DAYANANDA SAGAR COLLEGE OF ENGINEERING

Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore-560078

(An Autonomous Institute affiliated to VTU, Approved by AICTE &ISO 9001: 2008 Certified)

Accredited by National Assessment & Accreditation Council (NAAC) with 'A' Grade

Department of Mechanical Engineering

Batch Number

46

MAJOR PROJECT PRESENTATION

Title: Design and fabrication of multipurpose agricultural robot

Guide Name	MR. RAVI KUMAR S.R			
Designation	ASSISTANT PROFESSOR			
Student Name	1. KSHITIJ PODDAR	2. MADHAV SINGHANIA	3. NITISH KUMAR	4. SARRAF SHANUJ
USN	1DS19ME076	1DS19ME081	1DS19ME095	1DS19ME129

Abstract:

The Discovery of Agriculture is the first big step towards civilized life, advancement of agricultural tools is the basic trend of agricultural improvement. The qualitative approach of this project is to develop a system which minimizes the working cost and also reduces the time for digging operation and seed sowing operation by using automation. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil. This prototype can navigate it on any agricultural land and perform seed sowing operation simultaneously. Autonomous agriculture robot is one of the promising solutions for precision agriculture.

Literature survey

Automated seed sowing AGRIBOT using Arduino by Saurabh Umarkar; Anil Karwankar

Agribot is a robot designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil. The robot is autonomous and provides the facility for optional switching of the ploughing system when required.

Agribot – a multipurpose agricultural robot by akhila gollakota , M.B.Srinivas

This prototype can navigate it on any agricultural land and perform seed sowing operation simultaneously.Autonomous agriculture robot is one of the promising solutions for precision agriculture. This paper presents the proposed sensor and vision based agricultural robot for sowing seeds.

Design of microcontroller based agribot for fertigation and plantation by Akshay Y. kachor, ketaki ghodinde

Multiplying financial gain of farmers until 2022-23 from the bottom year of 2015-16 needs yearly development of 10.42 percent in farmer’s income approximately. At present two remarkable issues are there in agriculture which includes water shortage and high work costs. These issues can be settled by utilizing automation in agriculture, which enhances the precision agriculture.

Sensor and vision based autonomus Agribot for sowing seeds by Palepu V. Santhi , Nellore Kapileswar, Vijay K. R. Chenchela, C H Venkata Sivaprasad

Machine intelligence is a developing technology which has made its way to various fields of engineering and technology. Robots are slowly being implemented in the field of agriculture, very soon AgriBots are to take over the agricultural fields and be used for various difficult and tiresome tasks involving agriculture. They have become the inevitable future of agriculture. This paper proposes an idea that will help in effective cultivation of vast areas of land left uncultivated or barren. Numerous farmers are dying during hill farming mainly due to falling from heights, which can be reduced by this technological effort.

IOT based multipurpose agribot with field monitoring system by Siddharth Gupta, Rushikesh Devsani, Shraddha Katkar

Agribot which is a multipurpose bot can perform all the farming operations including ploughing the soil of the field, sowing seeds in the ploughing area, making the field in plain by using leveler, watering the crops, fertilizing them and monitor the agribot by using camera. The traditional farming methods consume a lot of manual labour. Some of the operations are manual, while others are operated using manually operated machines. Therefore, there are no such robots, which can perform all these operations autonomously.

Problem Statement

To build a robot that can perform various agricultural activities and overcome the issues faced during farming, whilst making the robot easy to operate by providing its control through mobile phones.

Objectives of the project:

1. Design and model the multipurpose agricultural robot which can perform the agricultural operation.
2. To fabricate the multipurpose agricultural robot.
3. To build a software so that multipurpose agricultural robot can be operated using a mobile phone.

Methodology

Problem identification

↓

Design of multipurpose robot

↓

Fabrication of the robot

↓

Electronics and control system

↓

Software development and Testing

Method and Methodology:

Problem Identification: The initial step in the development of the multipurpose agricultural robot was to identify the key challenges faced by farmers in various agricultural tasks. The identified problems included labour-intensive ploughing, time-consuming seeding, manual spraying of water, and the need for sand levelling.

Conceptualization and Design: Once the problems were identified, a conceptual design for the agricultural robot was developed. The design incorporated a mobile phone-based control system for easy operation. The robot was designed to be multipurpose, capable of performing ploughing, seeding, spraying water, and levelling of sand.

Component Selection and Integration: The next step involved selecting the appropriate components and technologies for the robot. The frame/chassis of the robot was constructed using Mild Steel (MS) material, which was welded together using arc welding to form a sturdy frame. Motors, mechanisms, and sensors were integrated into the design for ploughing, seeding, water spraying, and sand levelling.

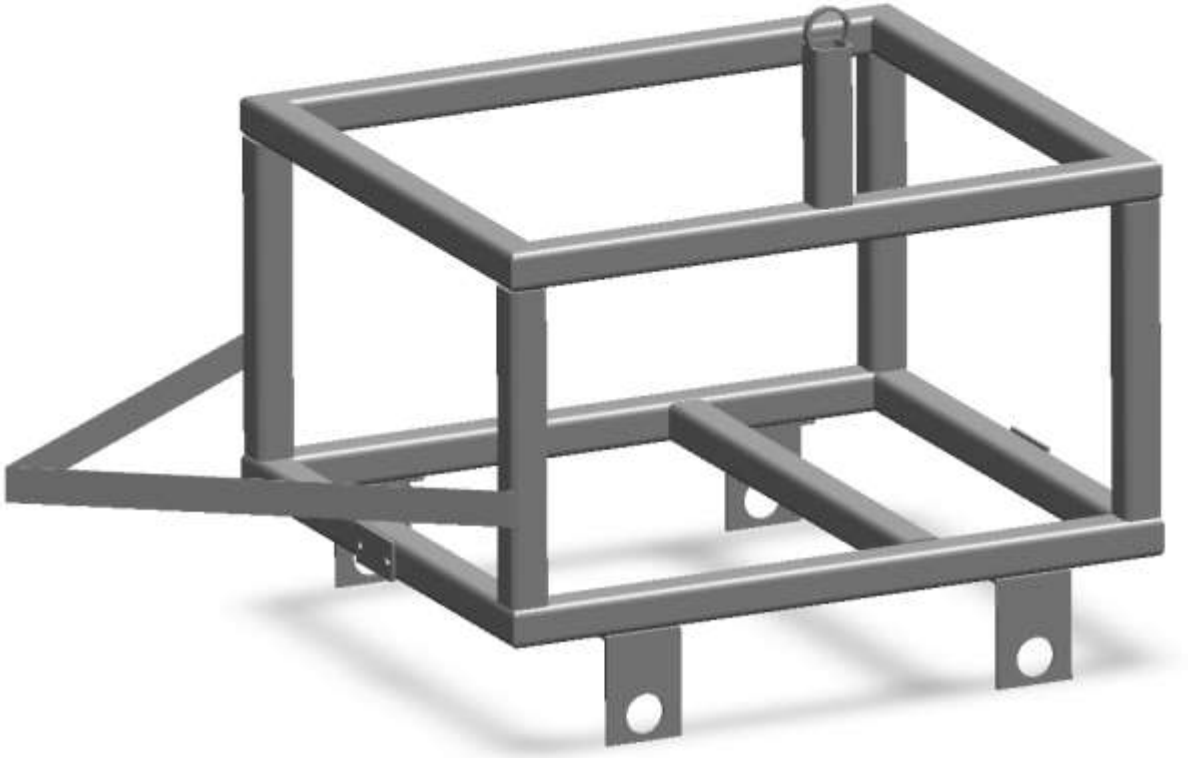
Mechanical Assembly : The mechanical assembly involved constructing the frame and chassis of the robot using SS material, ensuring durability and strength. The ploughing mechanism, seed dispenser, water spraying system, and sand levelling apparatus were integrated into the design, providing robust functionality.

