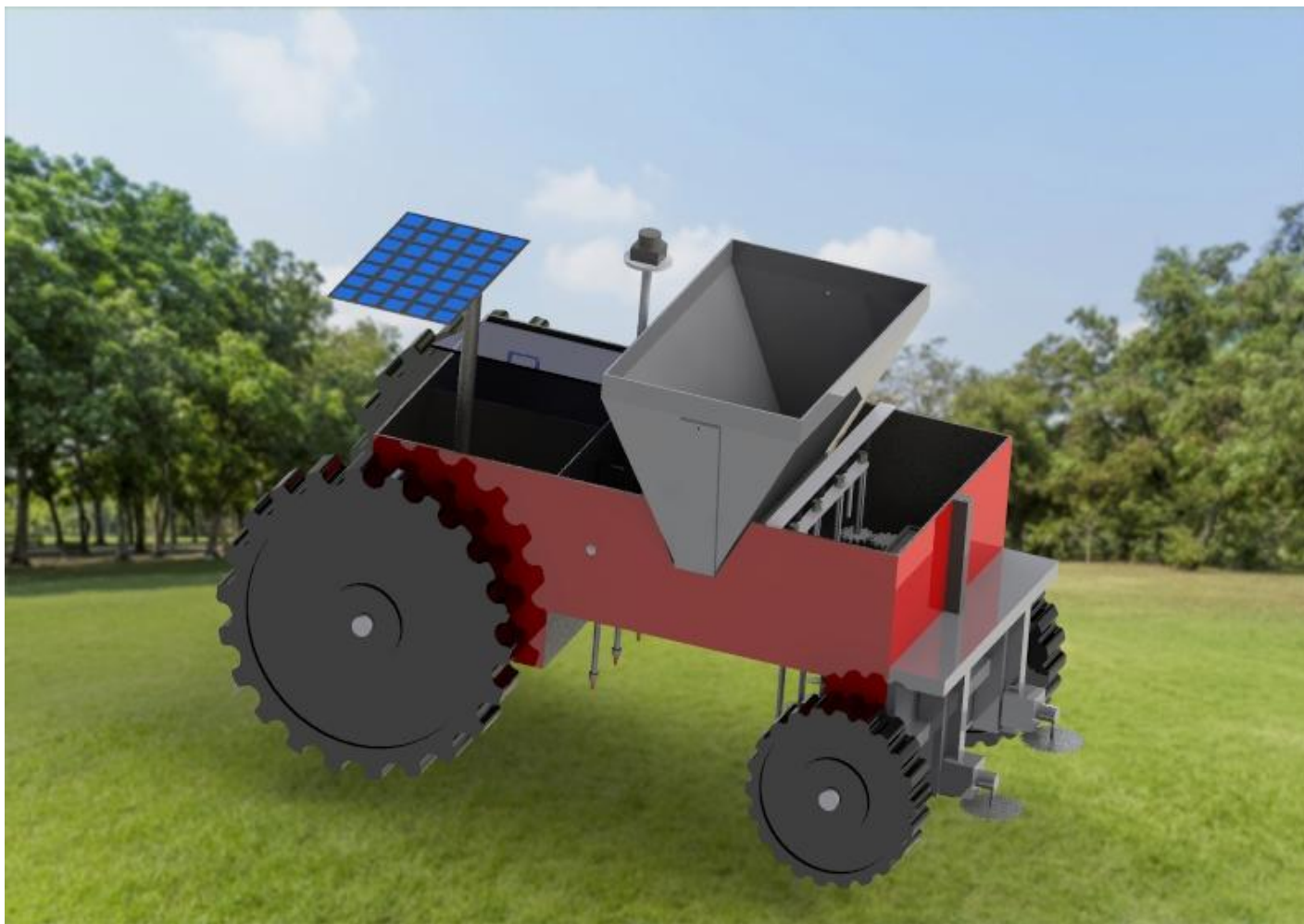


Inter IIT Tech Meet Challenge 2021
Mid Prep Event
Agrobot Design innovation challenge

Team AgroSquad



Solutions proposed:

The model built by us can solve two of the provided problems faced by the agro-based industry.

- 1) Weed Removal.
- 2) Seed metering for uneven or irregular seeds.

Design details, specifications and working of the model:

Approach to Weed removal:

We have made slots for cutter movement throughout the base, which will detect the weeds using cameras. Using cameras, with the help of machine learning algorithms we can distinguish between weeds and the crops, which will help us to remove the weeds. Once the camera recognizes weeds, it sends the information to the controller and the controller moves the cutter to the required location to remove the weed.

Working:

In our weed removal mechanism, we have two orthogonal slots with screws which allow the cutter to move in two independent directions perpendicular to the ground. We are using two 100 mm cutters for our purpose. They are mounted in such a way that accessibility of reaching the weed is high.

For the linear movement over the slots, we are using a helical mechanism in which the screw will rotate and the base which is mounted over the screw, moves linearly. This is controlled by servo-motors. This ensures the independent movement of the blade over weeds.

Approach to Seed metering:

The major components used in this mechanism are piston head, piston rod, rubber funnel, hopper along with suitable piping arrangements, rack and pinion mechanism and servo motor.

Working:

The seeds will be initially stored in the hopper. They will then be passed from hopper section to the vertical tubes through connecting slanted tubes, due to gravity. After reaching the vertical tubes, a piston lying above presses the seeds and pushes them through the rubber funnel.

- The piston will be controlled by using a rack and pinion mechanism. Pinions will be mounted on a common shaft, which will be driven using a servo motor.
- The rubber funnel is designed such that it allows only a single seed at once (and restricts

bulk movement of seeds), thereby allowing seeds to fall at appropriately fixed distances.

