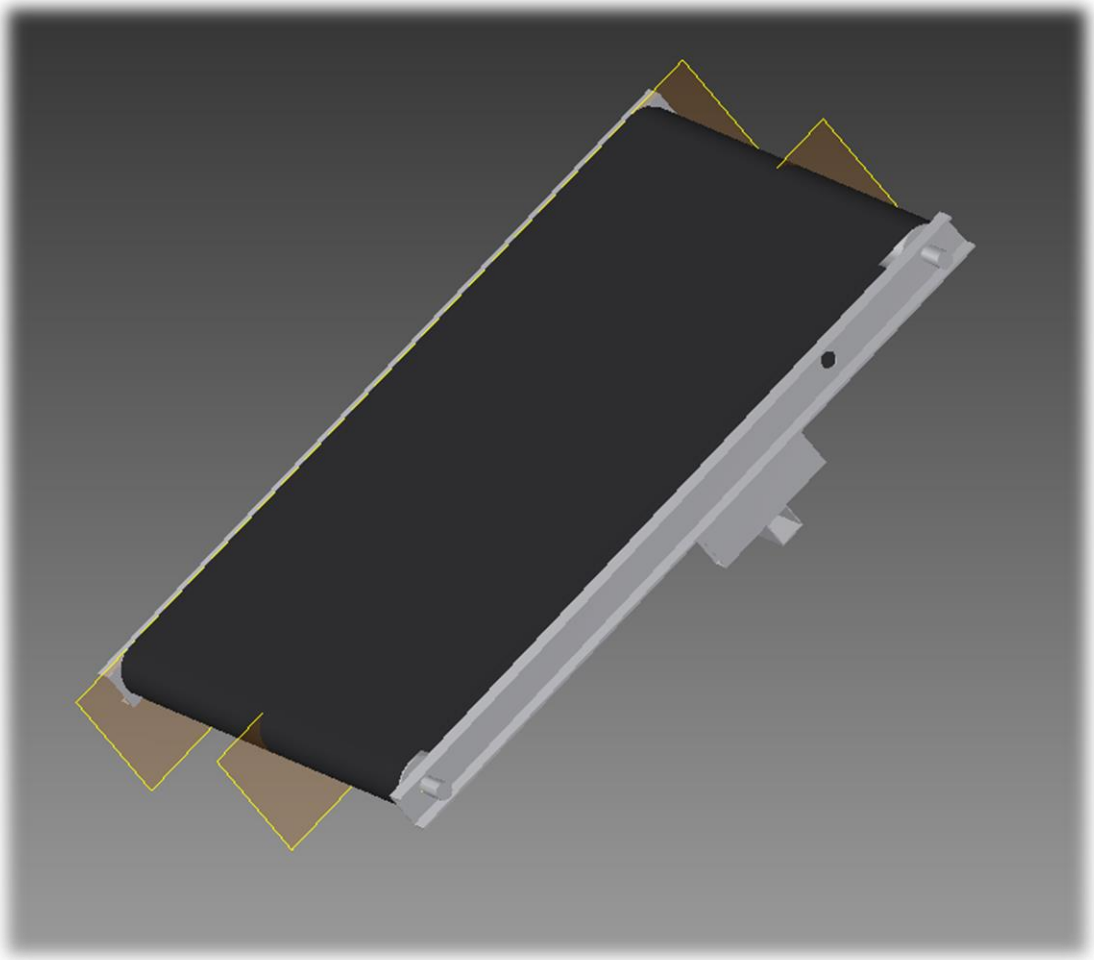
The problems faced with this was that:-

- The frame for the assembly of the wheels with the bot was to be made very precisely such that that the two parts should be paralle to eah other otherwise the axis would not be exactly straight. Hence we had to fix this frame by taking proper measurements from both sides.
- This required very much trial and error as we had to decide the distance between the wheel axis and motor axis such that the pulley belt would neither be very much tight nor be loose. For this we had to provide supports of 12mm and 8mm plywoods at the base.
- The pedestal bearings were fitted on the top of the frame from which the axis of the wheel would pass. These bearings should be exactly collinear and axial otherwise the wheel motor would have to bear much load and the axis of the wheels may break.
- The small bearings were to be fitted in the clamps through which the motor axis were to pass. We had a hole saw of 30mm and the bearings were of 31.5mm. So we had to enlarge the hole by drill machine or file in order to fit the bearings. This task took very long as we had to do this four times.
- We also had to make a Jig as per our wheels dimensions so that we could do welding easily and in proper orientation. We had to maintain a very low current of 33A to do the welding as the S.S. would melt at higher current. The welding took about 3-4 days.



CONVEYER BELT:

The design of the Conveyer belt assembly is shown below.



The frame over which the conveyer belt would be placed was made from aluminium box sections. Here also co-axial holes were made to hinge this.

The conveyer belt is made up of a wire mesh so that while collecting the garbage, water which also will come up will be drained through this mesh and only garbage will be transported to the dumper.

