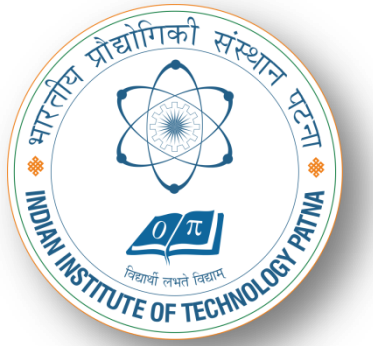
AUTONOMOUS WEED CUTTER

TCTD Challenge

Inter IIT Tech-Meet 2018

IIT Patna



OBJECTIVE

To design farm tools that reduce drudgery and provide intelligent automation.

Problems Faced by Farmers

- Sowing of seeds in the fields at proper distance and proper spacing.
- Transplantation of germinated wheat, maize and paddy grains to new fields.
- Removing of weeds grown in between the rows of crops, plantation and trees
- Use of costly and harmful herbicides (to eliminate the weeds), which affects the crop a lot.
- Problem of pests and insects that grow on the crops destroying them.
- Huge amount of water required to irrigate the crops.
- Problem of Cattle : they harm and destroy plants and crops on a mass scale.
- Problem of harvesting and planting of crops for small scale farmers due to lack of manual labor.

Post survey analysis

Inference of problems faced by farmers-

- **Absence of technological resources and education** (crop advisories & information about the weather forecast, natural calamities, automation (sensor based) real-time control functions, Irrigation & Fustigation scheduling etc. to optimize per unit inputs to outputs).
- **Improper irrigation** (only one-third of the cropped area is under irrigation).
- **Lack of Mechanization (**most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools and implements**).**
- **Reluctance to accept complex solutions**
- **Majority farmers in India have small farms**

Discussion with farmers and stakeholders

Idea	Reasons for rejection
AUTOMATED WATERING AND IRRIGATION	*Surface Irrigation is widely used*
CROP SPRAYING	*Not feasible for small farms*
WEED REMOVAL SYSTEM	*Accepted*
SEEDLING TRANSPLANTER	*Unsuitable conditions for an automation*
FIELD MONITORING USING DRONES	*Reluctant to accept complex technology*

AUTONOMOUS WEED REMOVER

Economically Feasible

Acquiescent

Reasons for selection

Applicable in diverse farms

Energy Efficient

Existing solutions

Manual removal (manually plucking)

Thermal removal (flame weeder)

Buried drip irrigation (limiting weeds access to water)

Herbicides (selective herbicides kill certain targets, leaving the desired crop relatively unharmed)

Mechanical solutions (power weeder or weed cutters)