Electronics and Control System: Arduino was utilized for software development and coding purposes. The electronic components, including microcontrollers, motor drivers, and communication modules, were integrated into the robot. The mobile phone-based control system was developed using an Android application to enable seamless operation and control of the robot's functions.

Software Development : Arduino was used for coding and software development, allowing for programming of the microcontrollers and establishment of communication between the mobile phone and the robot. Custom software was created to enable precise control of the robot's movements, seed dispensing rate, water spraying intensity, and sand levelling depth.

Testing : Extensive testing was conducted to validate the performance and functionality of the agricultural robot. Field trials were carried out to assess its ploughing capabilities, seed dispensing accuracy, water spraying uniformity, and sand levelling efficiency. Based on the results, necessary optimizations were made to improve the robot's performance.

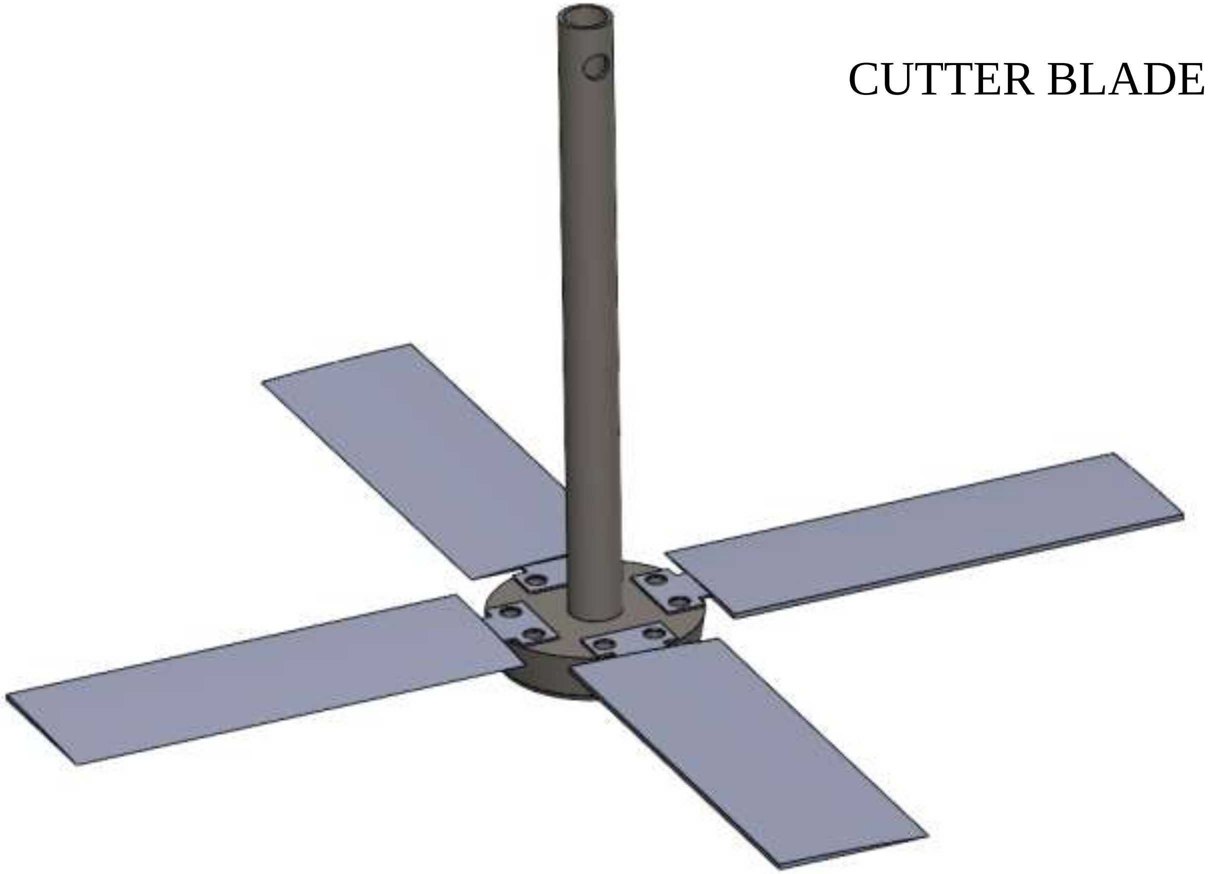
PART MODELS



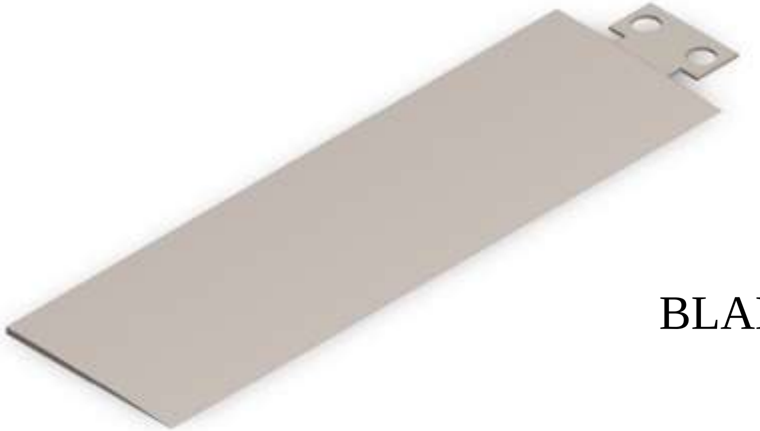
