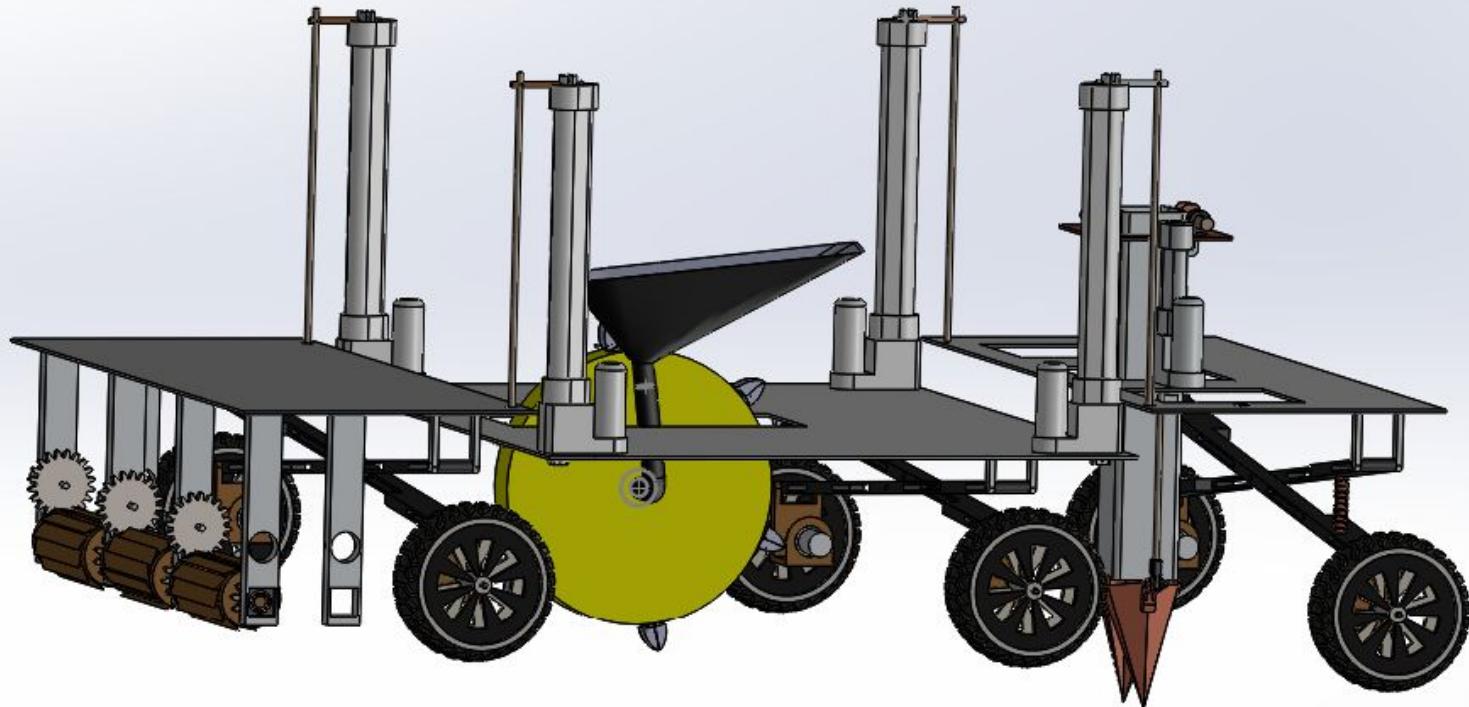


Inter-IIT Tech Meet '21



AgroBot Design Innovation Challenge
Team No. 14

Agrobot 2021 Team no .14



Carrier Bot:

Tasks:



Climbing the
steps for terrace
farming

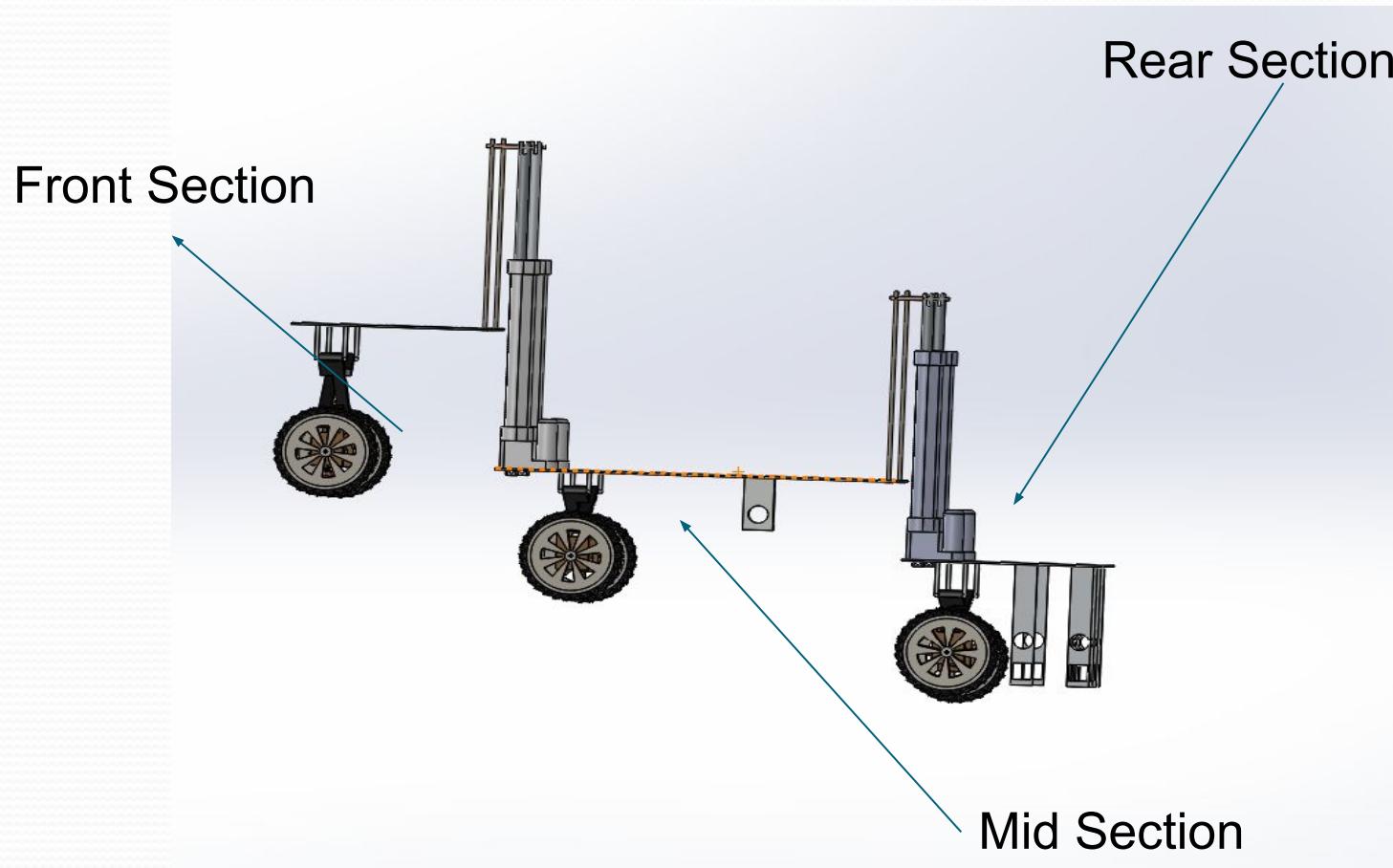


Moving on
uneven surfaces

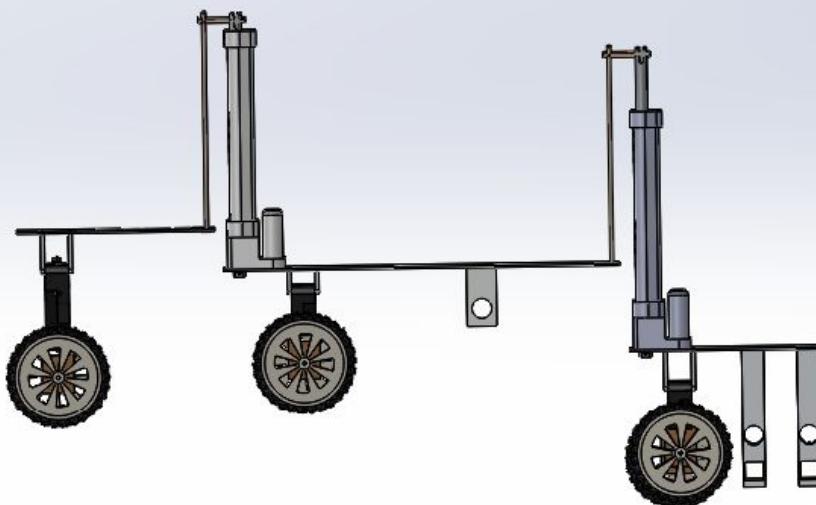


Carrying load
of whole
assembly

Climbing mechanism:



