AGROBOT

Physical Structure

The complete physical structure is broadly divided into 4 major parts

1. CHASSIS
2. DRIVE MODULE
3. WEED REMOVER
4. SPRAYER

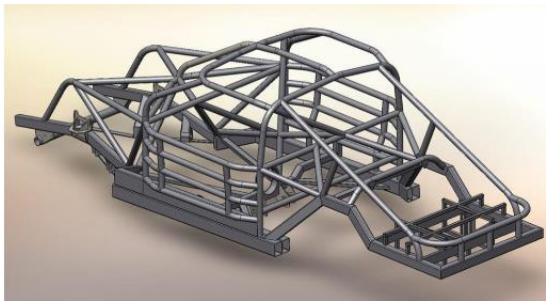
All the 4 modules are explained one by one

CHASSIS

Chassis is the main support structure of the vehicle which is also known as 'Frame'. It bears all the stresses on the vehicle in both static and dynamic conditions. In a vehicle, it is analogous to the skeleton in living organisms. The chassis used in our design is an integrated form of two different frame with the base being ladder type and the upper body of a space frame.

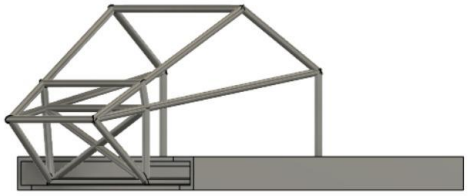
1) Ladder Frame: The simplest type of body-on-frame design is the ladder frame. The frame looks like a ladder, with 2 rails interconnected with lateral support members.
   This is used commonly in pick-up trucks and other commercial vehicles which deal with rough roads and uneven terrain.
   Our choice is justified as:
   a) it is simple in design and manufacturing
   b) is efficient providing optimum strength as is evident from their usage in pick up vehicles

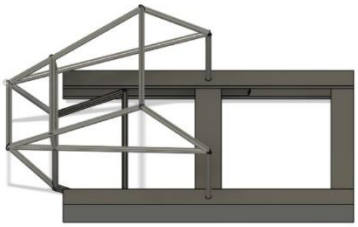
2) Space / Tubular Frame: The skeleton in this case is an internal framework of metal tubes. When compared to a Monocoque chassis (another chassis type), here the skeleton of the car bears most of the load.
   It is a very popular design for race cars and all-terrain vehicles like dune buggies.
   It will provide strength to the battery casing, is very efficient under impact testing and crash testing and its