FRAME

LEFT WHEEL

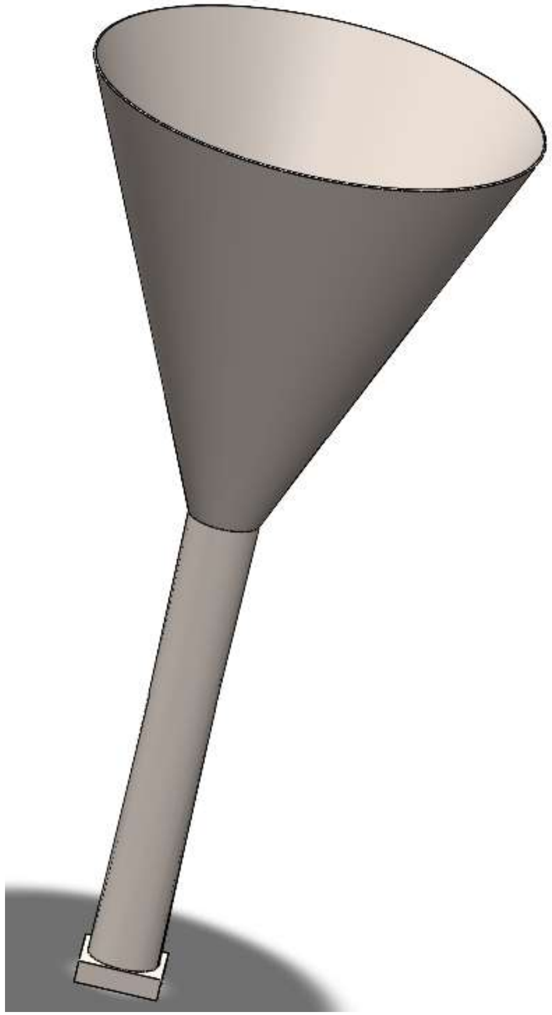
RIGHT WHEEL

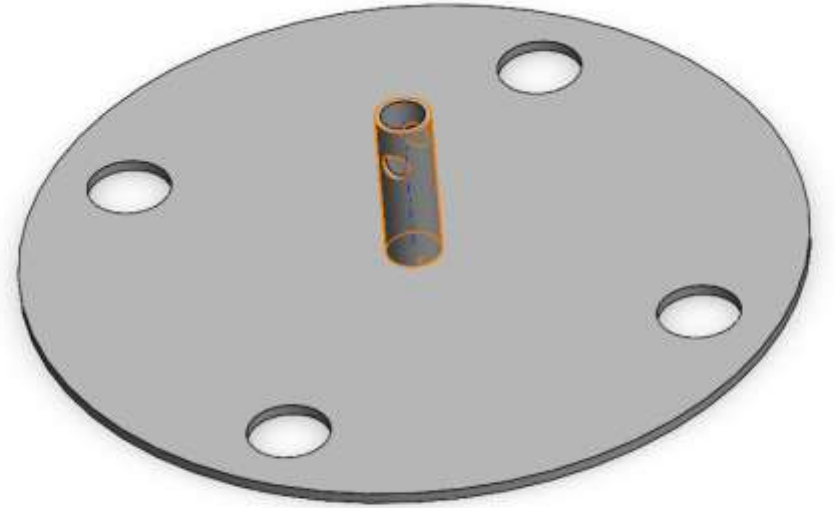


CUTTER BLADE



BLADE



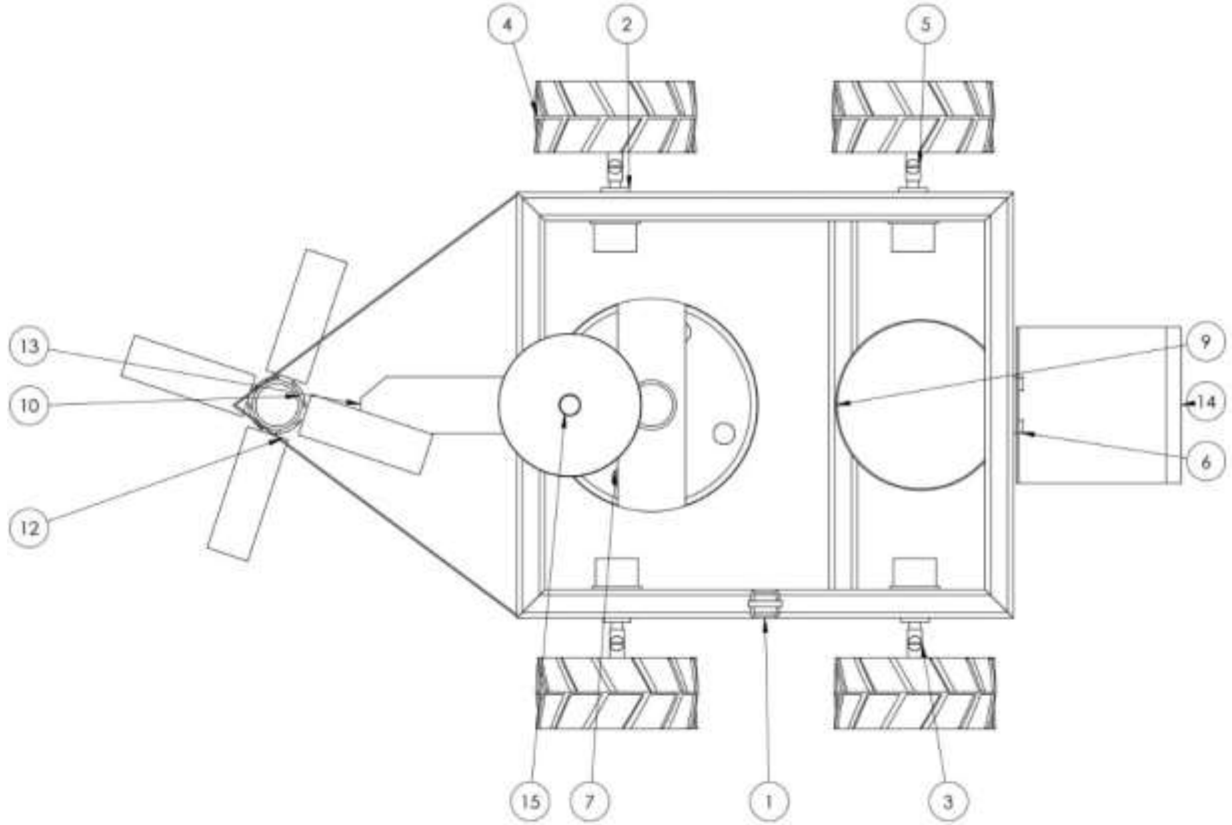


FUNNEL

DISC

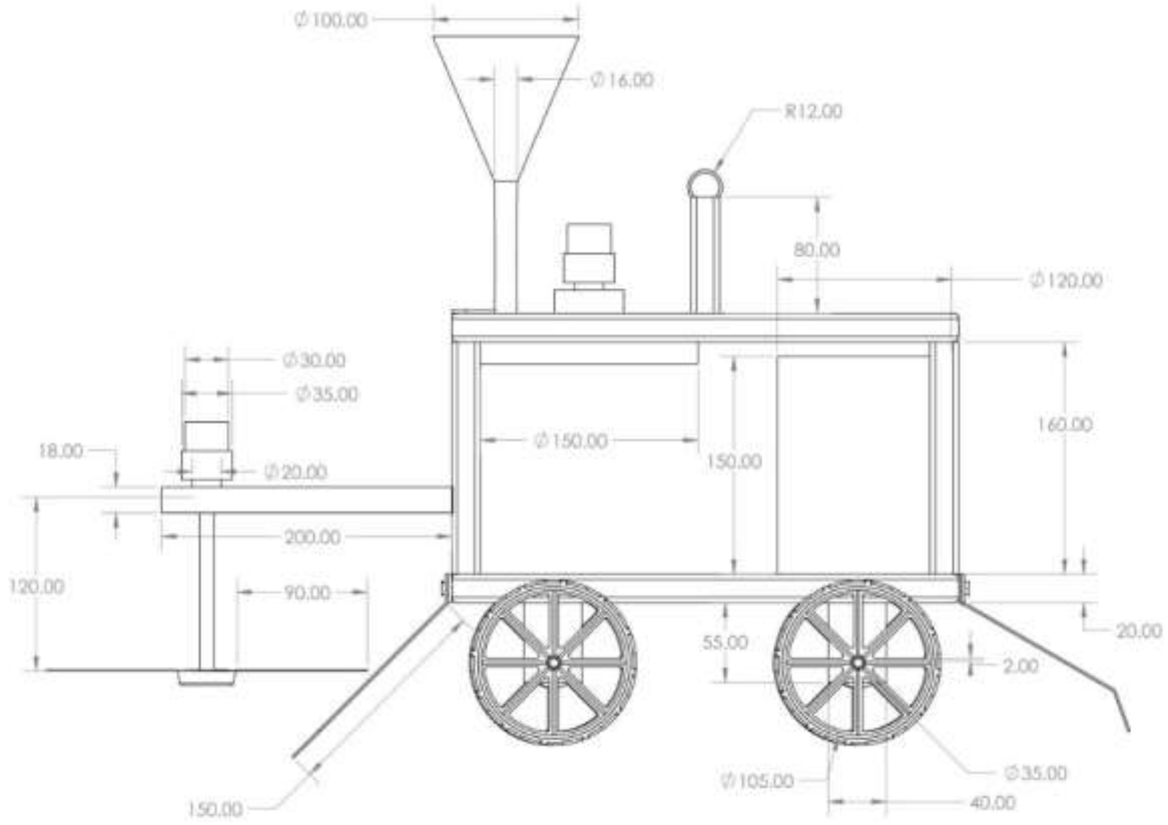
DC MOTOR 12 VOLTS

LABELLED DIAGRAM AND BOM

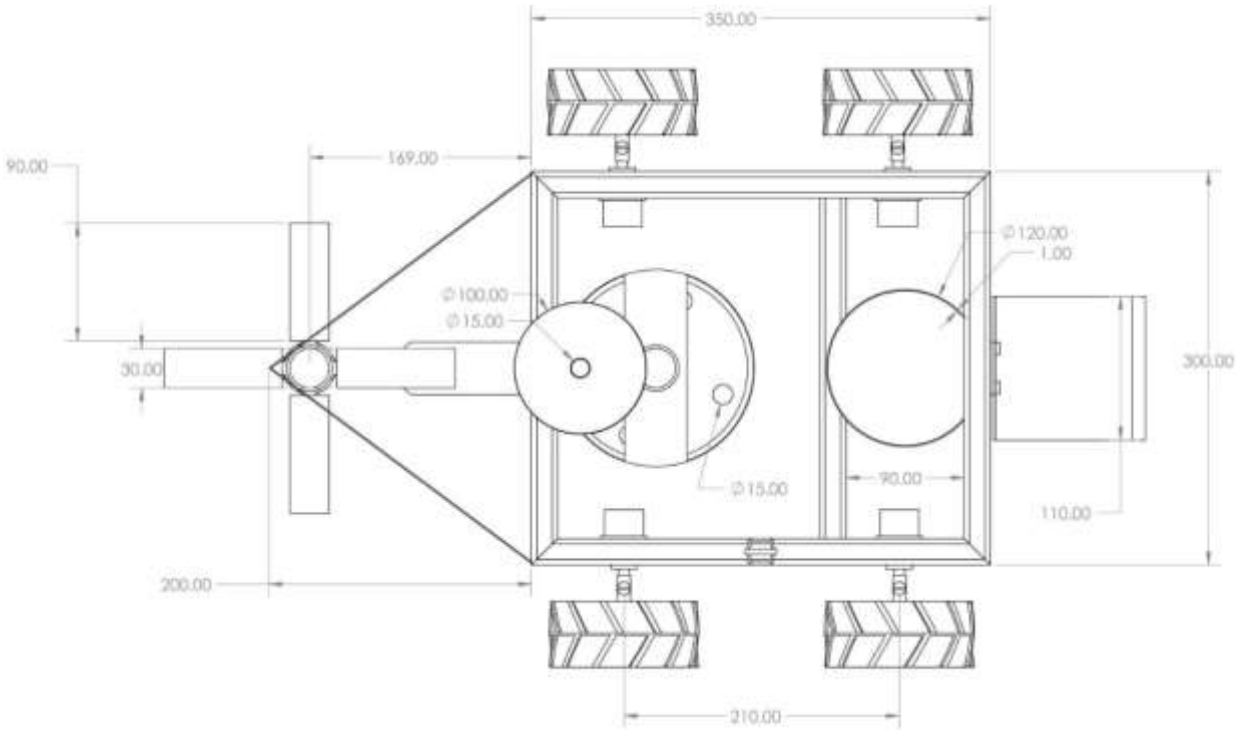


ITEM NO.	PART NUMBER	QTY.
1	base model side plate	1
2	motor	4
3	wheel left 2	2
4	wheel right 2	2
5	motor nut	5
6	NUT BASE	4
7	SEEDING MOTOR	1
8	CHIP PART FUNNEL	1
9	tank	1
10	motor for cutter	1
11	cutter chip	1
12	cutter base	1
13	digging plate f	1
14	levelling plate final	1
15	funnel	1

FRONT VIEW



TOP VIEW



CAD MODEL

Materials used

1. Frame body - mild steel
2. Cutter blade – stainless steel
3. Tank - plastic
4. levelling blade - mild steel
5. Digger plate – Mild steel
6. Funnel – Stainless steel
7. Rotating disc-Stainless steel
8. Tyre-Rubber
9. Welding-Arc welding

Calculations

1. Calculation of cutter

P=(2*pi*N*T)/(60)

15=(2*3.1414*1000*T)/(60)

T=(15*60)/(2*3.1415*1000)

T=0.1432 Nm

2. Selection of motor (wheel)

Total load of the agriculture robot = 90 N

Power required by the vehicle to carry load is given by