Working Principle

Differentiate the main Crop & weed from the field

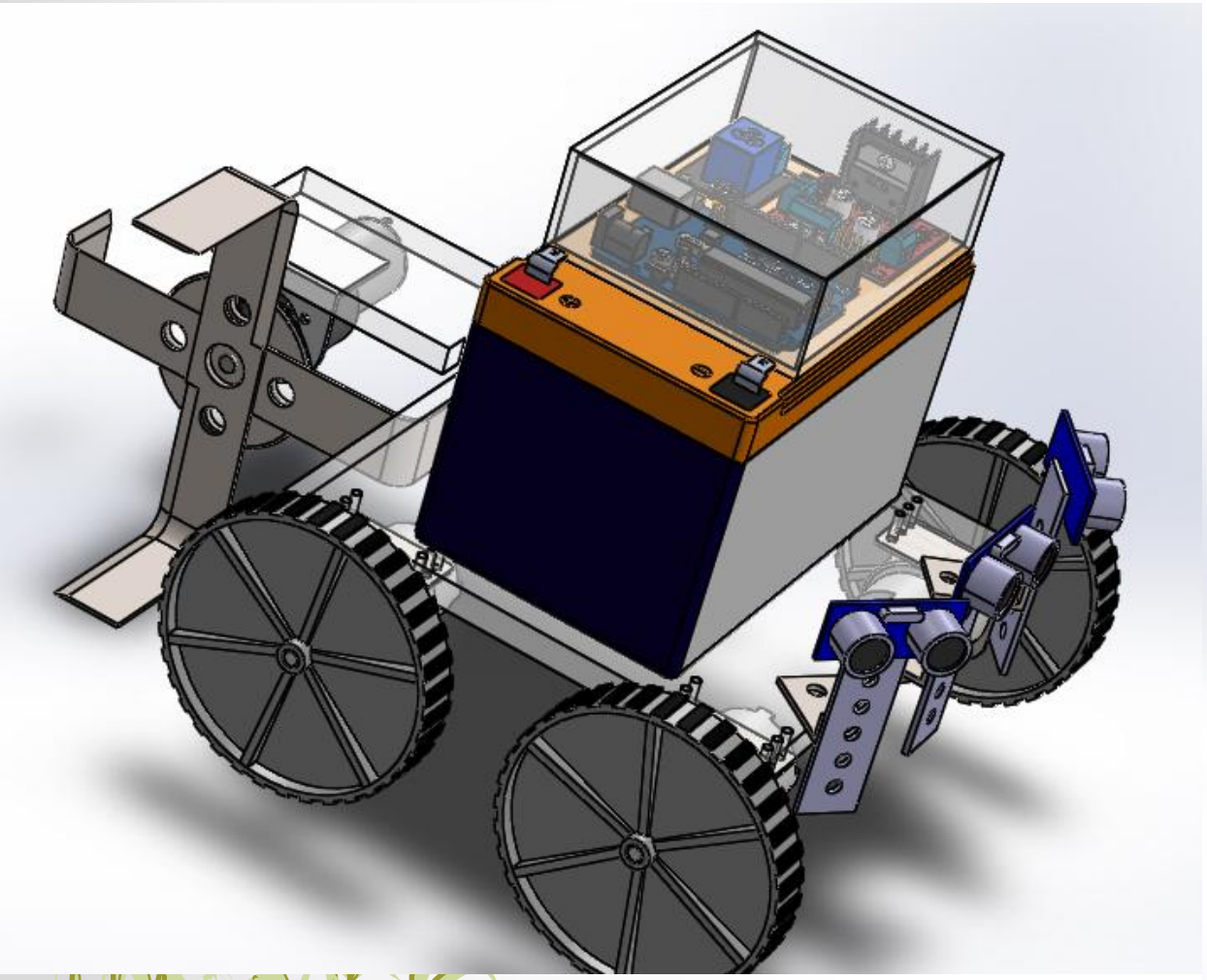