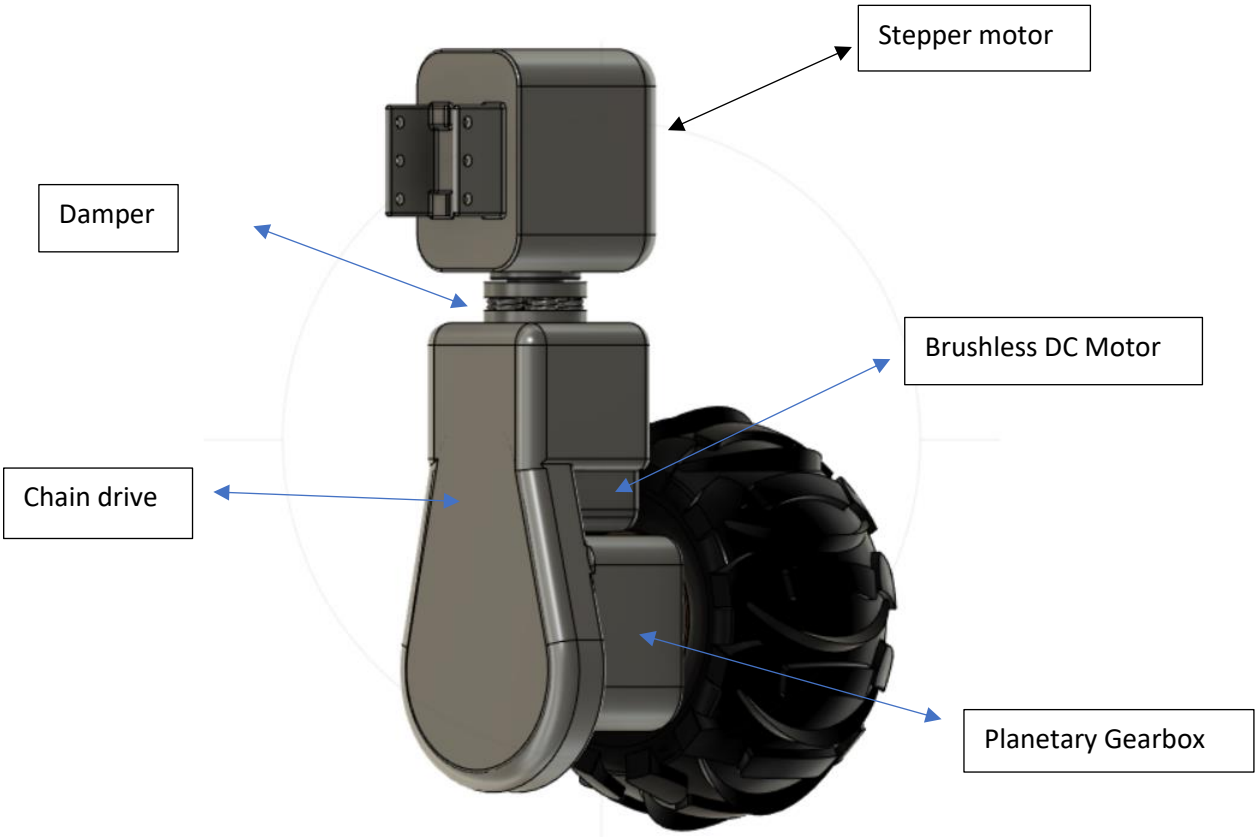
manufacturing is easy as welding requires no expensive stamping presses and jigs. In this way, our choice is justified.

We took inspiration from the chassis of dune buggies and implemented them on our ladder frame as per other constraints and had the following initial design at hand.





DRIVE MODULE



Complete bot is mounted on 4 such drive modules making our bot a 4-wheel driven bot

It consists of a DC motor that drives the wheel through a two-stage transmission.
First stage is the chain drive and then the in-wheel planetary gearbox.
Planetary gearbox has following application-

- Transform torque
- Transform speed

Rotation of drive module is facilitated by the stepper motor which is housed in the case that is in turn connected with the chassis.
the Stepper case and rest of drive module are separated by a damper

WEED REMOVER

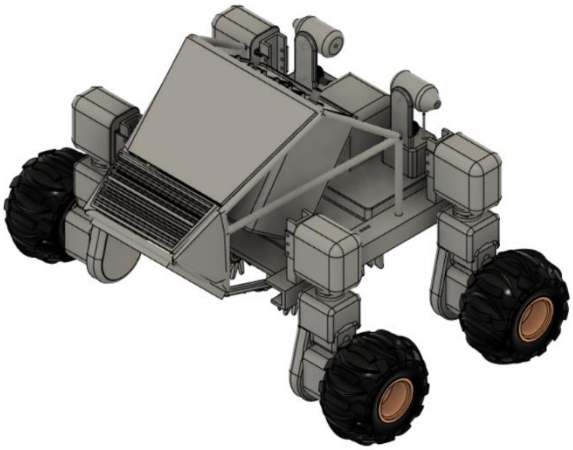
It consisted of a high rpm motor connected with pair of fibre string / blades of cutter. It is surrounded by two toothed wheels to uproot weeds

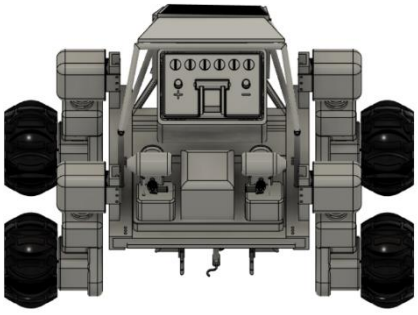
Bot consist of 2 cutter and 4 toothed wheels

SPRAYER

Two sprayers are mounted at the back of the bot. It functions by using an air blower powered by a high rpm motor. This air helps in suction of spraying liquid (Bernoulli's effect) to the spraying nozzle.