Climbing mechanism:

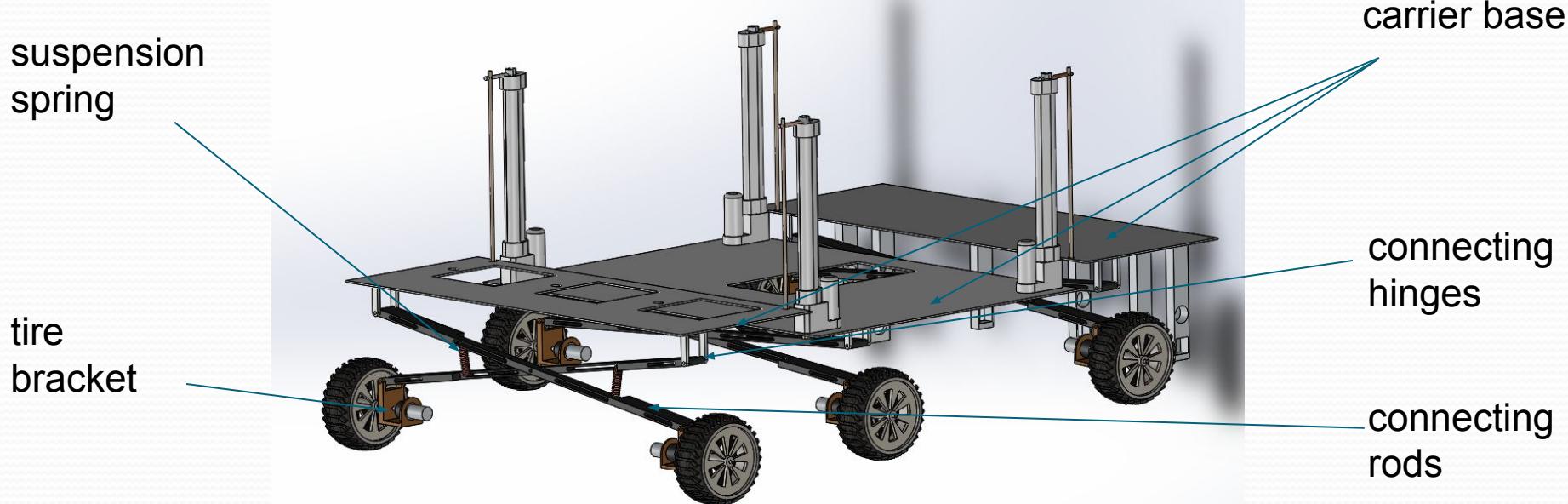


Climbing the steps for terrace farming:

The bot is divided into three sections - Front, Mid and Rear. The sections are connected using Linear Actuator and connecting rod. A front section, which will be lifted and rest on the step. And then Front section will pull and the rear section will push the midsection up from the ground, using *Linear Actuator*. And then, the Rear section will be pulled up. So in this way, we have a minimum of four contact points on the ground all the time.

The Front section of the bot is detachable.

Moving on uneven surface:



For traction, better control and comfortable motion over an uneven surface, we have provided a suspension mechanism having two cross align rods allowed to rotate from both base & tires with two vertical springs attached over it to re-attend the desired equilibrium state.

Moving on Uneven Surface:

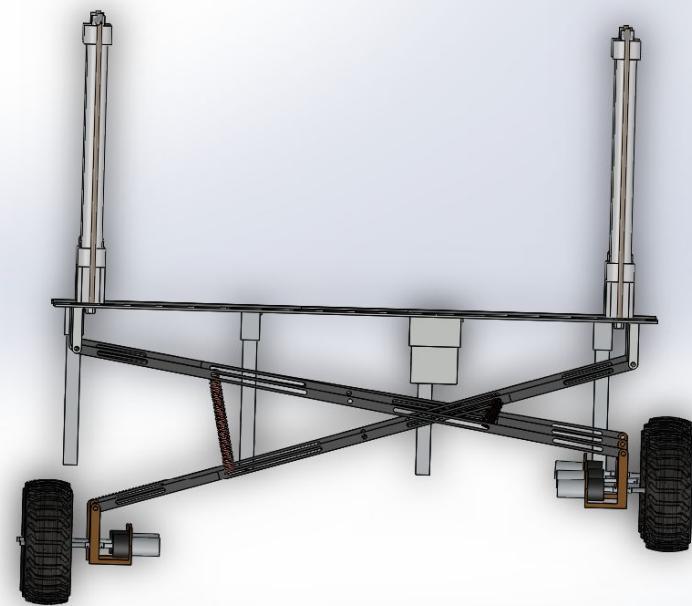
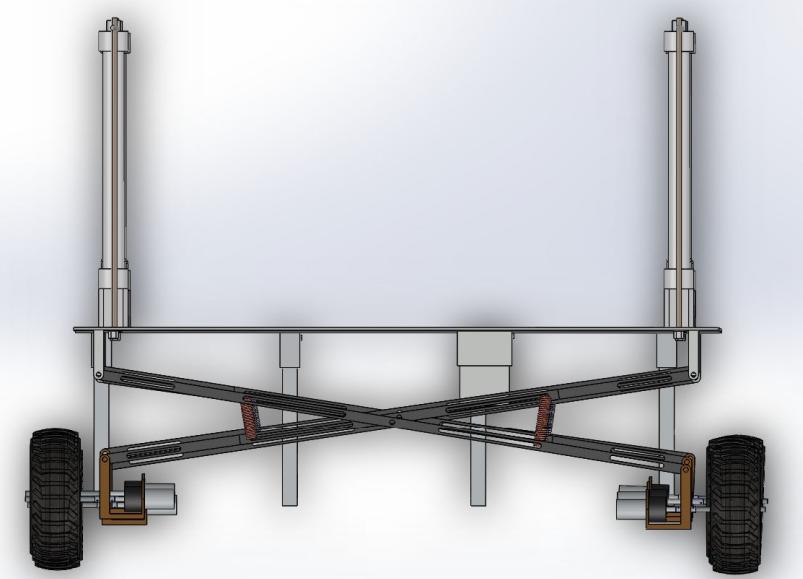
When any tire of bot comes in contact with some obstacles (holes, rocks, jumps, etc.), the distance between the centre of tire and surface of carrier base adjusts itself to maintain the contact between the ground and each tire.

- Then shock energy is absorbed in the spring connected to the rod between the tire bracket and carrier base.
- After some time springs release its energy to re-establish the equilibrium of bot.
- The connections between rod and carrier base or rod and tire bracket are allowed to rotate to keep tire and base parallel to the ground.

Hardware components required:

- Front,middle,back carrier base -
 $1235+3315+2730=7280$
- 4 (300mm,1500N,12V)linear actuator -
 $(5300*4)=21200/-$
- 6 Tire brackets, 6 Tires & 6 Rim - 7620 /-
- 6 Connecting rods - 2450 /-
- 6 Johnson Geared DC motors(100 rpm)
- $(439*6) = 2634 /-$
- 6 Connecting shaft & coupler - 390/-
- 6 Spring's - $626*6 = 3756/-$
- **Total cost - 45,330 /-**

