

AGROBOT

OUR SOLUTION

IDEA

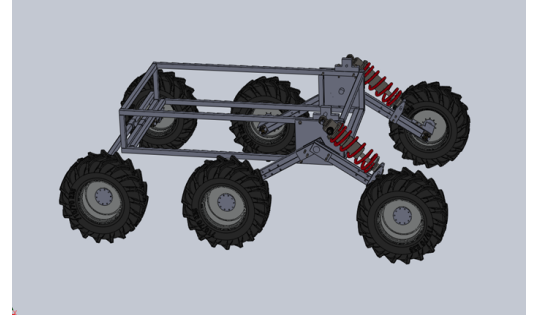
Our ideas involve building an affordable, reliable bot which can supply all the needs of a farmer living in a hilly region that is easily manufacturable at the same being extremely easy to repair. The problem statement explained that there were four major problems faced in the agriculture sector which includes farming in the hilly region, weed growth, sowing and transplantation. We are trying to tackle all four problems with different innovative solutions along with some extra features which would successfully automate the whole process. We have also taken consideration of manufacturing aspects as well as the reliability and ease of usage aspects in order to bring out the best product.

MODEL DESCRIPTION

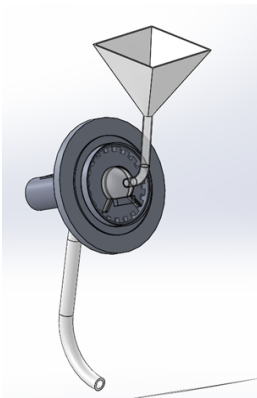
MECHANICAL DESIGN

DRIVETRAIN AND SUSPENSION

Six-wheel drive with modified Rocker Bogie suspension has been used. Front wheels are acting as rocker which are connected to the chassis through revolute joints. Chassis is acting as bogie. Rear wheels are interconnected by using revolute joints which is done to provide better traction. For smooth travelling in uneven terrain shock absorbers have been used at front.



SEED METERING MECHANISM

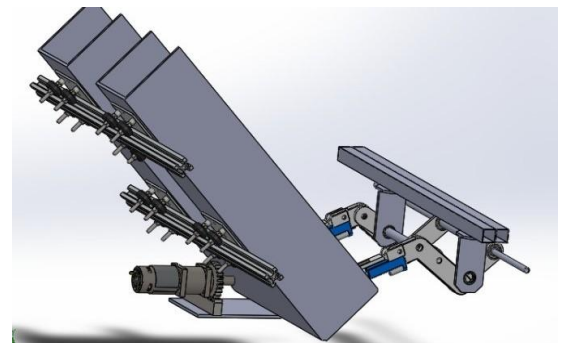


Seed metering mechanism has been designed in such a way which gives constant supply of seed at proper time intervals. Soil is ploughed using a plougher attached to it. Then the seed metering mechanism drops the seed in soil. After dropping off seed, it is covered by soil using leveller.

Seed metering mechanism works by separating individual seeds with the help of a circular disc with slots made on it. A funnel type container collects seed and sends it to the disc which then through a hollow tube directs seed into the soil.

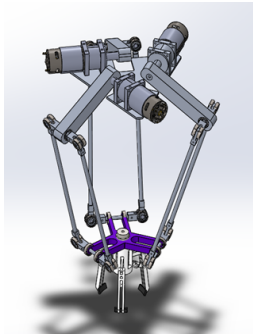
TRANSPLANTATION

The mechanism consists of a crank rocker mechanism which is driven through a chain drive. This provides continuous rotation to the crank. Each crank consists of an arm which has one linear actuator which is mounted on it which is used to plant the sapling in the soil. Each arm takes one sapling which is then pushed into soil by linear actuators.



Saplings are placed in storage. In order to cover all the sapling the storage rack oscillates one side to the other with the help of rack and pinion which helps it to cover the whole surface.