P=W*V   (V=Velocity of motor = 0.15m/s)

Power of motor (cutter)

P=V*I
P=12*1.3
P=15.6 watts

Calculations

P = W*V

P = 90*0.15

P = 13.5 watts

P = power watt
W = force(weight)
V = velocity

3. DC Motor Calculation

P=(2*pi*N*T)/(60)

13.5 = (2*3.1415*10*T)/(60)

13.5*60 = 2*3.1415*10*T

T = 12.9 Nm

T (each wheel) = 3.225 Nm

P = power watt
N = Speed rpm
T = Torque Nm

Calculations

4.Volume of tank

V=pi*r*r*h

V=(3.14*60*60*165) mm^3

V=1.8 litres

r = Radius of tank
h = height of tank

5 Water pump

Input voltage, DC = 12V

Flow rate = 1.2-2.6 kg/sec

Operating current=0.1-0.2 A

Suction diameter=0.8 m

Calculations

6. Flow rate of nozzle

Q=28.9*d*d*sqrt(P)

Q=0.79 lit/min (experimentally checked)

Q=0.21 gpm (converted)

0.21=28.9*0.11*0.11*sqrt(P)

P=0.36

Q = Flow rate of nozzle(gpm)
D = Nozzle diameter(inch)
P = pressure at nozzle(psi)

Ploughing force

Effective plough width (w) = 6 inches => 0.1524 m {1 inch = 0.0254 m}

Effective plough depth (d) = 1 inches => 0.0254 m

Area of soil being disturbed (A) = w*d => 0.1524*0.0254 m^2

=> 0.00387396 m^2

Ploughing force = Specific resistance of loamy soil *Area {loamy soil resistance =6000N/m^2}