- Approximate size of seeds to be sown is programmed into the microcontroller. The microcontroller will measure fall of a single seed and will command the servo motor (regulating the vertical movement of the piston) to stop the downward piston movement (thereby preventing the second seed to fall). When all the seeds present in the vertical tubes are sown, the piston will retract up and thereby allow the next batch of seeds to fill into the vertical tubes.
- Additional Arrangement: The piping arrangement is changeable. It can be modified by using piping tubes and piston of different diameters. This mechanism along with rubber funnel allows a variety of shapes and sizes of seeds to be sown.

Hardware components required and approx. cost for building the proposed model:

Hardware components	Specifications	Approx. Cost/component	Quantity	Approx cost
Solar panel	40W, 3000sqcm	5,000	1	5,000
Battery	Amaron-Pro-0055B24LS (45AH)	7,000	2	14,000
Servo Motor	2.2kg-cm; 11kg-cm	500(low torque); 600(high torque)	7(small)+4(medium)	5,900
Sheet metal	Thickness 10mm, SS304 Stainless Steel	220/kg	800kg	1,76,000
Suspension	26 x 7 x 7 cm	3000	4	12,000
Nuts and bolts	MS	55/kg	1kg	55
Pipes	Alloy Steel, 1/4 inch-1 inch	150/kg	5kg	750
Fuel tank	MS, 40 L, 23kg	7500	1	7500

Auger bit	8.75cm dia, 60cm length	3000	4	12,000
Cutter	TAPARIA TCTS 440 Wood Cutter	250	2	500
Lead screw	SS Square Thread Screw, 20mm dia	1000	3	3,000
Microcontroller	Raspberry Pi	5000	1	5,000
Gears	Spur gears, different sizes acc. to needs	250-500	14	7,000
Shafts	SS Linear Shaft Rod, 20mm dia	1500	3	4,500
Wheels (front)	16"	1600	2	3,200
Wheels (rear)	40"	5000	2	10,000
Camera	Car rear view camera	2600	2	5,200
LIDAR sensor	12m scanning radius	10000	1	10,000
Lights	-	1000	4	4,000
Brakes	Drum brake	1200	4	4,800
Li-Ion Battery	11.1 V, 2500 mAh	1000	1	1,000
Magnets	4 Permanent+4 Electro	150 & 600	8	3,000
Motor	5kW- 29kW	30,000	1	30,000

Total Estimated Cost of equipment = Rs. 3,24,405 + Misc. $\approx$ Rs. 3,50,000

Details on maintenance and replacement of parts:

The regular maintenance of the bot will include the following:

- Oiling
- Auger drill replacement, if damaged
- Sensors(camera, range finder) replacement, if damaged
- Rubber funnel
- Cleaning of all the parts included in the bot.

Interchangeable parts according to the needs:

- **Seed metering pipe module:** Size of the seed metering pipe module can be varied according to the size of the seeds which are to be sown. Irregular sizing of the seeds can be countered with the rubber part which is present at the end of the tube. The rubber part is designed such that the diameter of the hole is smaller than the average diameter of the seed. Only during the time when an external force is given by the piston, the rubber part gets expanded and releases the seeds. Hence, the problem of irregularity of the sizes of the seeds can be solved.
- **Weed Cutter:** Size of the cutter can be varied based on the thickness of the weed present in the field, though this doesn't create great impact, this option can be used to make a much more efficient cut of thicker weeds.

Other noticeable features of the proposed model:

Ploughing Mechanism:

The mechanism will consist of 4 drill shaped cutters of diameter 10cms(approx.), which will dig holes in the soil upto certain depth. The drills will translate vertically with the help of electromagnetic drill mechanism. In this mechanism, the drill is attached with a permanent magnet and the top surface of the bot is attached with an electromagnet. The pole of the electromagnet can be changed by changing the direction of current passing through it. This change in the poles, enables the drill to move up and down. Moreover, we have attached discs and stoppers which help us control the depth of penetration in the ground by the drill. In addition to this, we have attached motors with a gear mechanism which enable us to rotate the drill. Drills will execute helical motion. The main motivation to use a drilling type of ploughing mechanism is to ensure that the seed falls exactly into a specified location without scattering out.

Leveller:

It consists of a metal plate which is hinged at the bottom- rear end of the

agrobot chassis. It will be dragged on the ground and will thus close the sowed or metered soil.

Why proposed model is considerable for scalability and realisation:

- The pipe module for seed metering is replaceable. Hence different sizes of pipes (corresponding to different sizes of seeds) can be used.
- The proposed model uses drill type of arrangement for sowing. This can be used for making precise holes and thus better seed-metering.
- It uses image recognition to accurately locate the weeds.
- Main components such as weed-cutter, auger-drills are of standard sizes and therefore are readily available in the market. These components do not require any sort of customized manufacturing. Also, since these main components are widely available, this ensures replaceability and realisability as well.

References

- 1) Shujun Zhang, Lars Norum, Robert Nilssen, “Oscillatory Motion Application of Tubular Linear Permanent Magnet Machine”, Department of Electric Power Engineering, Norwegian University of Science and Technology(2009).
- 2) Grabcad (www.grabcad.com) reference:
 - (a) Cutter (used as weed cutter) by Rasesh Palav
 - (b) Servo Motor MG966R by Robottronic

Google Drive link for CAD models and simulation video:

https://drive.google.com/drive/u/1/folders/1SMVrt1rWLDXAjs_ng4JK-syamFrhmf7