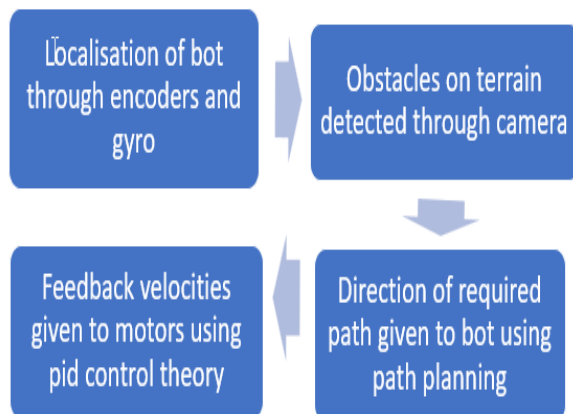
WEED REMOVAL



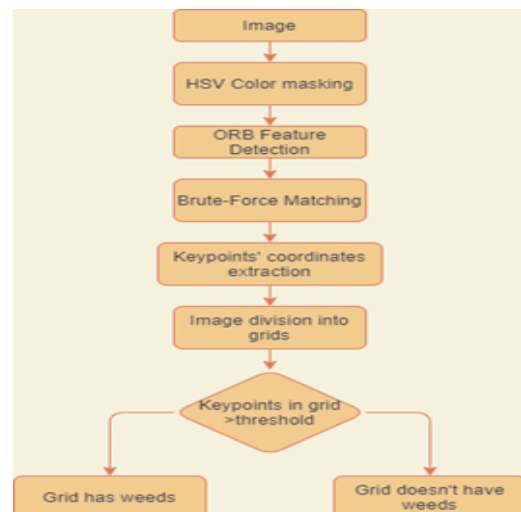
A Delta Robot is being used to uproot the weeds from soil. A depth camera is used to identify the exact location of the weed. The delta robot is actuated with three banebot motors with 32:1 gear reduction. Each motor consists of a rotary encoder mounted on top of it to take the feedback. A 3D printed gripper is also attached at the end to uproot the weeds. The gripper mechanism consists of a lead screw mechanism connected to three fingers to help it to open and close.

ELECTRICAL DESIGN

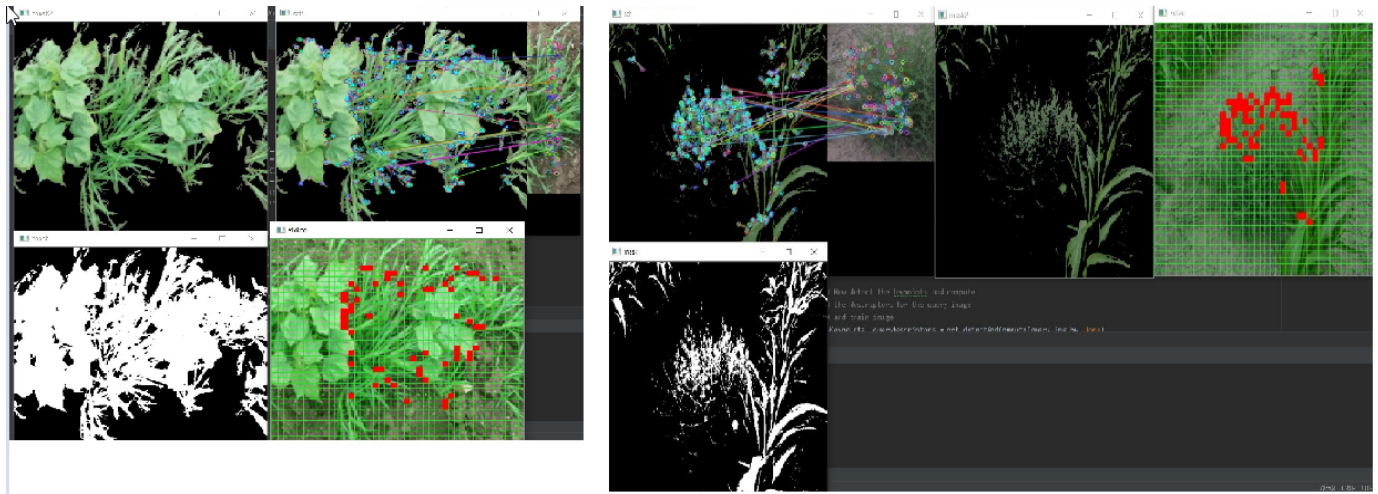
NAVIGATION AND WEED DETECTION ALGORITHM



Navigation



Weed Detection



IMAGES OF THE OUTPUT OF WEED DETECTION ALGORITHM(USING ORB PACKAGE)