↓

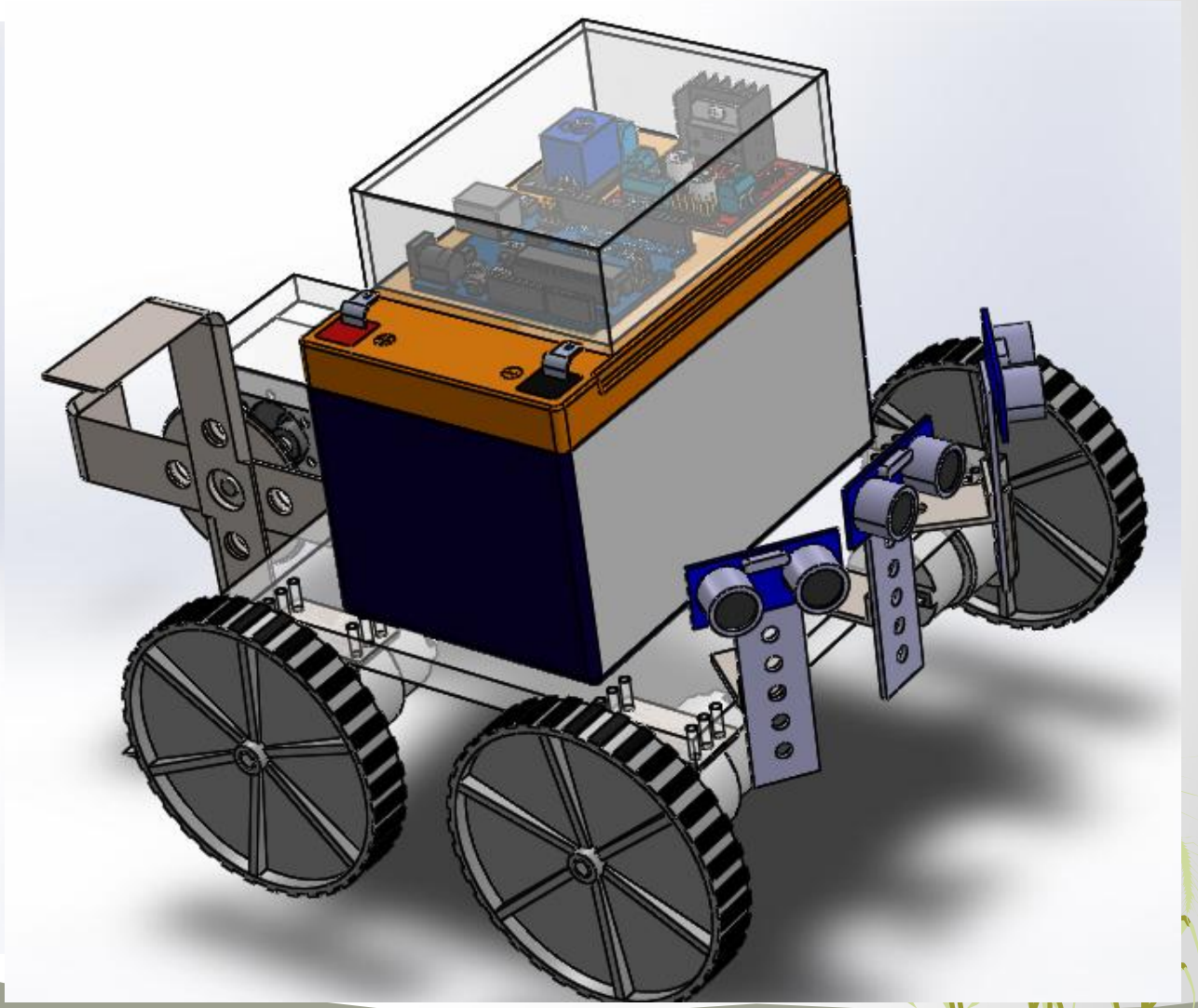
Uproots the weeds

↓