Suspension mechanism

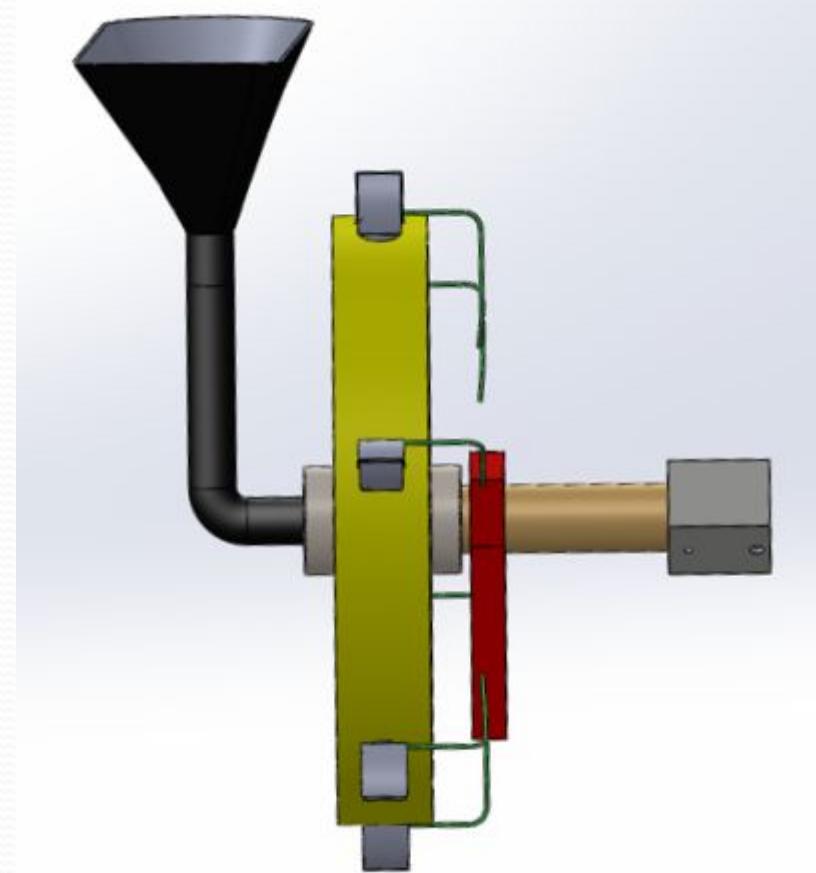
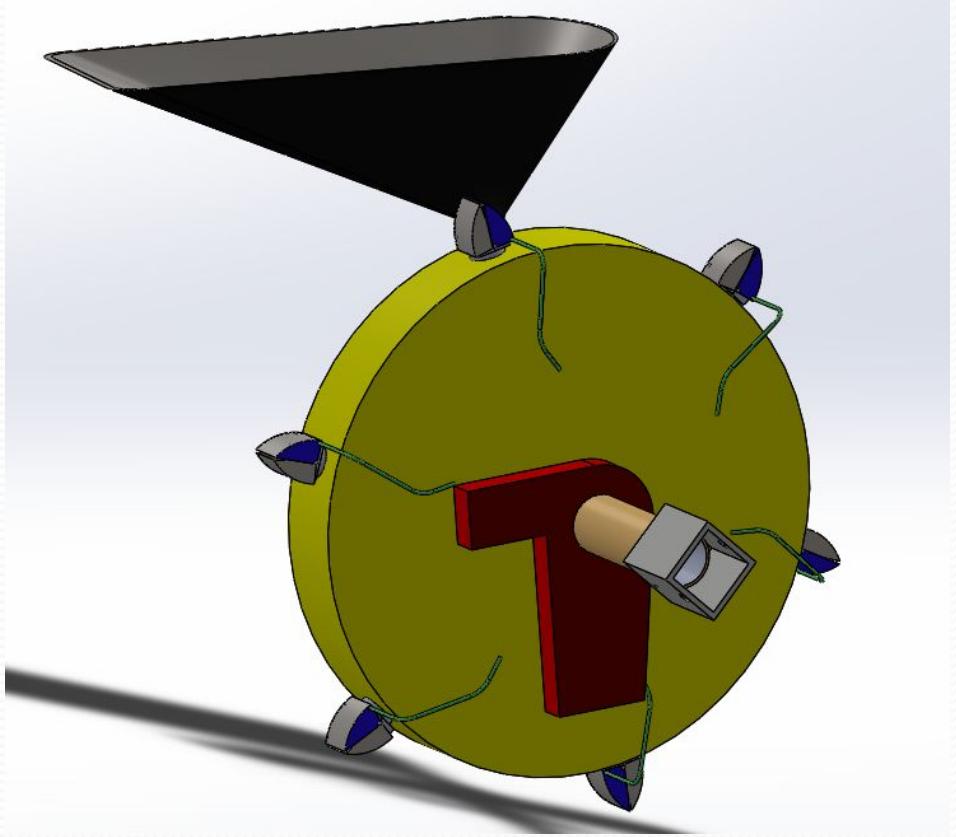


Seed Metering

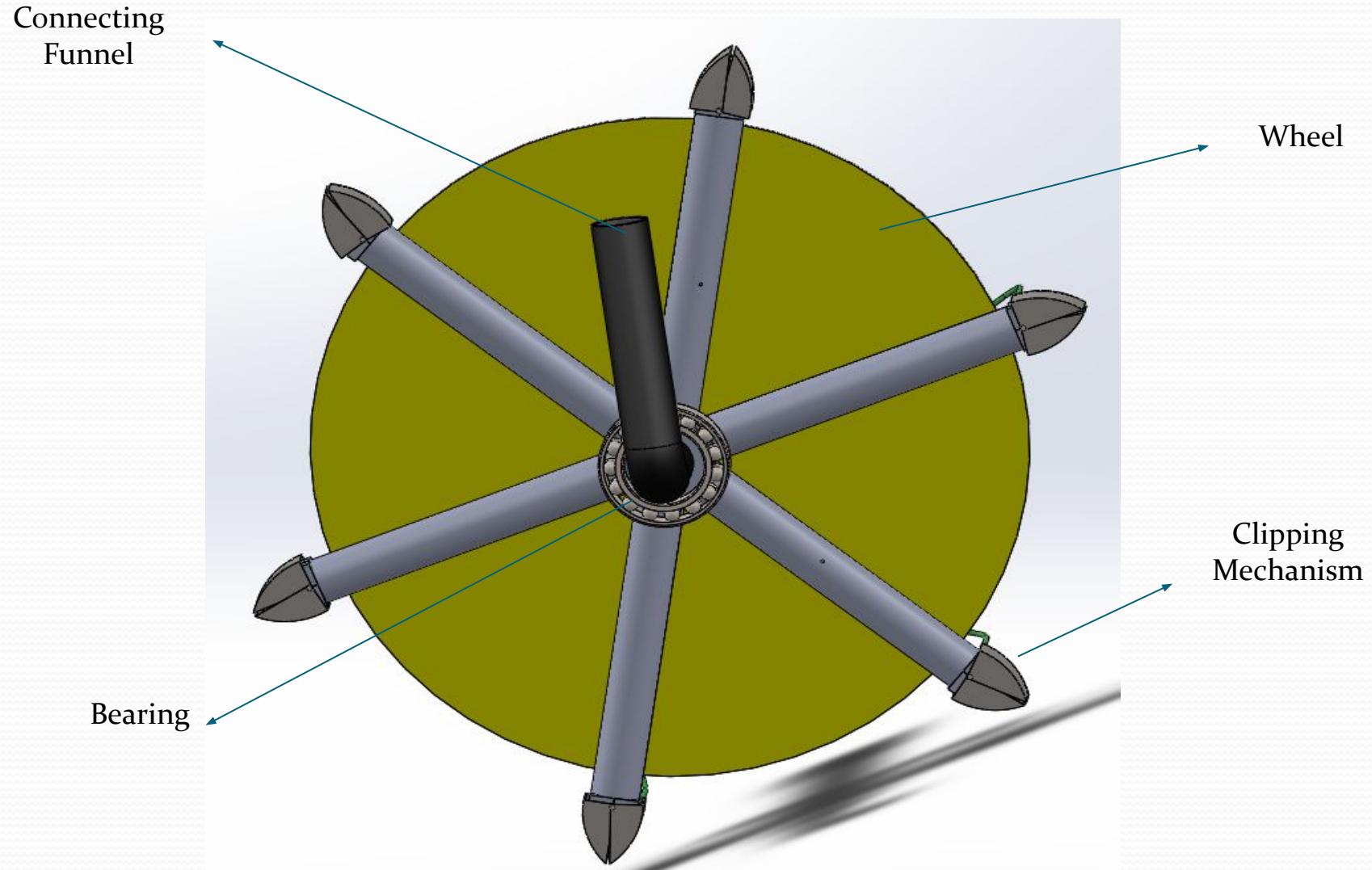
Seed Metering Mechanism:

The sowing of seeds is a crucial part of successful crop production. Conventional methods were not so effective. They cause uneven and irregularity in crops like a nutrition race among the densely sowed area, resulting in poor crop quality. This problem becomes severe in the case of uneven regions like hilly areas. So we made the efforts to provide an easy, optimised and cost-effective method which could eliminate all these problems.