=> 6000 N/m^2 * 0.00387396 m^2

=> 23.2438 N

Ploughing force

For 1 blade => 23.2438 N

For 5 blade => 116.219 N

Ploughing force in real world application

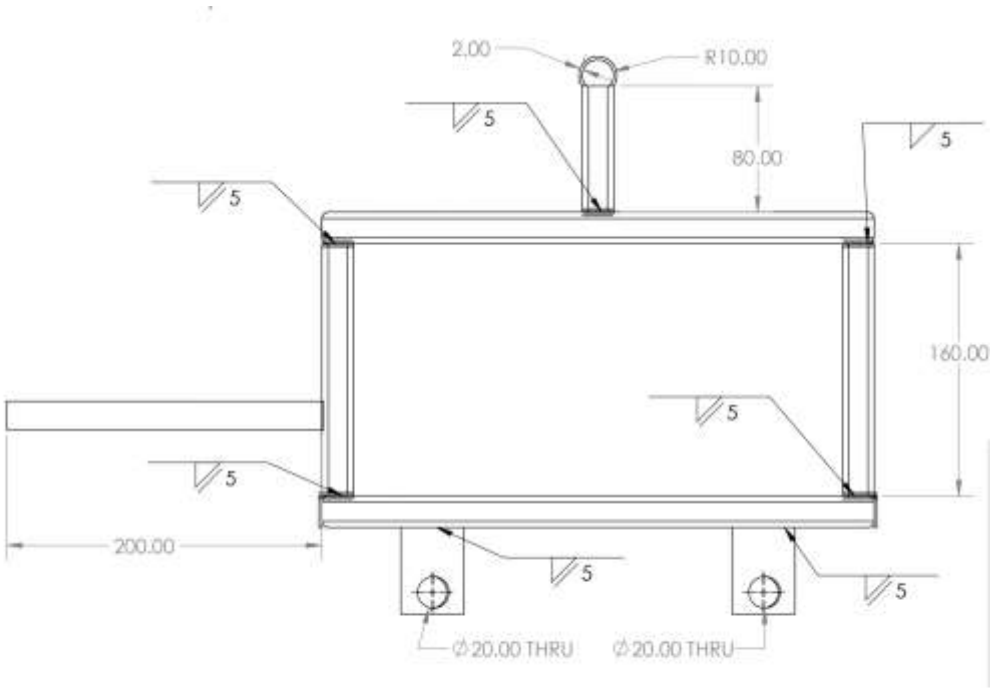
Varies from 1000-2000 N

Blade dimensions, w = 12 inch, d = 6 inches.

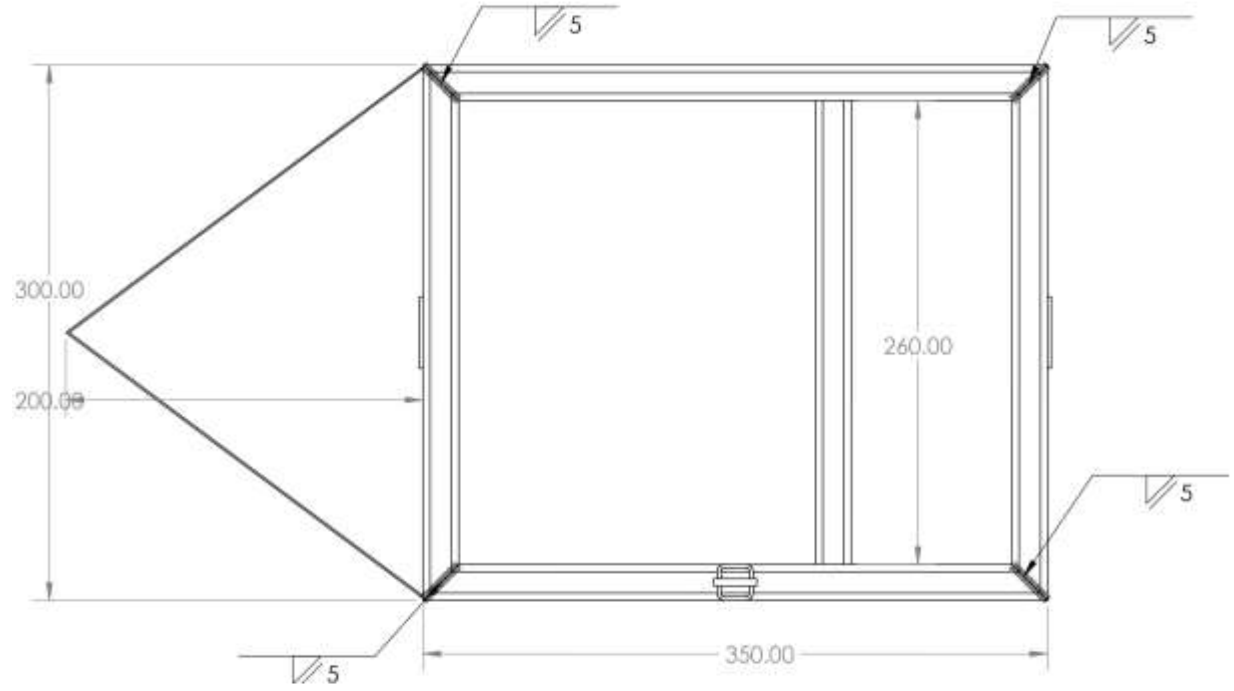
Ploughing force = 278.70912 N (1 blade)

BASE DIMENSIONS AND WELDING PLACES

FRONT VIEW



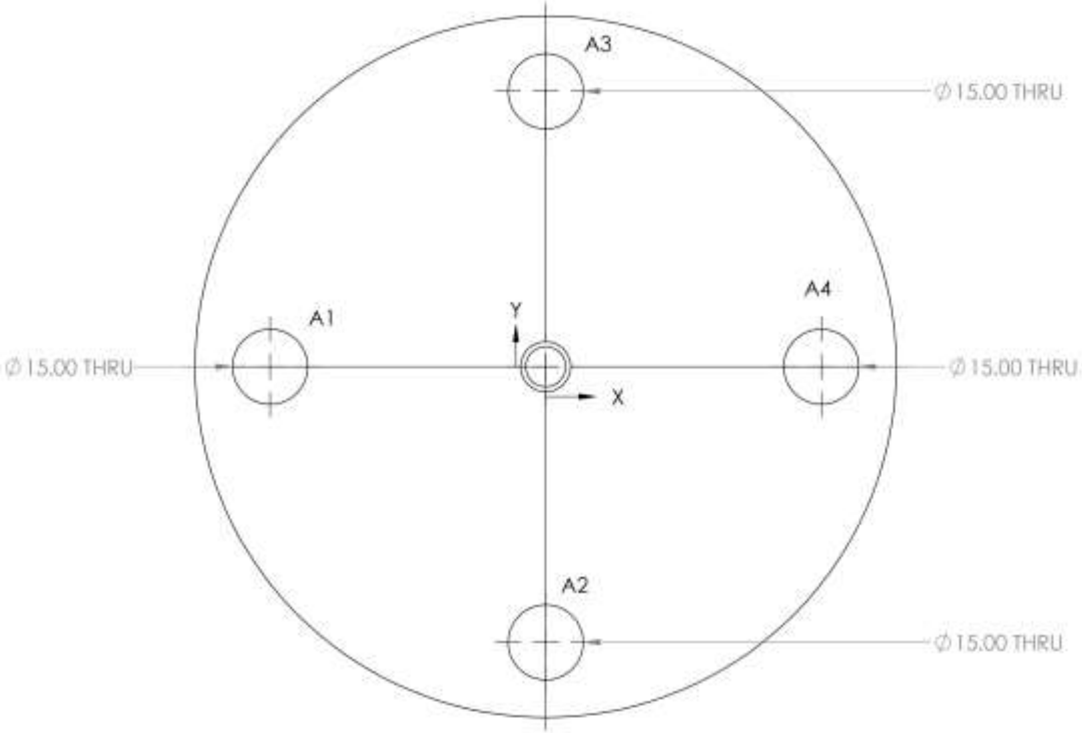
TOP VIEW



LENGTH	DESCRIPTION	QTY.
350	TUBE, SQUARE 20.00 X 20.00 X 2.00	4
300	TUBE, SQUARE 20.00 X 20.00 X 2.00	4
160	TUBE, SQUARE 20.00 X 20.00 X 2.00	4
260	TUBE, SQUARE 20.00 X 20.00 X 2.00	1
80	TUBE, SQUARE 20.00 X 20.00 X 2.00	1