HARDWARES AND COST ANALYSIS

S. No.	Item	Quantity	Cost	Total
1.	12V Banebot Geared Motor	12	₹450	₹5400
2.	Aluminum and other mechanical accessories			₹3500
3.	Cytron motors	2	₹130	₹260
4.	Rack (150mm)	1	₹90	₹90
5.	Wheels	6	₹2000	₹12000
6.	Shock Absorber	2	₹550	₹1100
7.	Raspberry Pi	1	₹4830	₹4830
8.	Lithium Polymer Battery Pack (LiPo) (ORANGE Transmitter (Tx) 2500mAh 3S 3C(11.1 v)	4	₹1000	₹4000
9.	Microsoft Kinect	1	₹5000	₹5000
10.	Seed Studio 105020001 Grove-I2C Motor Driver	7	₹1500	₹10500
11.	MPU 9050 gyro +acc module	1	₹440	₹440

12.	Orange 400 optical rotary encoder	2	₹1500	₹3000
13.	Intel RealSense SR300	1	₹7000	₹7000
14.	Panasonic through hole rotary encoder	2	₹400	₹800
15.	Miscellaneous			₹4000
			Total Cost	₹61920

FEASIBILITY OF OUR MODEL

MANUFACTURABILITY

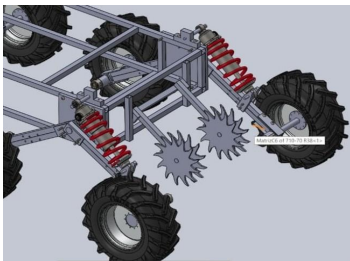
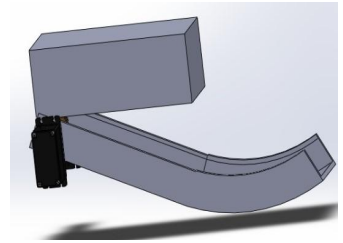
- **Availability of materials used :** Our skeleton structure of chassis and the mechanisms are made up of 19X19 aluminium which is not only very commonly available but also cheap. Some parts are made of ABS plastic a common 3D printing material.
- **Methods used in manufacturing :** Welding can be used for joining aluminium channels. We can use machining and drilling operations for plate cutting and holes used for temporary fastening respectively. We have also used 3d printers for manufacturing, this helps to reduce the overall weight of the robot but keeps its strength intact.

REPLACEMENT OF PARTS

- **Temporary fastening has been utilised** which makes it easy to assemble and disassemble. Subassemblies can be easily replaced without affecting the functioning of other mechanisms.
- **No special technical know-how required** at the end of the customer which makes our design to render its services to anyone. Different parts are easily available in the market which can be replaced easily.
- **Easily accessible material** We have made the model completely from easily accessible materials including 1060 aluminium channels and rods. So if any parts break down the customers can easily replace them with parts from a local store.

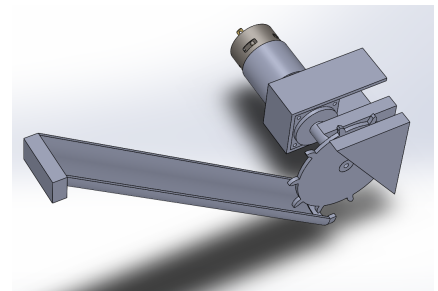
ALTERNATE DESIGN AND EXTRA FEATURES

- **Soil Testing mechanism:** We have developed a mechanism that can test soil at a given location with sensors embedded on it. This can help the farmer to optimise the location for placements of the sowing. It can be equipped with pH, humidity and temperature.
- **Alternate Weed removal mechanism by inclined rotating cutters:**



An alternative mechanism for weed removal has been thought out. This involves two rotating cutters which are inserted in soil and run continuously. Advantage of mechanism is that it can be performed by less number of actuation. But accuracy is less therefore weed removal by delta robot was chosen.

- **Alternate design for seed metering:-** We have also made an alternate design for seed metering which can be used for sowing. This mechanism can work for seeds like ginger and turmeric. It involves piercing seed through a circular plate and obstructing the seed's path by wedges. This results in fallout of seed.



SCALABILITY AND REALISATION

Our agrobot has been especially designed for realisation. Full CAD model was designed keeping the manufacturing aspect in consideration. Most of the parts are easily available hence can be replaced or modified if needed. All technologies which have been used are simple which can be made by products readily available in the market.

Our agrobot is suited to our country which has diverse terrains. Agriculture sector has stagnated for years. Productivity is very low in some regions. In such an environment our design can prove to be a breakthrough in agricultural technology. It addresses all the challenges which are being faced by today's farmers. Thus it will surely help boost our primary sector which in result will increase the wealth of our nation and people living in it.