Proposed design:



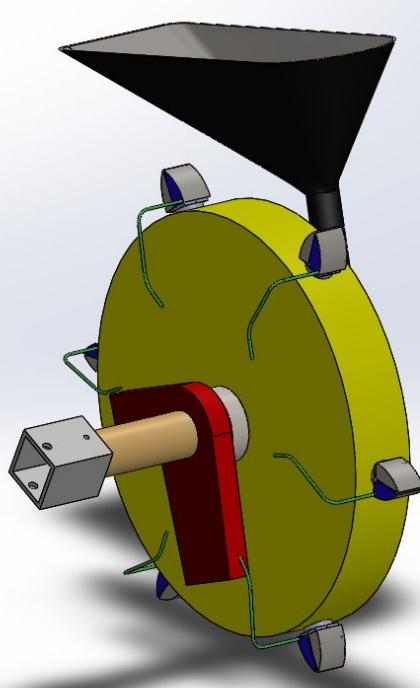
Sectioned view of the wheel:



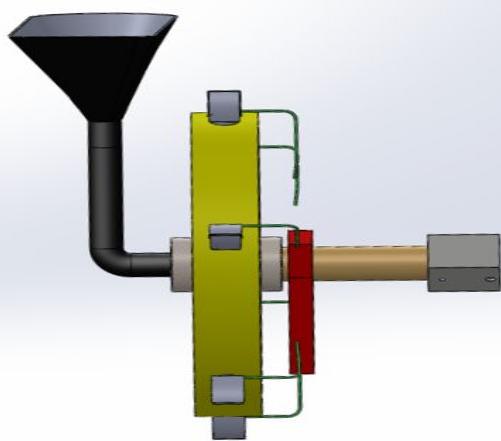
Mechanism:

- The seeding mechanism consists of a funnel/container through which seeds enter the wheel assembly center. The wheel consists of 6 pipes that connect to the center through which seeds slide down and sow in the ground. To ensure the proper interval between 2 successive seeds, we have arranged pipes in such a way that there is a perimetric gap of approximately 20 - 25 cm between 2 consecutive openings.
- At the tip, there is a spring mechanized protruded system that ensures seed only comes out when the opening of the pipe reaches the lowermost point. And the protruded part helps to sow the seed deep into the soil.

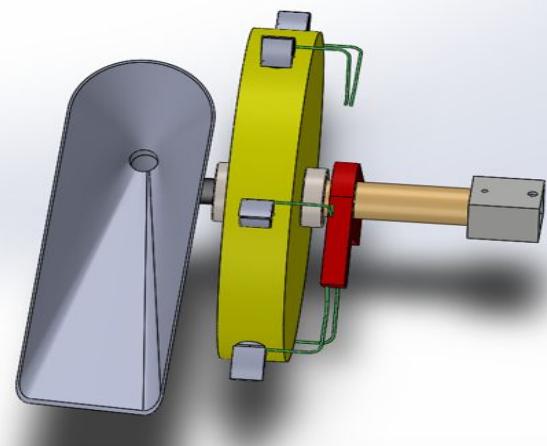
Side View



Front View



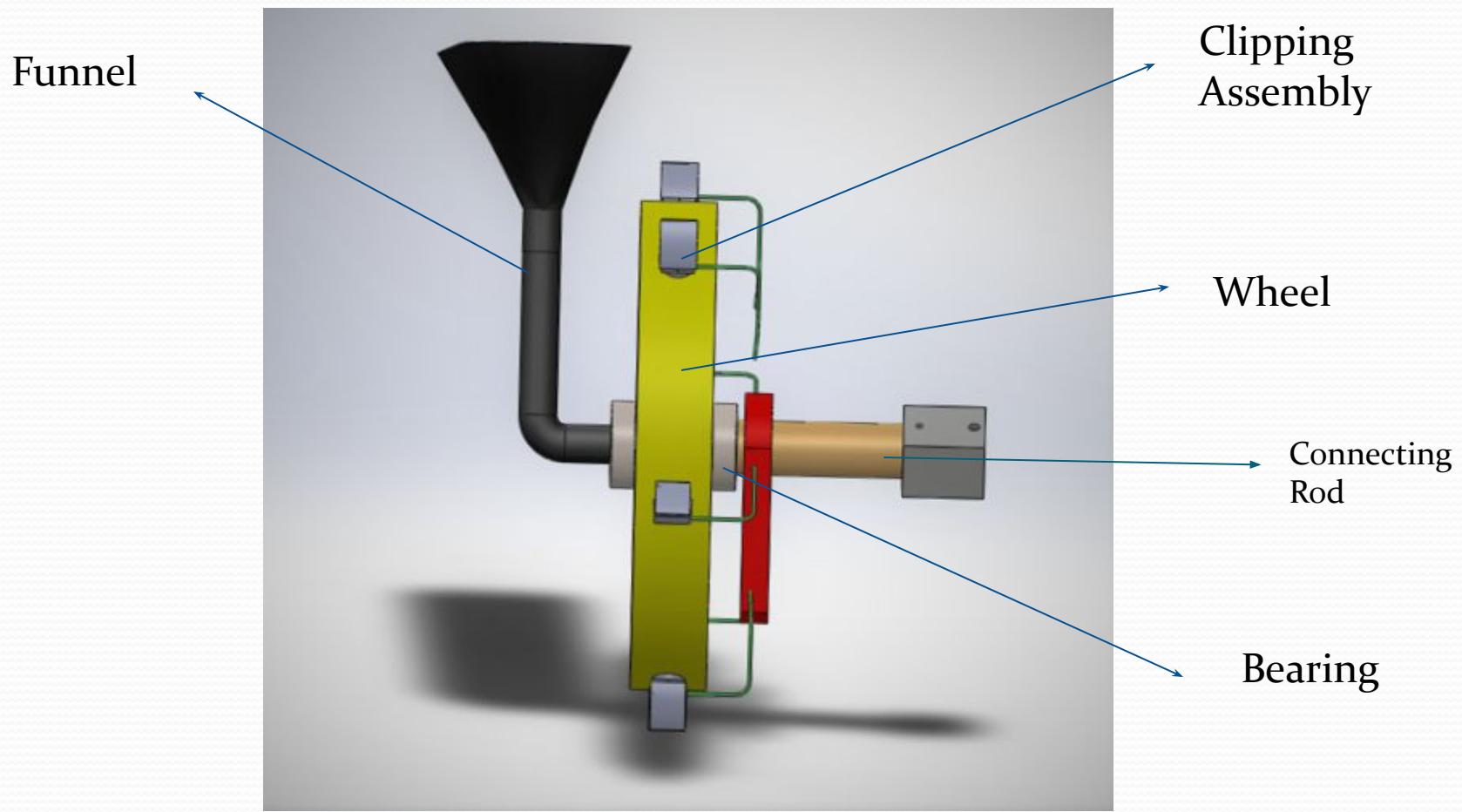
Top View



**Seed-Metering
Device
Model**

Hardware components required:

- Funnel/Container
- Steel pipes
- Center steel drum
- Clip Assembly
- Springs
- PVC Plastic wheel (in which all the assembly is done)
- Bearings
- Connecting pipes