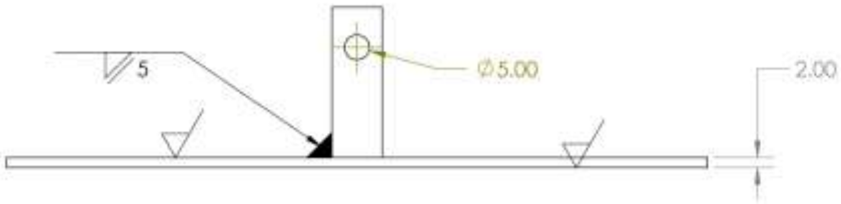
TUBE TABLE

SEEDING PLATE DIMENSIONS AND WELDING PLACES

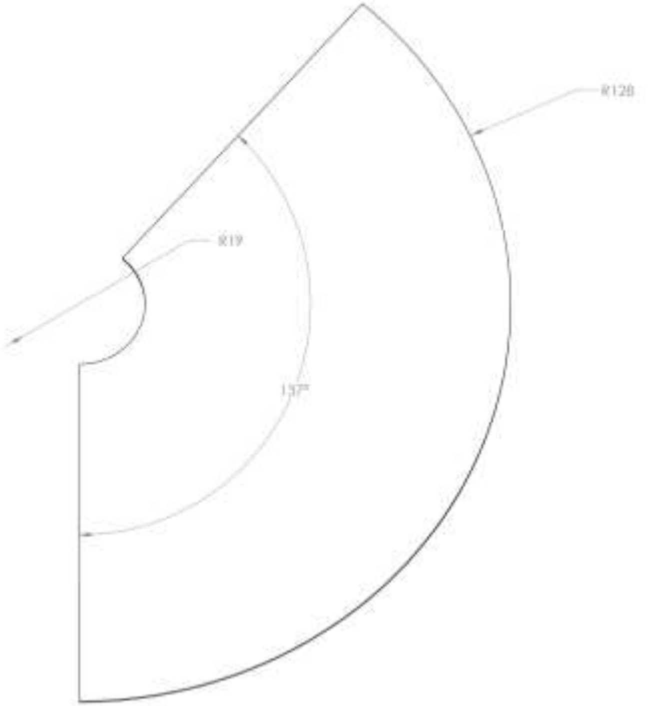


HOLE TABLE

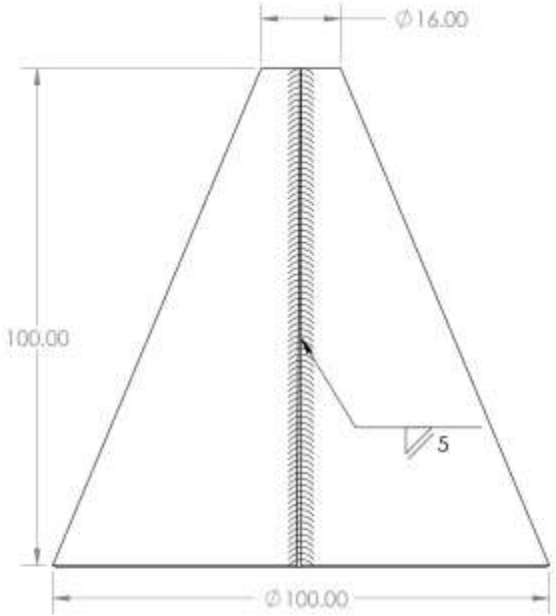
TAG	X LOC	Y LOC	SIZE
A1	-55	0	∅15.00 THRU
A2	0	-55	∅15.00 THRU
A3	0	55	∅15.00 THRU
A4	55	0	∅15.00 THRU



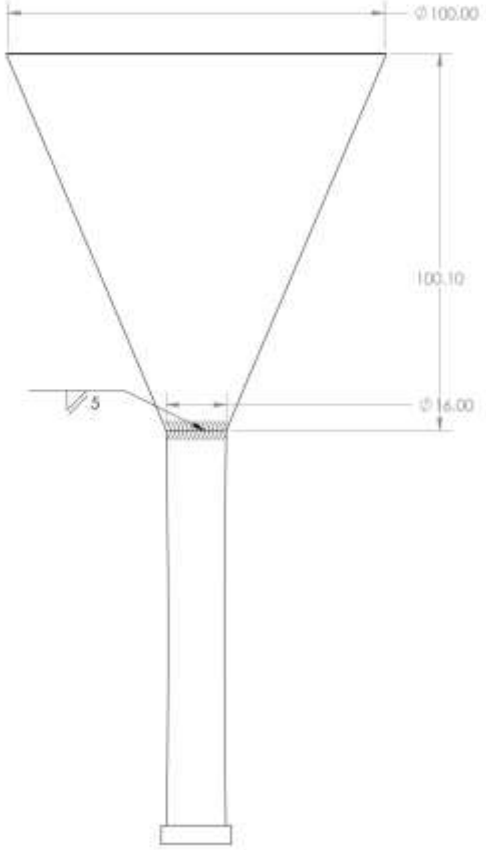
FUNNEL DIMENSIONS AND WELDING PLACES



FLATTEN SHEET METAL

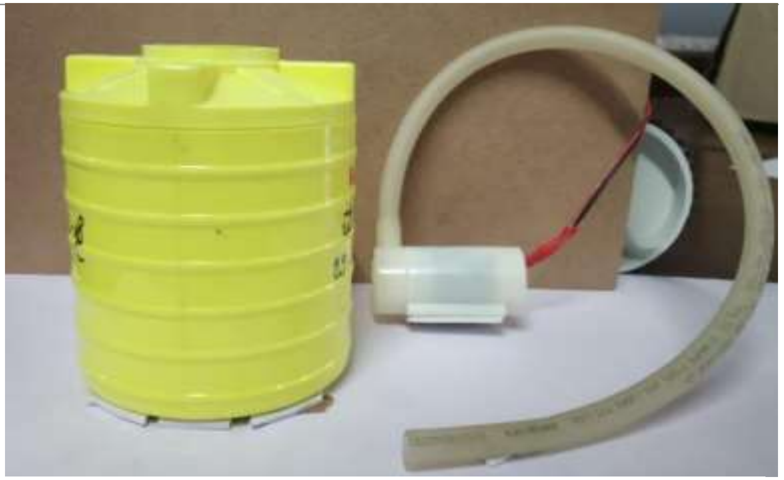


FUNNEL WITH WELDING



FUNNEL WITH LONG TUBE

Sprinkling(Operation)



Steps

1. Submersible pump

2. Water Intake

3. Pumping mechanism

4. Water Delivery

5. Brass Nozzle

Flow rate of nozzle

Q=28.9*d*d*sqrt(P)

Ploughing

Process of ploughing happens because of ploughing blade.