The wire mesh would be laid over a frame made by the chain of bicycle and rim spokes which we had made. This would run over four (two on each side) sprockets (free-wheels used in bicycles over which the chain runs over).Now we had to also think about how to complete this assembly.

The problems faced with this was that:-

- The mounting of the motor required for the motion of the conveyer belt was difficult as it would at some elevation from the base of the bot at some height in air. We finally thought of a way to make a strong base for the motor by inserting multiple plates outside the box section at the location where motor was to be mounted. Thus the strength of the part became considerably good and the overall thickness of the section was also increased. Hence the motor could easily be mounted such that the coupler was also accommodated.
- The chain assembly posed a very big problem. Upon testing we found that the the chain would frequently disengage from the sprocket and thus would stop the the movement of chain. So we adjusted the distance between the left and right chain assembly and also made sure that the two individual chain assemblies are parallel to each other. We also welded the sprockets to the shaft at the proper distance.
- The small bearings were to be fitted in the plates through which the motor axis were to pass. We had a hole saw of 30mm and the bearings were of 31.5mm. So we had to enlarge the hole by drill machine or file in order to fit the bearings. This task took very long as we had to do this four times.

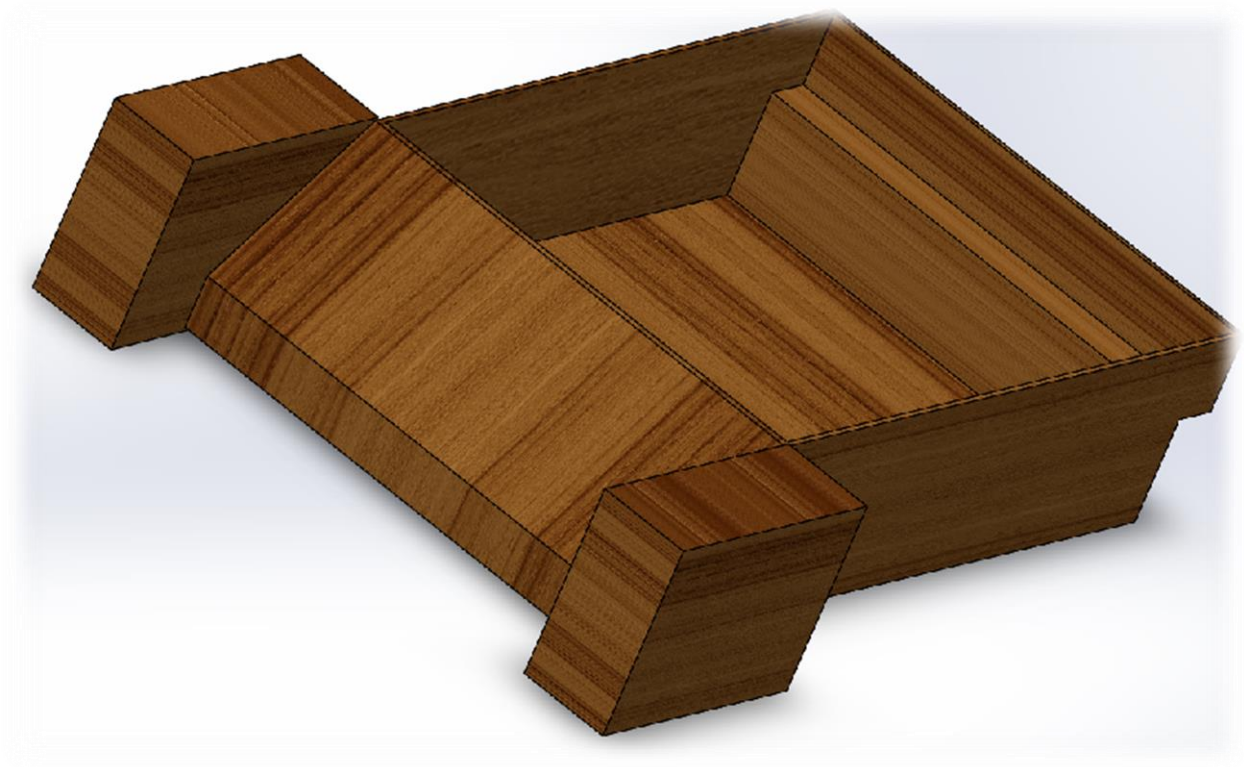
  We made a video of the conveyer belt testing. The link is given below:

  https://drive.google.com/open?id=1fzCtKUJaTC_JY0II-J_MTXBbZ5uP1NqD

BODY:

We made the body of the whole bot inside which the bot will be placed to protect it from water.

We made this box from plywood and then coated it with FRP (Fibre Reinforced Plastic). The purpose of using the FRP was to insulate the plywood from water and provide the strength to the structure. The CAD model as well as the actual prepared part is shown below in the figure.



We had to provide two separate structures as you can see at the front part of the bot. The C.G. of our bot was coming out to be at the front side of the bot. These were made hollow from inside and the main purpose of these were to provide buoyancy to the bot to keep it from drowning from the front portion.

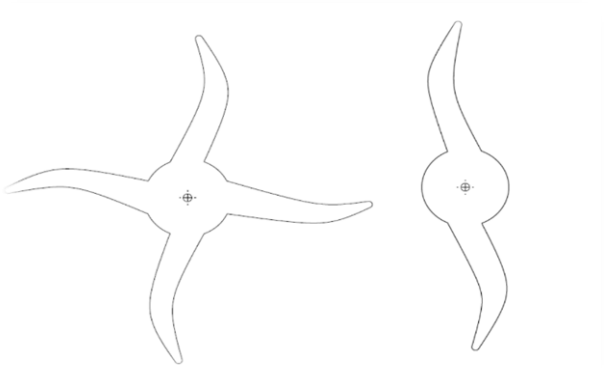
We had to provide two coatings of FRP on the edges so as to seal the edges completely and prevent entry of water into the bot.

CUTTING MECHANISM:

After thinking about both the designs of the cutter – rotating type and reciprocating type ; we made prototypes of both types with tin sheets and plywood. We tested them and came to the conclusion that rotating type is more suitable. Ther ewer reasons to believe so:

1) For the same rpm of the motor, we could get more efficiency from the rotating type cutter.
2) The shearing effect was more prominent in the rotating type.

So, we made the blades for the cutter from thick steel plates in the desired shapes.



After cutting we sharpened their edges so that they would cut more easily at high speeds. Then we polished their surfaces by the help of grinding blade. The finally prepared blades are in the figure shown below.

FINAL BOT:

FUTURE MODIFICATIONS:

- We can also devise a mechanism to remove oil and dirt from the water which can help stabilize the ecosystem of the aquatic lives.

- To be able to distinguish between obstacles and boundaries and the garbage the robot has to clean and pick up.
- To be able to execute driving successfully on water surface.

RESULT:

The bot was working properly.