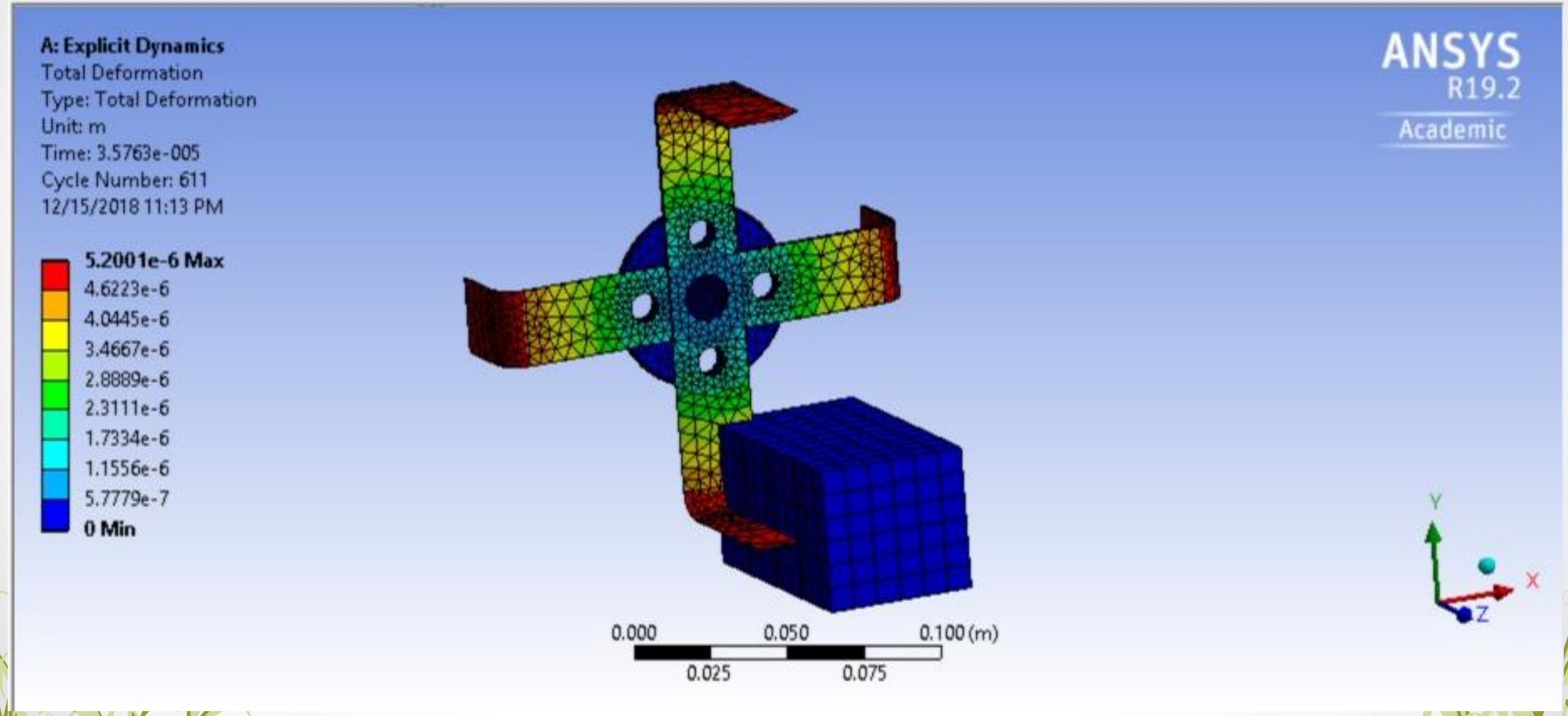
Prevents harm to the sown crop by turning away from it