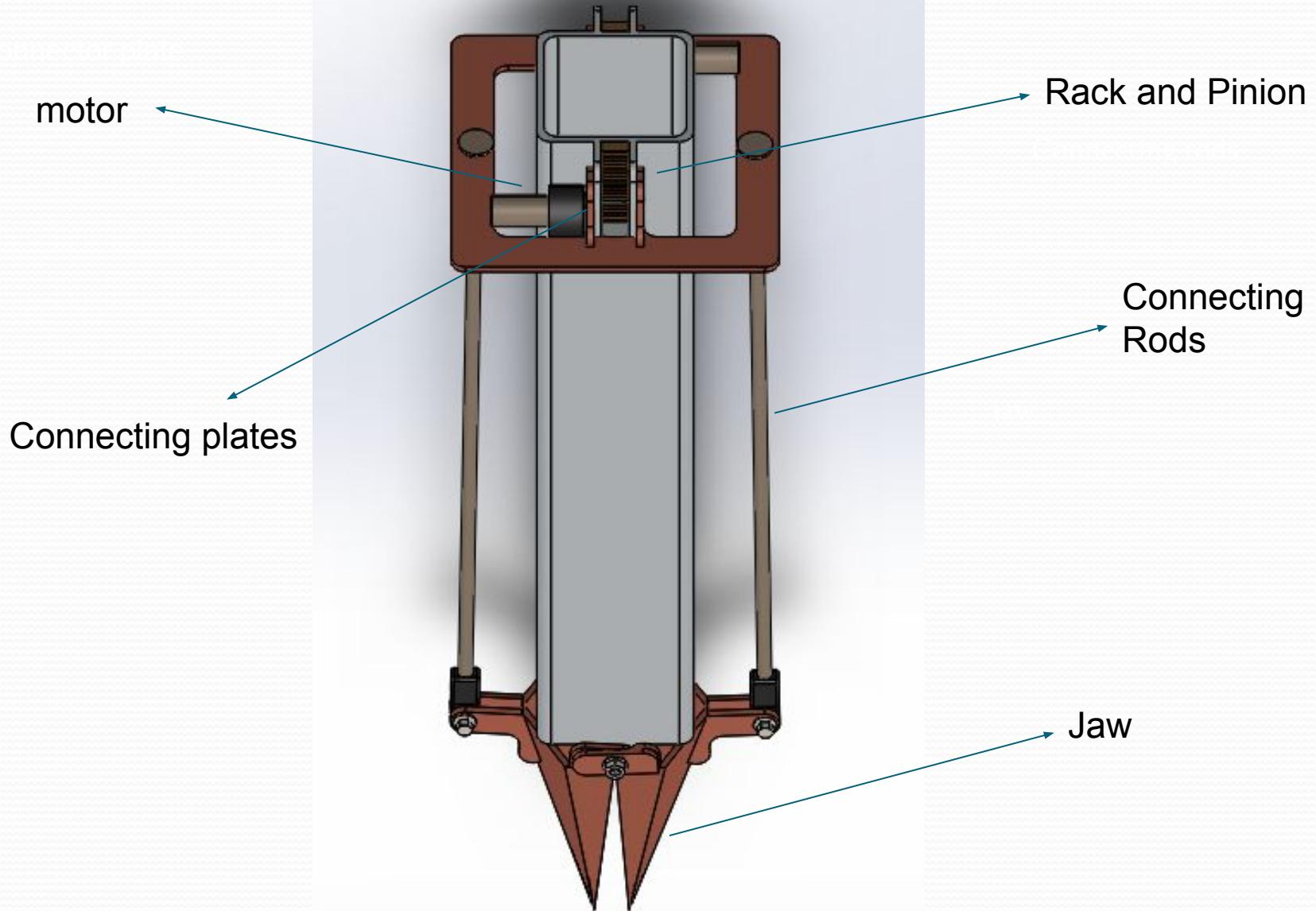
Cost of manufacturing:

- We are using AISI 1020 mild steel to manufacturing the component of the seed metering mechanism.
- The total weight of the assembly is 7kg, the cost of steel is Rs 65/- per Kg so the price of the steel is Rs 455/-
- The price of the pvc plastic is Rs 70/- per kg and we required 2 kg so the total price is Rs 140/-
- The price of two bearing $Rs\ 250*2 = Rs\ 500/-$
- linear actuator (100 mm 1500N 12V)= Rs 3900/-
- **The total price of manufacturing = Rs 4,995/-**

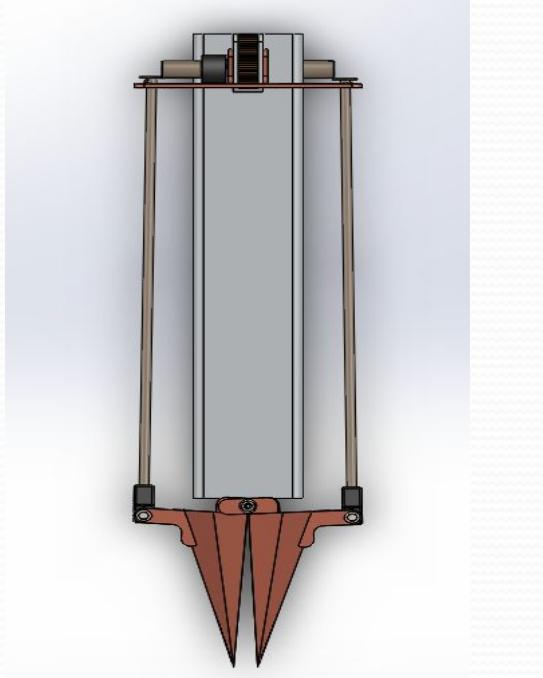
Transplantation

Transplantation

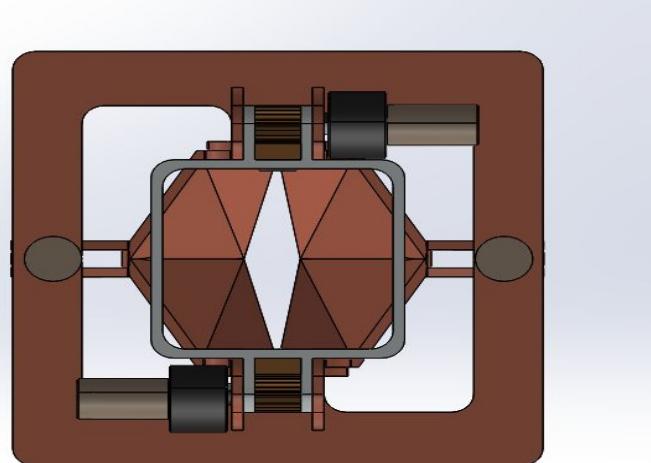
- The process of transplantation involves removing a plant from one location and replanting it at another, it is an extremely delicate and fragile process.
- So to make this process simple the mechanism with the help of rack and pinion is created.



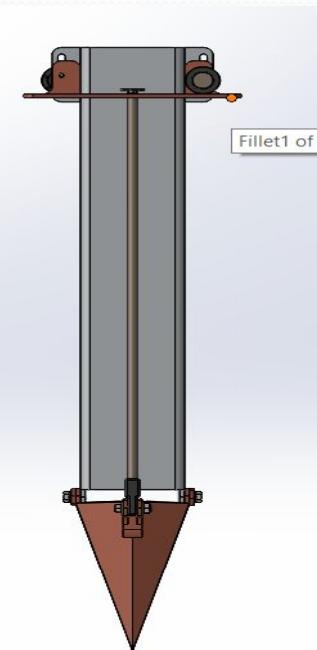
Front View



Top View



Right View



Mechanism:

With the help of a linear actuator, the whole mechanism move down and it will go down into the soil, where we want to plant the sapling. After that, the rack and pinion mechanism will move the connector plate up. Hence this will move the connecting rods up through which the jaw of assembly will open and sapling will go into the hole. After that, the linear actuator will move up to take out the assembly from the ground. The rack and pinion mechanism will move backward and close the jaw.

Cost of manufacturing

Transplantation mechanism:

We are using AISI 1018 mild steel to manufacturing the component of the transplantation mechanism.

The total weight of the assembly is 8kg, the cost of steel is Rs 65/- per Kg, so the price of the steel is Rs 520/-

The price of rack and pinion is Rs 800/-

Price of linear Actuator (100 mm stroke)= 3900

Total price = Rs 5,220/-

Maximum of 3 transplantation assembly can be used. This calculation is done for one transplantation assembly only.