FINAL DESIGN





Changes told be made:

1. hybrid battery
2. adjustable ground clearance
3. adjustable chassis width for large scale spraying
4. Better Weeding system

Solutions that we came up with:

1. To start off we calculated out power demand than used battery storage to find working time

Component	Number	Power per component	Total power
High torque motor	4	100W	400W
High Rpm motors	1	72W	52W
Pump	1	48W	48W
			Total – 500W

(Considering the smaller work time of stepper motor and linear actuator, we can safely ignore their contribution to total power, though this negligence will be taken care of in the factor of safety)

Battery used:
– 2 x Luminous Rickpower (whose original values are not available)
- so for calculation purpose we have an alternative 2 x Luminous ILTT 220 Ah battery

So available power = 2*220*12 = 5280 Wh
We take Safety factor to be 10% which increases our power consumption to 550 W
Working time = 5280/550 = 9.6 hrs
Further ignoring the factor of 0.6 we get 9 hrs of work time.

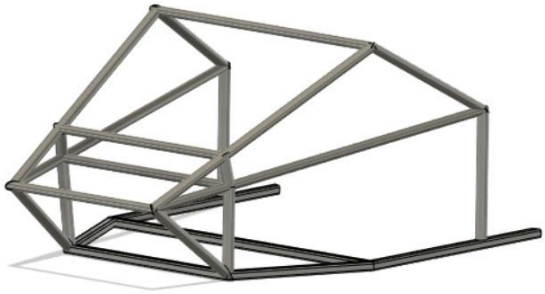
After this amount of work time, we can take safe assumptions that a sufficient charging time is feasible.
This can be done either by using electrical power line supply or by using a separate charging unit that houses a generator.

Charging unit:

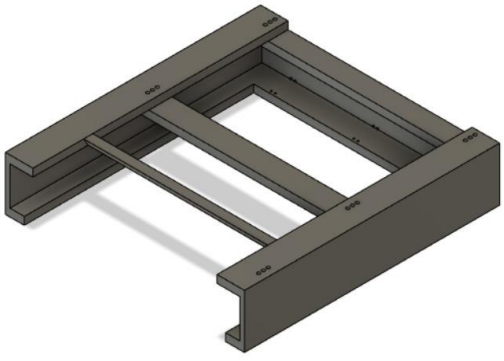
Charging unit is equipped with Honda 850 VA Handy Series Portable Generator
Rated power - 750 VA
Power factor – 0.95
Available Power – 712
Time for charging – 5280/712 = 7.4
So, charging time is around 7 hrs (overnight charging)

2. We made the bot large enough for a better ground clearance.

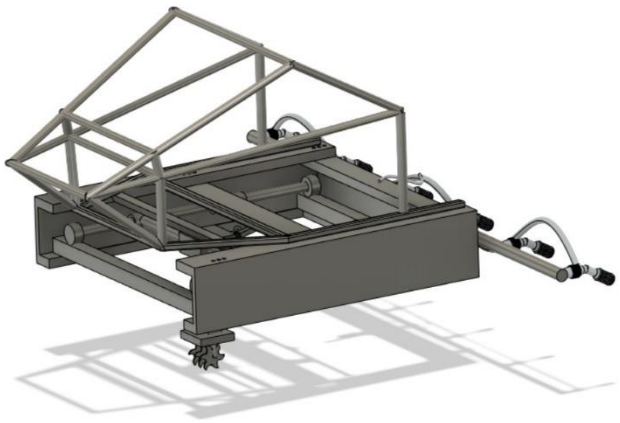
Chassis:



Space Frame

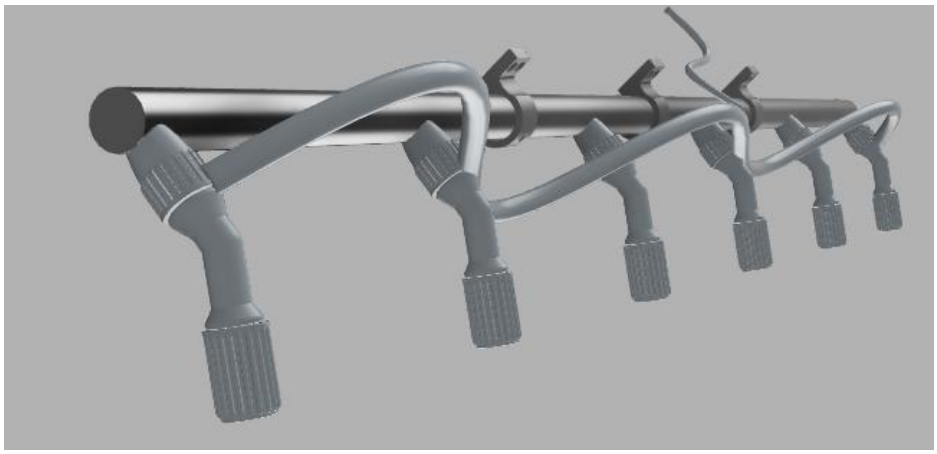


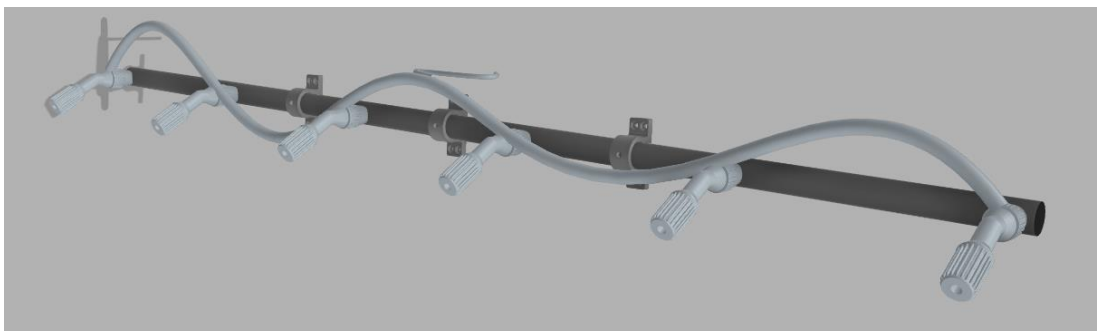
Ladder Frame



Assembled bot with sprayer and weeder attached.

3. Inspired from Shaktiman, we designed a multi discharge nozzle with an adjustable nozzle option for usage of different spraying fluids. The whole set up is of length 230cm and consists of 6 sprayers separated from one another by a distance of 45cm (average gap between 2 rows of a crops) in India. This whole spraying system can be customizable too.





Nozzle Guide for Band and Directed Spraying					
	 Even Flat Fan	 Twin Even Flat Fan	 Hollow Cone	 Full Cone	 Disc and Core Cone
Herbicides Pre-emerge Post-emerge Contact Post-emerge Systemic	**Very Good** **Good** **Very Good**	**Good** **Very Good** **Good**	**Very Good**	**Good**	
Fungicides Contact Systemic	**Good** **Very Good**		**Good**		**Very Good** **Good**
Insecticides Contact Systemic	**Very Good**	**Very Good**	**Very Good**		**Very Good** **Good**
Growth Regulators	**Good**			**Very Good**	