CAD Model

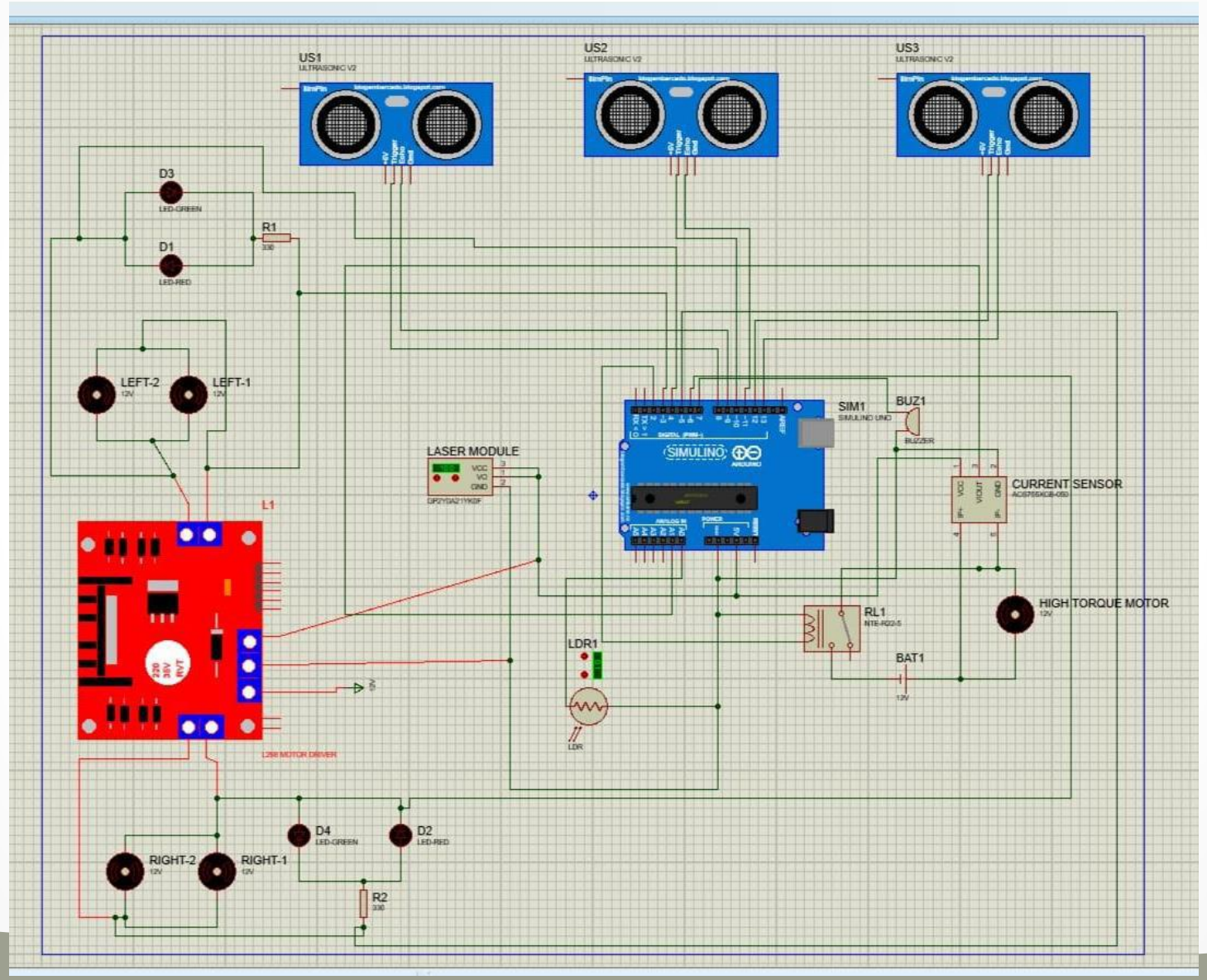




Dynamic Analysis



CIRCUIT SCHEMATIC



Comparative Study between different types of Proximity Sensors

Characteristics	Inductive	Capacitive	Ultrasonic	VL53L0X
Material sensed	Ferrous Metals	Liquid, metals, dry goods	All Materials	All Material
Sensing distance	0.5-120mm	0 -50 mm	0-50 mm	5-2000 mm
Sensitivity	Good	Good	Excellent	Very good
Cost	290 INR	210 INR	60 INR	930 INR
Reliability	Very good	False trigger concern	False trigger concern	Good

COST INCURRED & EFFICIENCY CALCULATIONS

- Battery life = 3.5 hrs = 1 basketball court area
- 1 *Bigha* = 8 basketball courts (7.87 exact)
- 1 Hectare = 3 *Bighas* (2.92 exact)
- This infers about 8*3 = 24 charges required per hectare
- Battery life- 250 cycles
- 10 hectares with a battery
- Cost of electricity (for 10 Ha) = (12*9.2*240*6.5) / (1000*0.8) INR = 229.32 INR

  (12V operating voltage ; 9.2 Ahr battery ; Efficiency of battery 80% ; Cost per KWhr 6.5)
- Maintenance Cost : Cost of battery 2500 INR + Maintenance cost of components 800 INR
- ***Therefore, cost incurred by our machine per hectare = 3530/10 = 353 INR***

Business Analysis

Suitable Condition for working

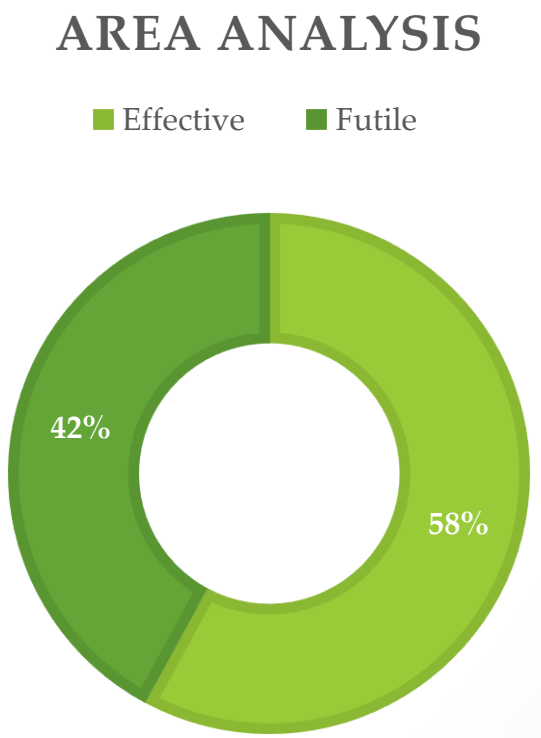
- Plantations should be on a planar region
- Significant amount of intra-cropping distance
- Minimum height difference of a few cm between the crop and weed