WEED REMOVING TOOL

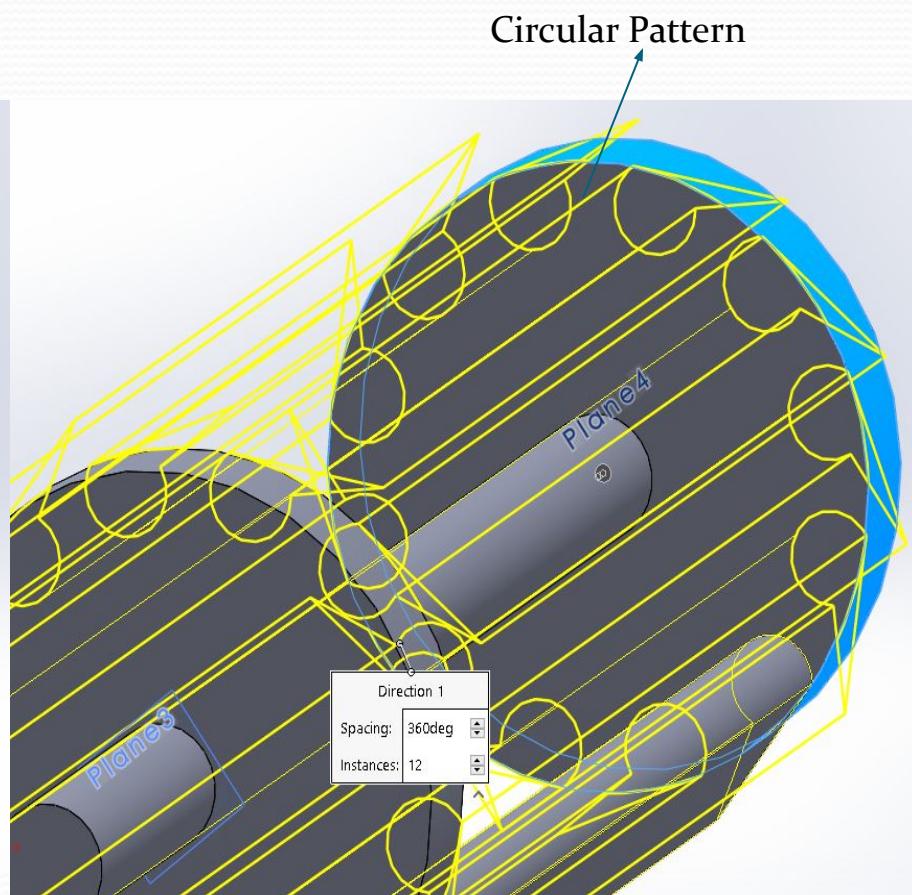
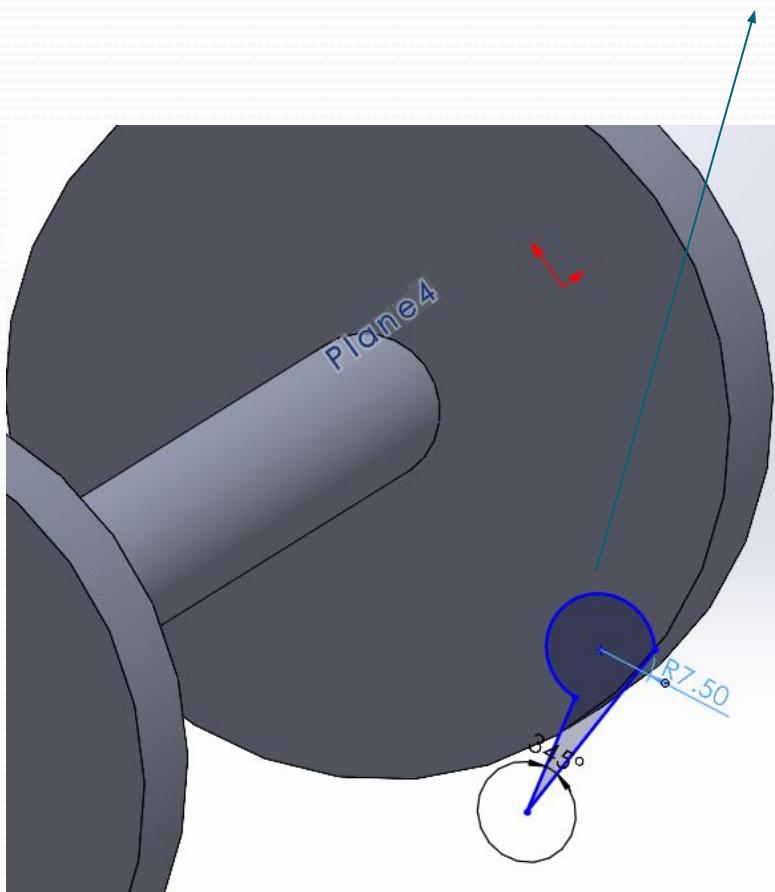
WORKING AND DESIGN DETAILS OF WEED REMOVER:

- The weed remover consists of 12 blades which are welded to a circular disc. The disc is mounted on a shaft which consists of gear and bearing.
- As the shaft rotates the blades rotates along with the shaft, then the blades penetrate through the soil thereby removing the weeds.

BLADES ARRANGEMENT:

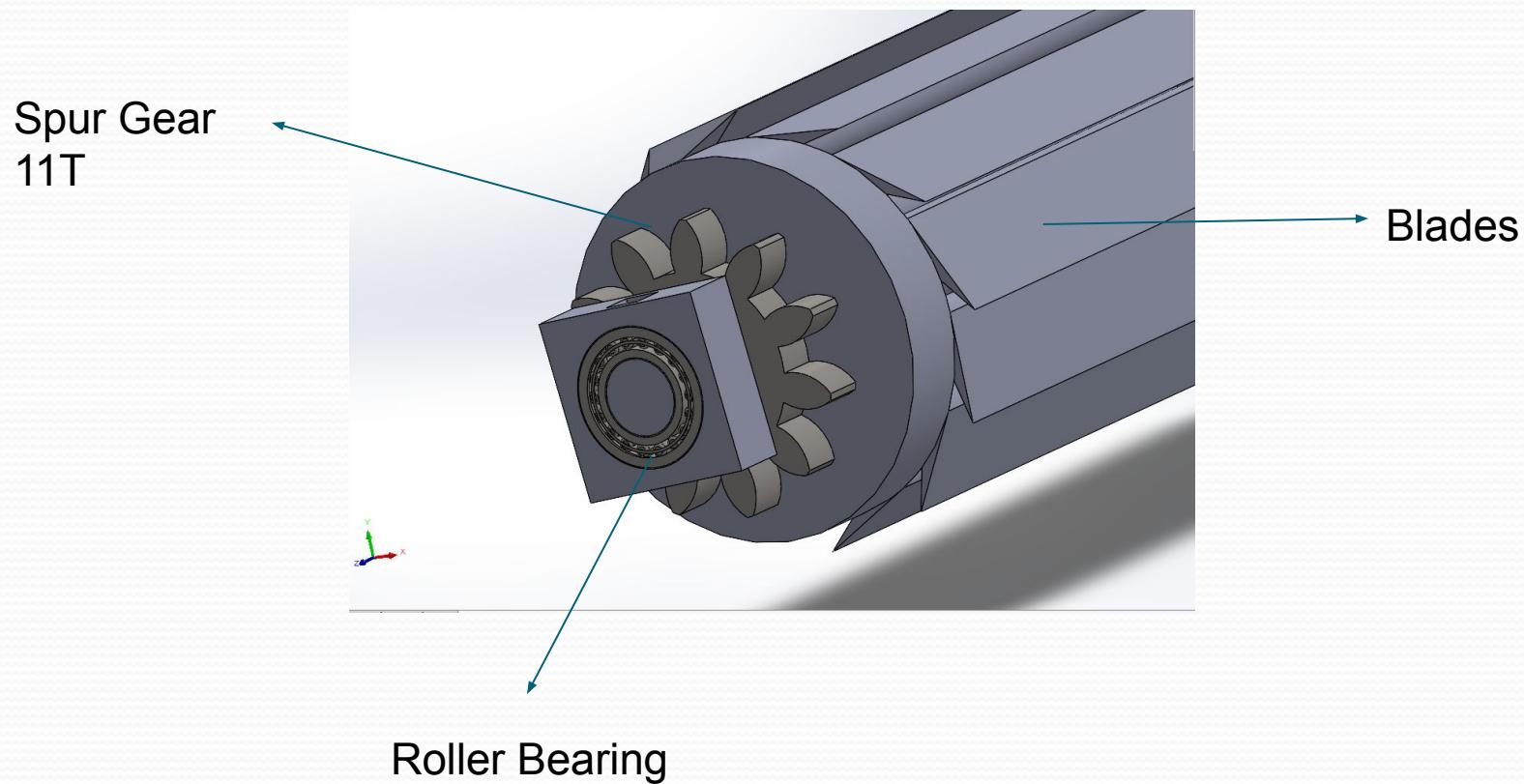
- The sharp corner of one blade lies directly below the end of the forward blade so that continual removal of the weeds along the field will be maintained. The blades are welded to disc through a circular arc surface whose radius(7.5 mm) is chosen optimally so that it is neither too low which reduces weld area nor too high which reduces free space in between blades. This free space is useful for movement of soil and weeds above the blade after removal.
- As the average height of weed is 2-2.5 cm and depth of roots are 1-2.5 cm, the sharp edge of the blade is extended 7.5 mm outward with the circular disc.
- The angle of the sharp edge is 15 degrees. The diameter of the circular shaft is 40mm.

CROSS SECTION OF BLADES:



CONNECTIVITY WITH AGROBOT:

- A square shaped cap with a slot is mounted on the stationary part(relative) of the bearing. A rod is welded and is connected to the agrobot.
- For this a roller bearing of outer diameter 47mm and inner diameter 20 mm is used.
- Power is transmitted form a motor gear combination to the weed removal through a spur gear containing 11 teeth.