Amount of ploughing force depends on

1. Soil resistance

2. width of blade

3. depth of blade

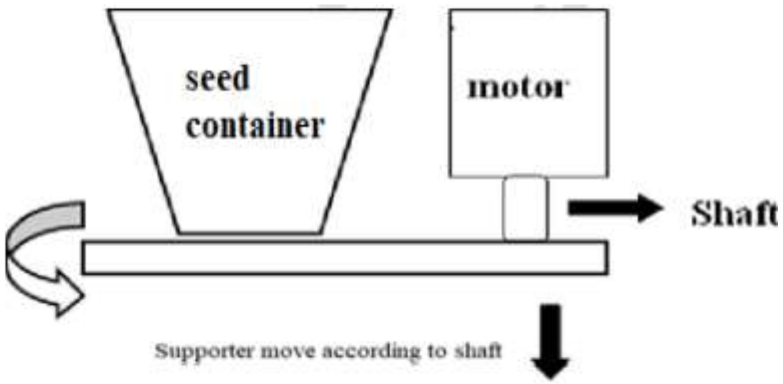
Soil resistance of loamy soil = 6000 N/m^2

Ploughing force = Soil resistance*Area of ploughing blade

Seeding

<u>Main Components</u>

1. DC motor
2. funnel
3. Seeding plate



<u>Seed Dispensing mechanism</u>

1. Connect the seeding plate to the DC motor.
2. Join the base of funnel with holes on seeding plate with Very low clearence.

Cutting

<u>Main Components</u>

1. Two sharp cutter blades

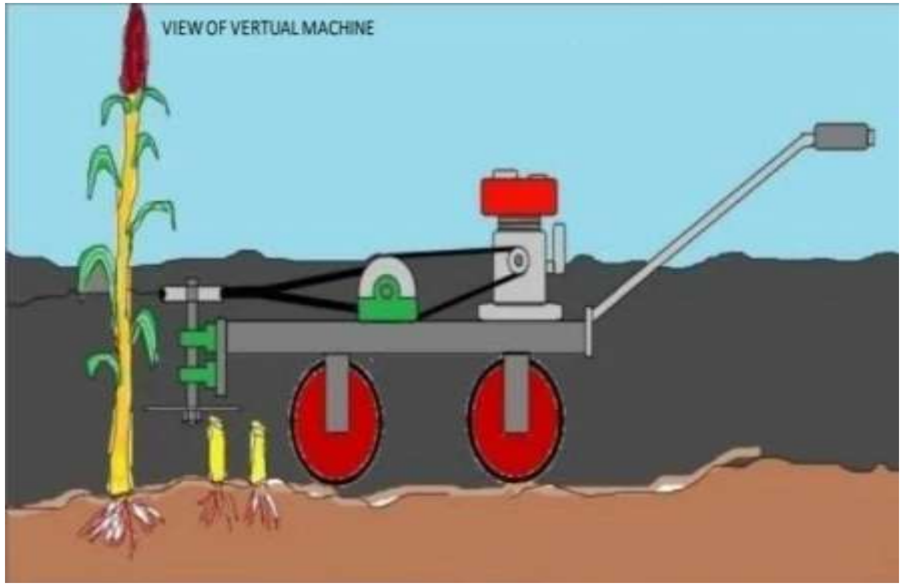
2. DC motor

Power of motor = V*I

For cutter, N=1000 rpm

<u>Torque</u>

P = (2*pi*N*T)/(60)



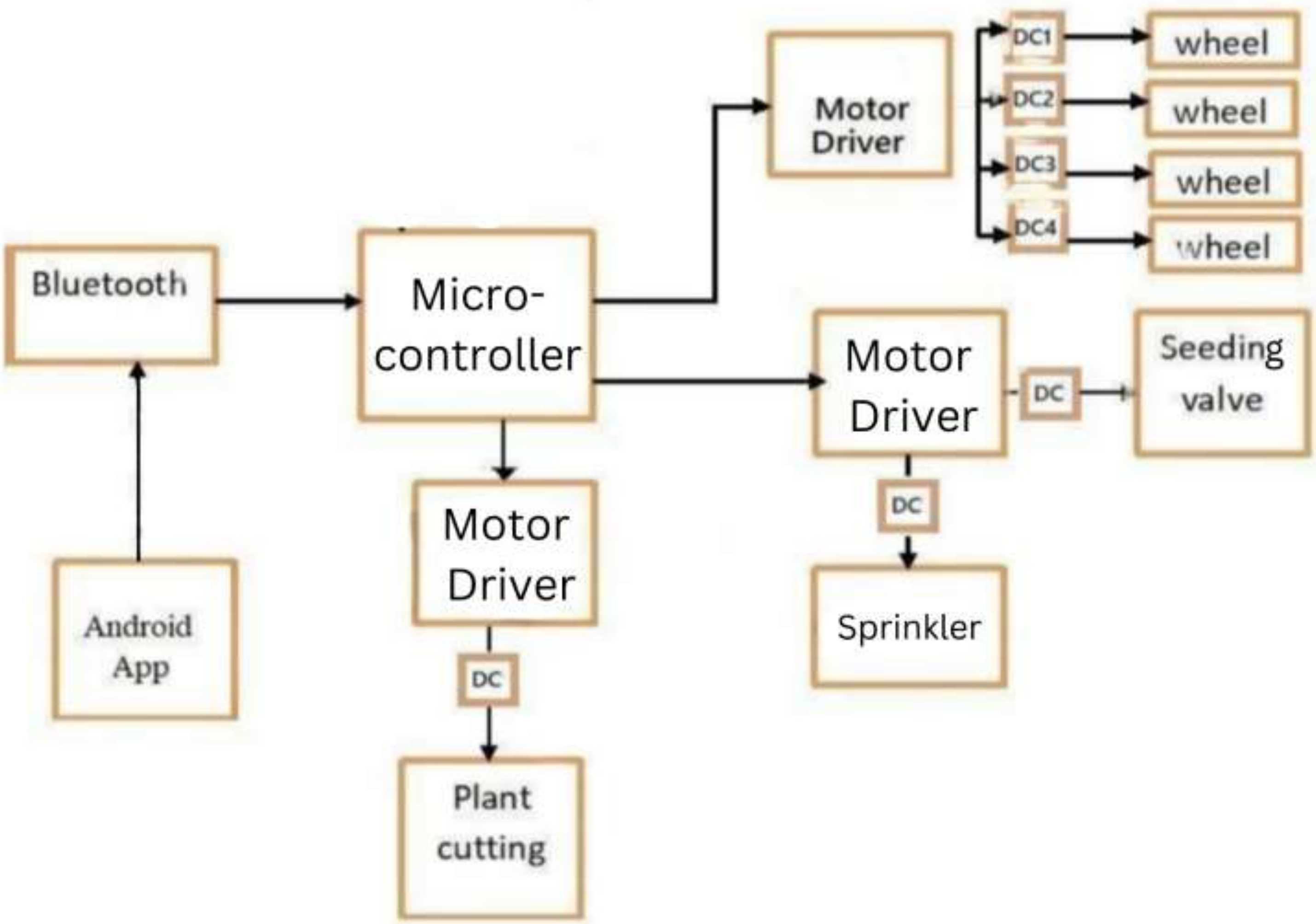
Levelling

Flat inclined plate used for this purpose.

When robot starts moving forward, the even surface has up’s and down’s leveler will make all the area to flat surface.

FINAL FABRICATION

BLOCK DIAGRAM OF ELECTRONIC PART



ELECTRONIC PART USED FOR THE PROJECT

This section gives details of the hardware components required for the system implementation and deployment. Agricultural robot requires the following hardware components: Arduino Uno , DC motor, H-bridge, water pump & L293d motor driver.

ARDUINO UNO

Arduino is an open source computer hardware and software that designs single-board microcontrollers; the products are shared as an open source hardware and software .

Arduino UNO specification:

- Its operating voltage is 5v.
- Required input voltage is 7-12V.
- The input voltage limits to 6-20V.
- There are 6 analog inputs.
- There are 14 digital input and output pins.