VEGETABLES

Total area under cultivation : 10,290,000 Hectares

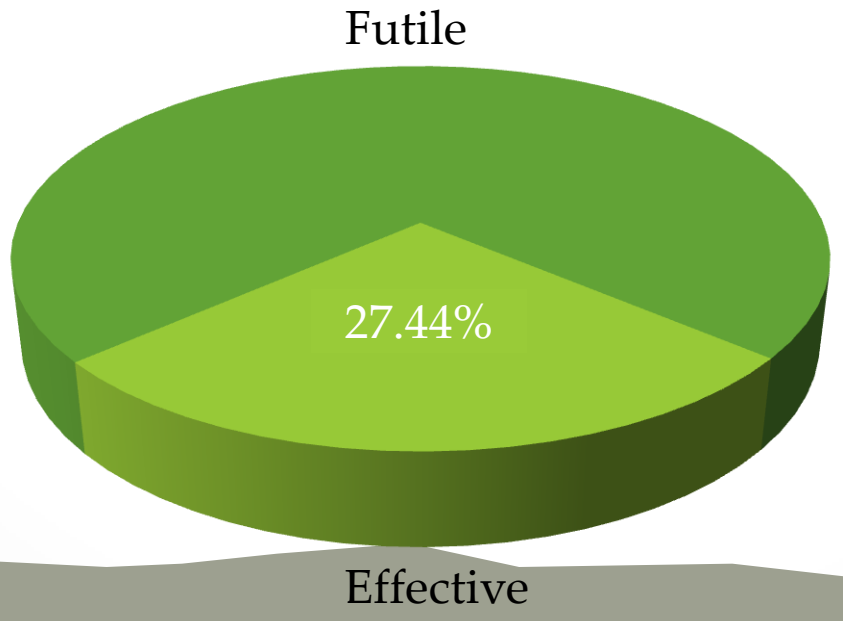
Area our machine can be effective : 5,967,000 Hectares (***57.1 %***)

S.NO.	VEGETABLES	PRODUCTION	AREA
1	Beans	2278	230
2	Bottle gourd		157
3	Brinjal	12400	669
4	Carrot	1379	86
5	Cucumber	1142	78
6	Chillies (Green)	3406	287
7	Lady Finger	6146	528
8	Bitter Gourd	5452	546
9	Potato	46546	2164
10	Radish	2927	206
11	Pumpkin	1582	72
12	Sweet Potato	1639	135
13	Tomato	19697	809
TOTAL		107166	5967



Crop	Fruits	Spices	Flowers & Aromatic	Others
Area under cultivation (Hectares)	6,480,000	3,535,000	309,000	Maze, Sugarcane and a few others increasing area by 36,170,000
Area suitable Machine (Hectares)	584,000	763,000	309,000	