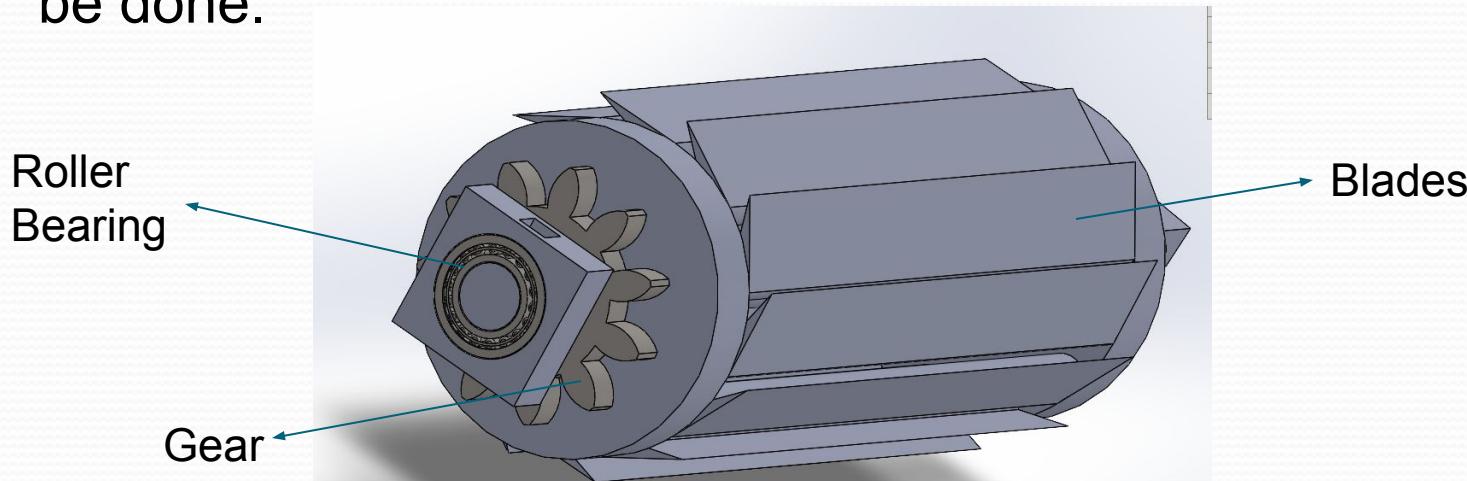


COST ESTIMATION AND HARDWARE COMPONENTS:

- Cost of each blade - ₹ 80 : Total 12 blades- ₹ 960
- Cost of spur gear - ₹ 250
- Cost of roller bearing - ₹ 200
- Cost of circular disc - ₹ 100
- Cost of square cap - ₹ 200
- Manufacturing cost - ₹ 200 (welding)
- cost of Johnson Geared Motors & gear (1000 rpm) - ₹ (589+300) = ₹ 889
- **Total cost - ₹ 2,799**
- Maximum 3 weed remover assemblies can be attached in back side of bot. This calculation is done considering one weed remover.

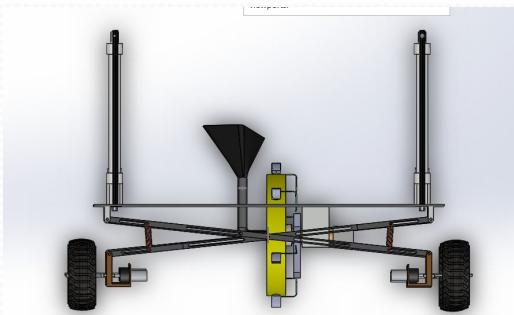
MAINTENANCE AND REPLACEMENT OF PARTS:

- As the rod connecting agrobot and weed remover is detachable, we can replace the weed remover from agrobot in case of failure or damage. The weed remover has to be maintained properly from rust. To prevent rust painting should be done.

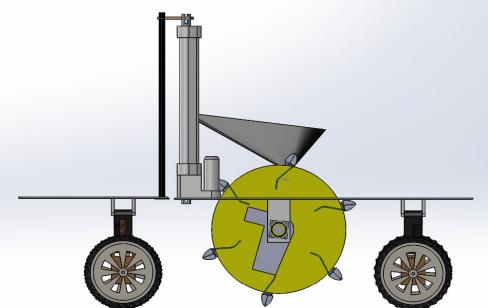


Separate assemblies

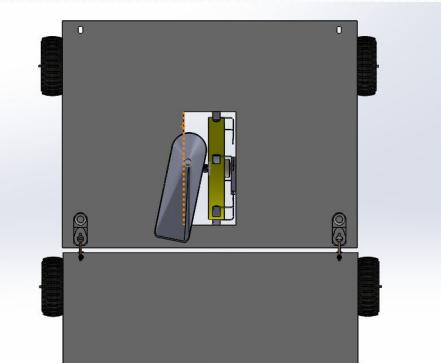
CARRIER with SEED METERING



FRONT VIEW



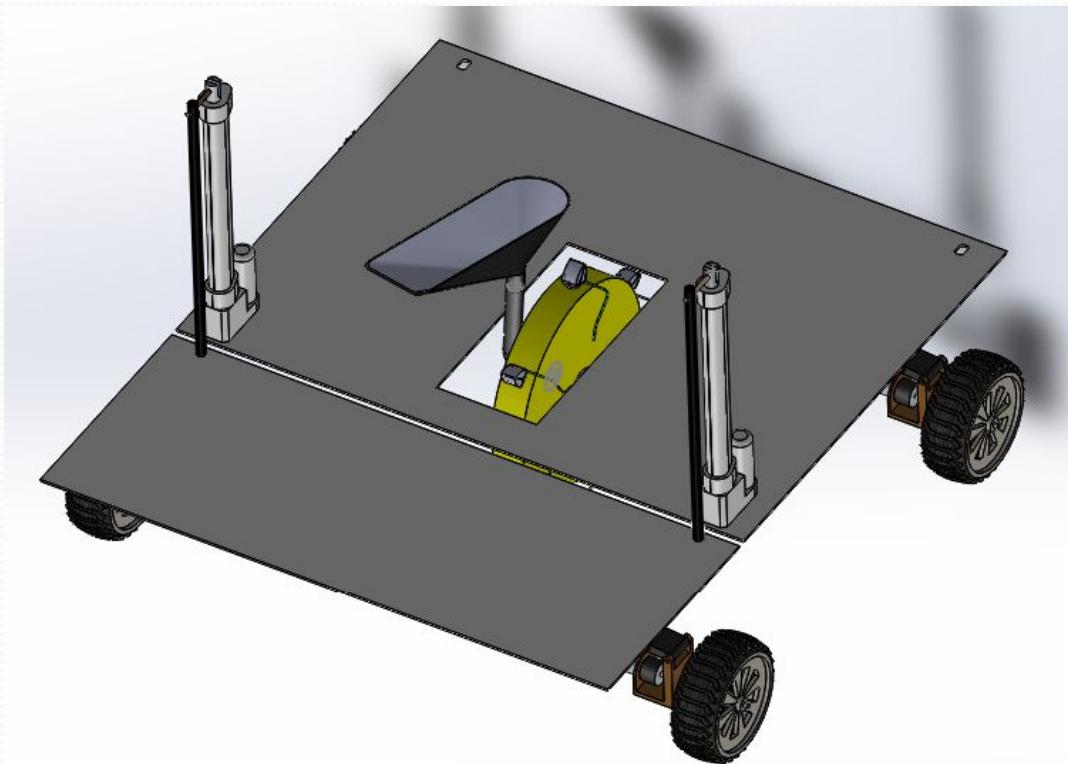
SIDE VIEW



TOP VIEW

Separate assemblies

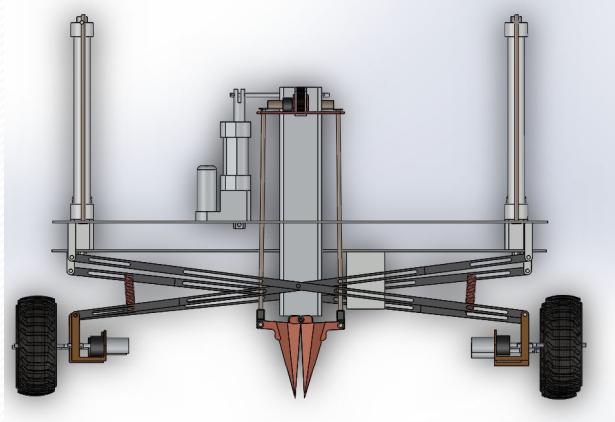
CARRIER with SEED METERING



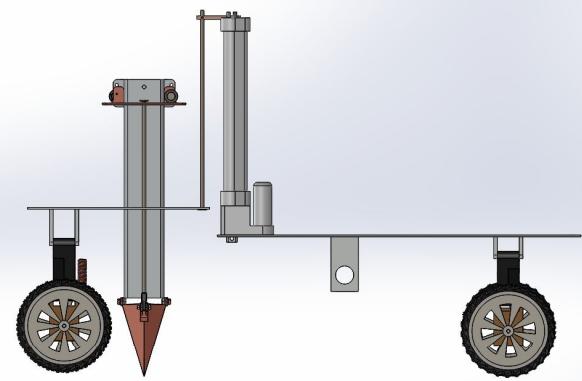
The front portion of the bot can be removed, and the assembly of the seed metering mechanism can be screwed below the middle section to use it.