DC MOTORS

Almost every mechanical movement that can see around is caused by an AC (alternating current) or DC (direct current) electric motor.

H-BRIDGE

An h bridge is an electric circuit that switches the polarity of a voltage applied to load. These circuits are often used in robotics and other applications to allow DC motors to run forward or backwards. The h bridge arrangement is generally used to reverse the polarity/direction of the motor, but can also be used to ‘break’ the motor, where the motor comes to a sudden stop.

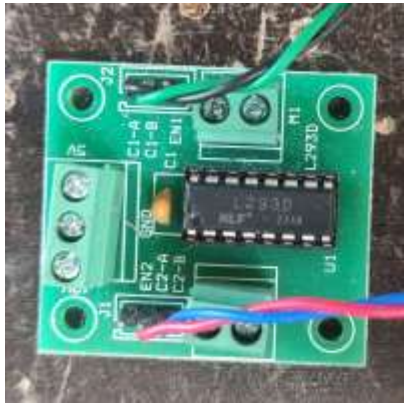
WATER PUMP

These water pumps are used to spray the water by detecting the moisture level of the soil while the farming pesticide pump is used to spray the particular pesticide onto the leaf when it is attacked with some disease which will be stored in the database. These pumps are cost effective and easy to use.

L293D

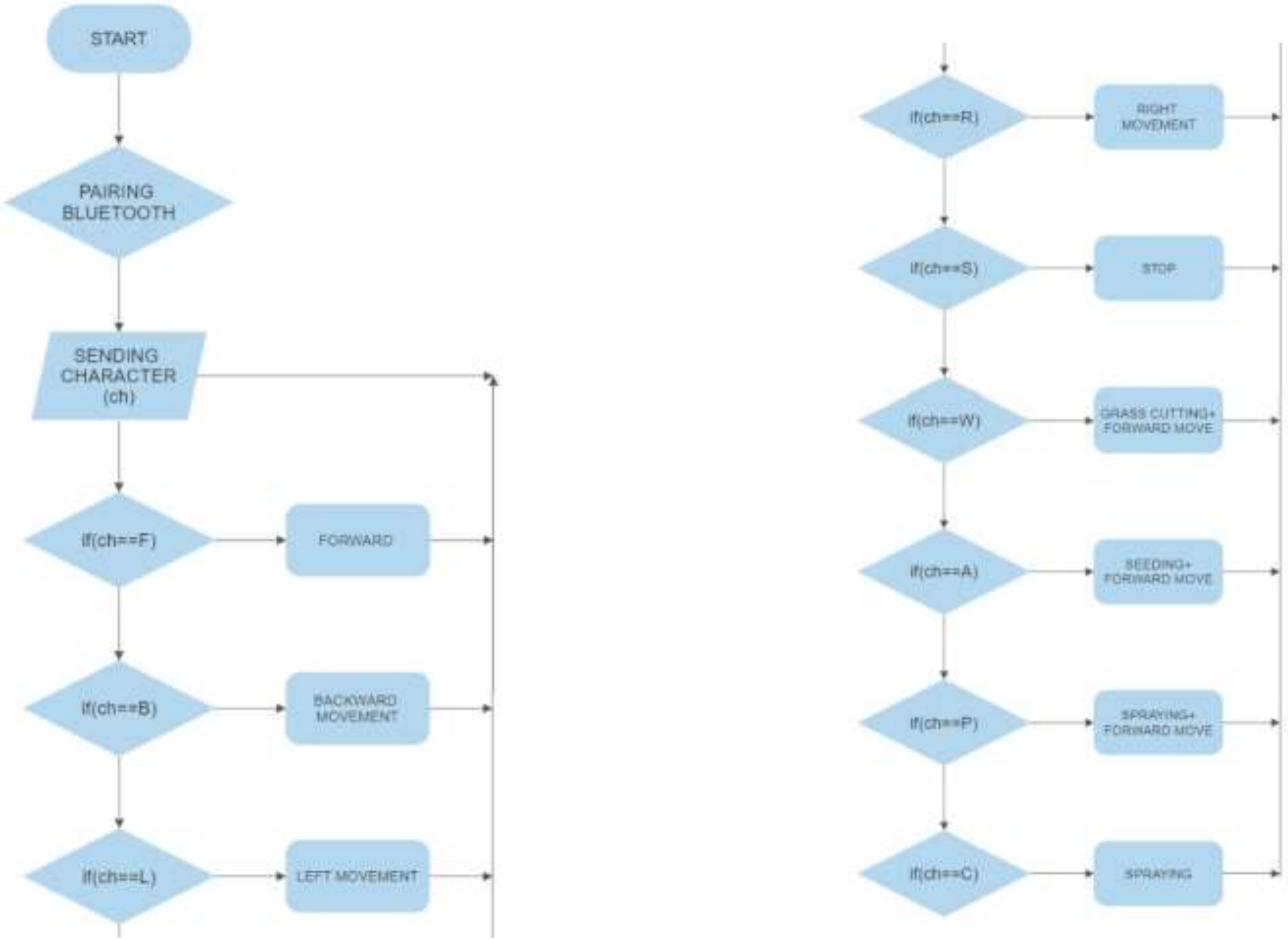
The L293D is a popular 16-Pin **Motor Driver IC**. As the name suggests it is mainly used to drive motors. A single **L293D IC** is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently.

L293D



Water pump

ALGORITHM CODE



FABRICATION

First step in Fabrication was to fabricate a base model which is made of the mild steel. Here we have used arc welding for joining.

Arc welding is a welding process that utilizes an electric arc to join metals together. It is one of the most common and widely used welding methods in industries such as construction, manufacturing, and repair.

Fabrication of the mechanical part is completed here.

References

[1]. Bharath Mishra, Sumit Nema, Mamta Lambert, Swapnil Nema ‘Recent Technologies of leaf Diseases Detection using Image Processing Approach- A Review’ 2017 International Conferences On Innovation In, Embedded and Communication System 17-18 March 2017

[2]. Gulam amer, S.M.M.Mudassir, M.A Malik 2015 ‘Design and Operation of wi-fi Agribot Integrated System’ international conference on industrial instrumentation and control(ICIC) may 28-30,2015

[3]. Rahul D S, Sudarshan S K, Meghana k, Nandan K N, R Kirthana and Pallaviram Sure ‘IoT Solar Powered Agribot for Irrigation and Farm Monitoring’ Second International Conference on Inventive Systems and control(ICISC 2018)

[4]. Mr. V.Gowrishankar, Mr.Venkatachalam ‘IOT Based Precision Agriculture Using Agribot’ 2016 Global Research And Development Journal For Engineering

[5]. Rahul D.S, Sudarshan S.K, Meghana K, Nandan K N, R Keerthana, Pallaviram Sure ‘Agribot For Irrigation And Farm Monitoring’ Proceedings Of The Second International Conference On Inventive Systems And Control(ICISC 2018)

[6]. Qingfeng Wei, Chenxue Zhong, Jun Yu, Changshou Luo, Lei Chen ‘Agricultural Robotics: Unmanned Robotic Service Units In Agricultural Tasks’ 2018 2nd IEEE Advanced Information Management, Communicates, Electronic And Automation Control Conference(IMCEC)

[7]. Ege Ozgul, Ugur Celik ‘Review Of Wheeled Mobile Robots ‘ Navigation Problems And Application Prospects In Agriculture’ 2018 5th International Conference On Electrical And Electronic Engineering(ICEEE)