4. Mechanism:

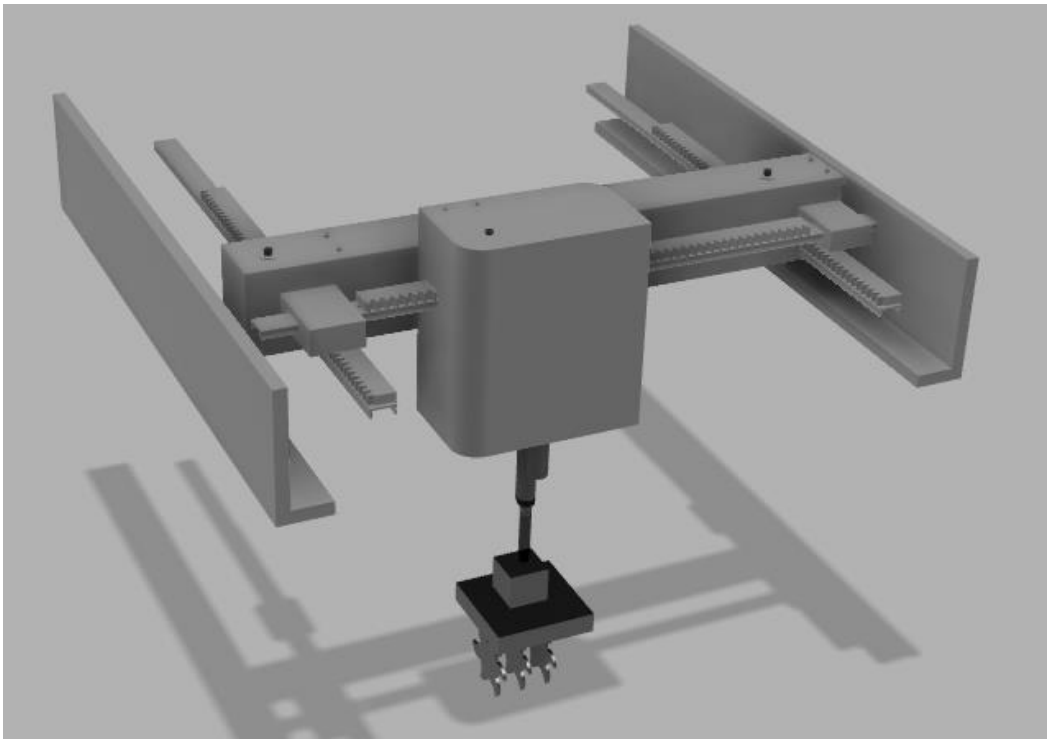
At the bottom of the bot a rectangular frame will be established which will be operated using a combination of sliders, linear actuators and rack and pinion. This is achieved by attaching two sliders at opposite sides of the base. A third slider is attached to both the sliders perpendicular to them, that is, parallel to the other pair of sides. The two sliders will allow motion in the Y axis and the third slider will give a motion in X axis and for motion in Z axis the linear actuator is used. The vertical actuator will be attached by dc motor and having 3 cutter blades designed to uproot the weed. The weed will be identified using a camera attached at the centre of the frame.

Advantages:

As the system is attached to the whole base, maximum area is covered to identify and cut as well as uproot weed. Since the vertical moment is allowed only when the camera senses the weed the cutter goes and do the job precisely.

Disadvantages:

Operating the system while the vehicle is in motion is difficult. As multiple servos are in use, managing the electronics part is difficult. Differentiating weeds from crops using camera will also result in a difficult algorithm.



Estimated Bill:

- 3 Rack and Pinion = 200*3 =600
- 3 sliders = 400*3 = 1200
- 1 actuator = 5200
- 1 High Rpm DC motor = 5200
- Pricing based on 150/kg = 35790
- 6 stepper motor - 36000
- 4 high torque dc motor – 6000 * 4 = 24000
- 1 centrifugal pump = 1000
- Helical coil (rough) = 1000
- Nylon string = 120
- Batteries x 2 = 15000 x 2 = 30000
- Total = 1,40,000