Separate assemblies

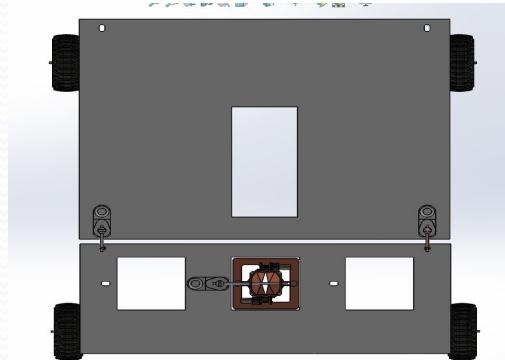
CARRIER with TRANSPLANTATION



FRONT VIEW



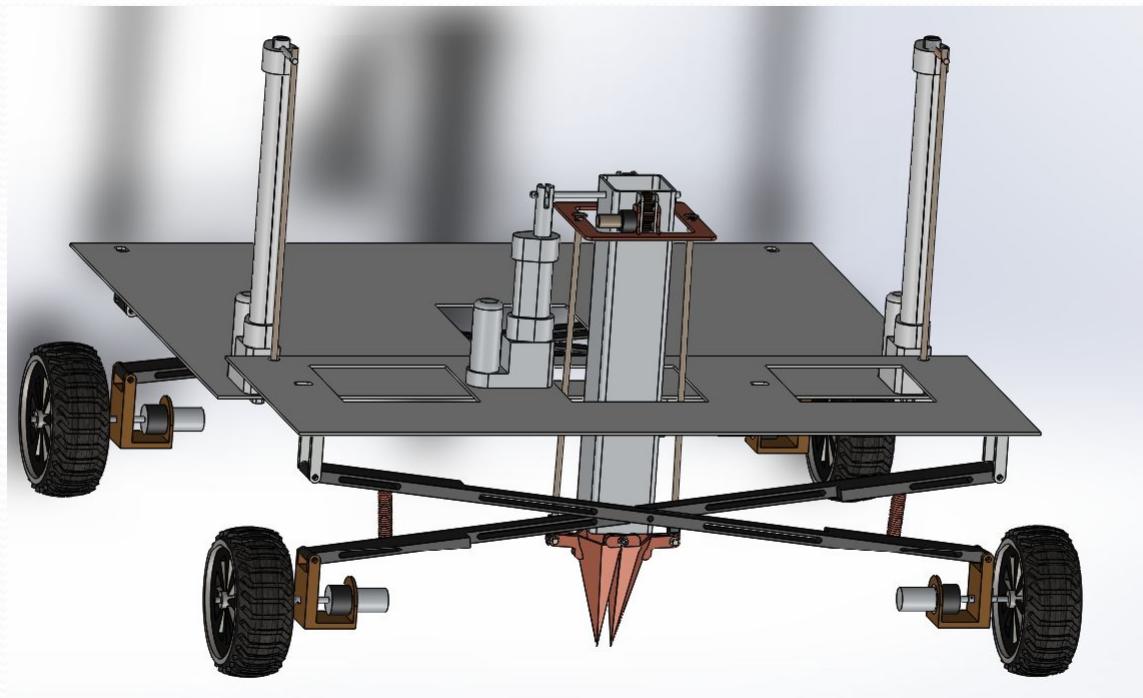
SIDE VIEW



TOP VIEW

Separate assemblies

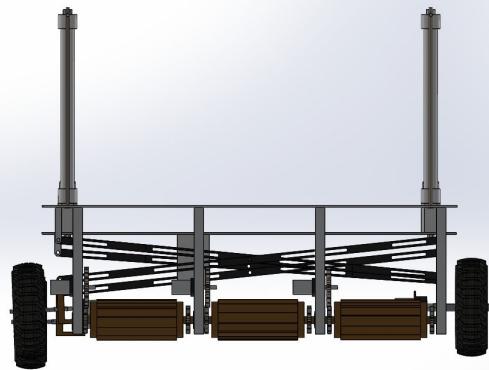
CARRIER with TRANSPLANTATION



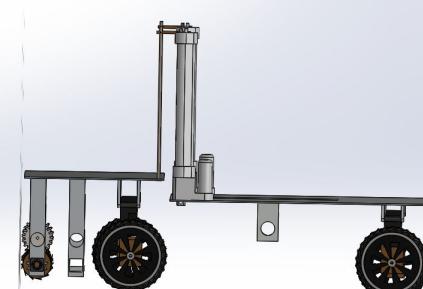
- Transplantation assembly can be attached to front side of bot with one small linear actuator to move in and out form ground.
- At a time we can attach maximum 3 transplantation.

Separate assemblies

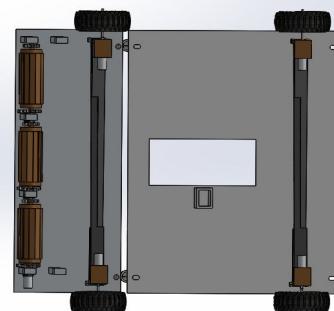
CARRIER with WEED REMOVER



FRONT VIEW



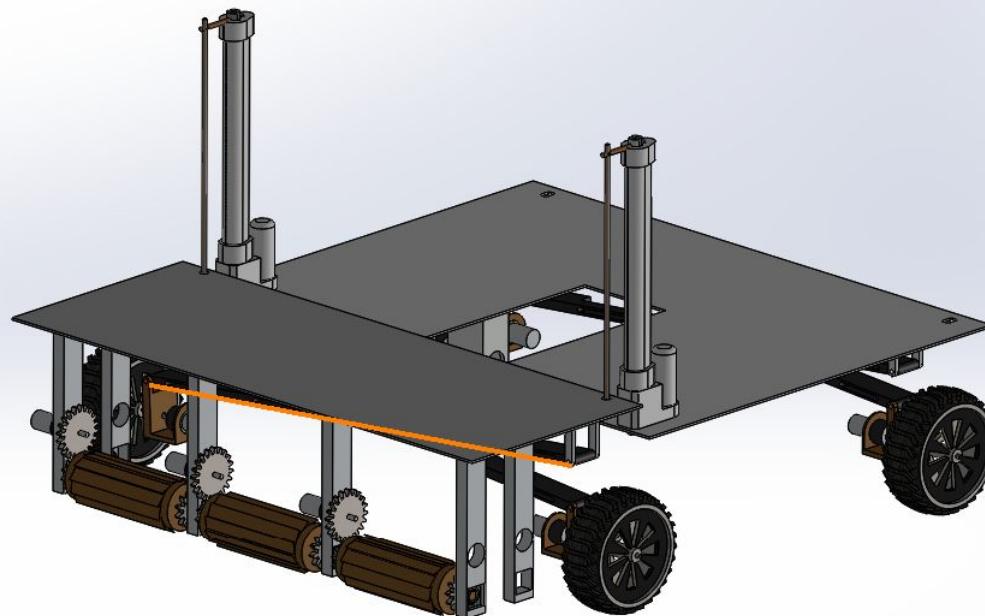
SIDE VIEW



TOP VIEW

Separate assemblies

CARRIER with WEED REMOVER



Maximum 3 weed remover assemblies can be attached in back side of bot and powered by an motor and gear mechanism on top of it.

Conclusion:

1. Total cost can be approximated to ₹ 58,344 /-
2. Robot can climb upto a height of 50 cm and move on uneven surface.
3. Seed can be planted with a distance of 24 cm.
4. The of sampling can be transplanted into the ground upto a depth a 100 mm.
5. The detection of weed is done by the operator and depending upon the requirement suitable number of weed removers can be used at a time.
6. Robot can move with the speed of 1.046 m/sec.
7. Suitable Arduino, Motor drivers, Receiver, Battery and Transmitter can be used for the automation of our bot.