TOTAL SHARE IN INDIAN AGRICULTRE

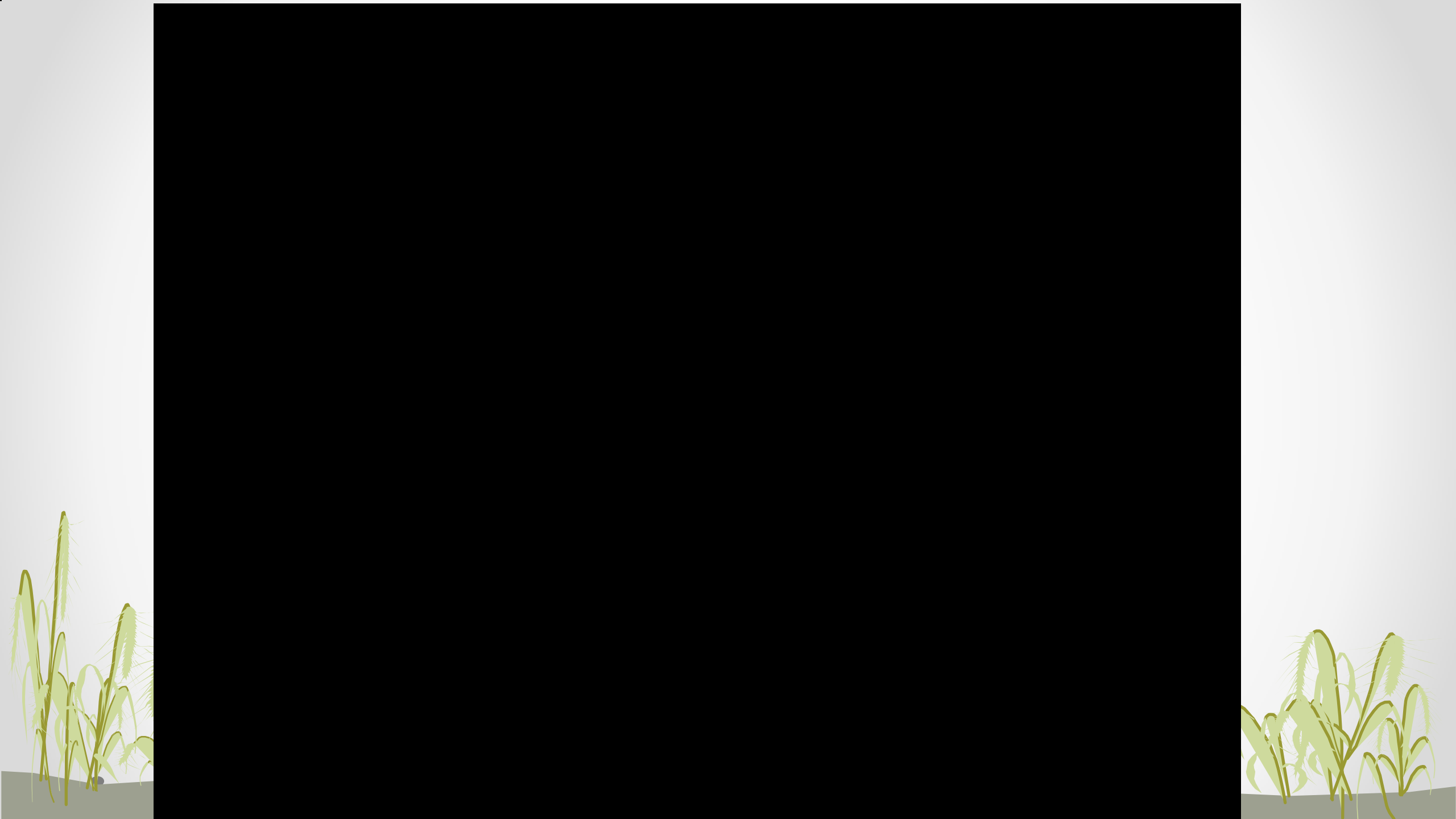


PART	COST	QUANTITY	SUBTOTAL
ULTRASONIC SENSOR	80/-	3	240/-
LASER MODULE	75/-	1	75/-
LDR DETECTOR MODULE	80/-	1	80/-
LIPO BATTERY	2500/-	1	2500/-
ARDUINO	250/-	1	250/-
CURRENT SENSOR	150/-	1	150/-
BUZZER	20/-	1	20/-
RELAY SWITCH	79/-	1	79/-
MOTOR DRIVER	80/-	1	80/-
BATTERY CHARGER	2300/-	1	2300/-
COPPER CLAD BOARD	80/-	1	80/-
		TOTAl	5854/-

ACCESSORIES	PART COST	QUANTITY	SUBTOTAL
MACHINE SCREW	5/-	16	80/-
JOHNSON MOTORS	800/-	1	800/-
BASE MOTORS	120/-	4	480/-
MOTOR CLAMPS	20/-	4	80/-
MOTOR CLAMPS(JOHNSON)	15/-	1	15/-
WHEEL	20/-	4	80/-
CUTTER AND COMPONENTS	100/-	1	100/-
COUPLING	129	1	129
		TOTAL	1635/-
MISCELLANEOUS			
JUMPER	1/-	30	30/-
GLUESTICK	10/-	2	20/-
SOLDER WIRE			10/-
PLYWOOD			200/-
TAPE	10/-	2	20/-
		TOTAL	280/-

Total – 7769/-

Further modifications and scope

We interacted with some governmental and non-governmental organizations such as **Udyog Mitra; BIA** (Bihar Industries Udyog Association); **Department of Agriculture, Government of Bihar** etc. and collected their feedback and reviews on our machine

- An improvement in chassis and suspension system would widen the target areas of our machine.
- Proximity sensors can be included in the design which would detect presence of any intruder in the field such as cows, Nilgais (Blue Bulls) etc.
- A GPS tracker can be added in our machine so that it doesn't go back to areas where the field has been already weeded.
- Appropriate sensors which can measure the length of main crop will prove to be a boon for the farmers as this would give them information about the proper development of the crop and also warn them against any problem.
- We could provide our machine in various sizes.