DAYANANDA SAGAR COLLEGE OF ENGINEERING

SHAVIGE MALLESHWARA HILLS, KUMARSWAMY LAYOUT, BANGALORE-78

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

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

Department of Mechanical Engineering

PROJECT REPORT

On

"DESIGN AND FABRICATION OF MULTIPURPOSE AGRICULTURAL ROBOT"

By

SARRAF SHANUJ 1DS19ME129

MADHAV SINGHANIA 1DS19ME081

KSHITIJ PODDAR 1DS19ME076

NITISH KUMAR 1DS19ME095

VIII SEMESTER

Under the guidance of

Prof. Ravi Kumar. S. R

Asst. Professor, Dept. of Mechanical Engg.,

DAYANANDA SAGAR COLLEGE OF ENGINEERING, Bangalore

ACADEMIC YEAR 2022-23

DAYANANDA SAGAR COLLEGE OF ENGINEERING

Accredited by National Assessment & Accreditation Council (NAAC) with 'A' Grade *(AICTE Approved, an Autonomous Institute Affiliated to VTU, Belagavi)* Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-560078

DEPARTMENT OF MECHANICAL ENGINEERING

(Accredited by NBA)

Certificate

Certified that the project report entitled **'Design and fabrication of multipurpose agricultural robot'** is a bonafide work carried out by **Mr. Sarraf shanuj** , bearing USN**: 1DS19ME129**, **Mr. Madhav Singhania** bearing USN**: 1DS19ME081, Mr. Kshitij Poddar** bearing USN**: 1DS19ME076**, **Mr. Nitish Kumar** bearing USN: **1DS19ME095** under the guidance of **MR. RAVI KUMAR S.R** , **Asst. Professor** , Department of Mechanical, Dayananda Sagar College of Engineering, Bengaluru, in partial fulfilment for the award of Bachelor of Engineering in Mechanical Engineering under Visvesvaraya Technological University, Belagavi.

Mr. Ravi kumar. S. R
Assistant Professor, Dept. of Mech. Engg
Dayananda Sagar College of Engineering.
Bengaluru

Dr. R. Keshavamurthy
Professor & Head, Dept. of Mech. Engg
Dayananda Sagar College of Engineering.
Bengaluru

Dr. B. G. Prasad
Principal
Dayananda Sagar College of Engineering.
Bengaluru

DECLARATION

We the below mentioned students hereby declare that the entire work embodied in the project report entitled '**Design and Fabrication of multipurpose agriculture robot**'' has been independently carried out by us under the guidance of **Mr. Ravi Kumar. S. R,** Assistant Professor, Department of Mechanical Engineering, Dayananda Sagar College of Engineering, Bengaluru, in partial fulfillment of the requirements for the award of Bachelor Degree in Mechanical Engineering of Visvesvaraya Technological University, Belagavi.

I further declare that I have not submitted this report either in part or in full to any other university for the award of any degree.

S. NO.	NAME	USN	SIGNATURE
1	KSHITIJ PODDAR	1DS19ME076	
2	MADHAV SINGHANIA	1DS19ME081	
3	NITISH KUMAR	1DS19ME095	
4	SARRAF SHANUJ	1DS19ME129	

SL.NO.	Name of the Examiner	Signature with Date
1.		
2.		

ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to **Dr. B. G. PRASAD**, Principal, DSCE, who has given us an opportunity to successfully complete our project.

It gives us an immense pleasure to thank **Dr. R. KESHAVAMURTHY**, Head of the Department, Mechanical Engineering, DSCE, for his valuable advice and guidance which has helped us complete our project.

This project would not have been profound without the persistent encouragement of our beloved internal guide **Mr. RAVI KUMAR. S. R**, Associate Professor, Department of Mechanical Engineering, DSCE, whose sound technical knowledge helped us immensely throughout our project. His symmetric approach towards documentation and discipline towards work fostered us to put in better efforts. He with his immense experience also predicted the forthcoming practical problems and mentored us to tackle these problems with ease.

Finally, we express our gratitude to all the teaching and non-teaching staff, who has indirectly helped us to complete this project successfully. Last but not the least we would like to thank our parents for their blessings and love. We would also like to thank our friends for their support and encouragement to successfully complete the task by meeting all the requirements.

ABSTRACT

This project deals with manufacturing and development of robots in agricultural applications. The main area of application of robots in agriculture is at the harvesting stage, digging, ploughing and seeding. This robot is designed to replace human labor. The jobs involved in agriculture are not straightforward and many repetitive tasks are not required to do, so the agricultural industry is behind other industries in using robots. This paper represents a robot capable of performing operations like automatic ploughing, seed dispensing and pesticide spraying. It also provides manual control when required. The main component here is the microcontroller that supervises the entire process. Initially the robot digs the entire field simultaneously dispensing seeds side by side. On the field the robot operates in automated mode. For manual control the robot uses the Remote controller as control device and helps in the navigation of the robot on the field.The aim of this paper is to create an intelligent spraying robot that will decrease pesticide use and human health damage, allowing farmers to be protected and labour intensity can be reduced. The robot will have full route planning and navigation systems, as well as driving control, spraying mechanism and system construction.

CONTENTS

LIST OF FIGURES

1. Introduction

Farmers today spend a lot of money on machines that help them decrease labour work and increase yield of crops. There are various machines that are available for ploughing, harvesting, spraying pesticides etc. These machines have to be manually operated to perform the required operations and moreover separate machines are used for every function. The yield and profit returns from employing this equipment are very less as compared to the investment. Another issue is the growing demands of the world’s population. Automation is the ideal solution to overcome all the above mentioned shortcomings by creating machines that perform more than one operation and automating those operations to increase yield on a large scale. All kinds of agricultural robots have been researched and developed to implement a number of agricultural productions in many countries, such as picking, harvesting, planting, grafting, agricultural classification, etc. And they gradually appear as advantages in agricultural production to increase productivity.

Autonomous agricultural robots are an alternative to the tractors found on fields today. Cultivation tasks like seeding, spraying, fertilizing and harvesting may be performed by autonomous agricultural robots in the future. To reach full utilization the agricultural robot needs to be a vehicle with some basic capabilities and the possibility to support multiple applications. In the current generation, man power shortage is a major problem specifically in the agricultural sector and it affects the growth of developing countries. In India at most 70% of people are dependent on agriculture. The revolutionary invention in the agriculture system is becoming an important task because of rising demand on the quality of agricultural products and lack of labour availability in rural farming areas.

Agriculture is the process of cultivation of plants for producing food, fiber and other desired products. Agriculture has been chosen as the primary occupation by more than 42% of the total population in the world. Since more than 70% of the Indian population depends on agriculture, it is called the ‘Backbone of India’.

According to recent studies it has been found that farmers still follow traditional methods to carry out agricultural activities because of which the labor force is increased and accuracy of the final outcome is decreased. This project aims to solve agriculture related issues and increase accuracy of the final outcome by developing an agricultural robot which does agricultural tasks automatically such as ploughing, leveling, seeding and irrigation along with detection of leaf disease and indicating the farmer with suitable pesticide

The main aim of Agribot is to apply robotic technologies in the field of agriculture. Automation in agriculture is being developed to implement a number of agricultural activities without any man force. Most of the countries follow the traditional methods for ploughing, seeding, leveling, and irrigation of plants. The traditional ploughing method includes animals such as buffalo or oxen that draw the soil using a tool called plough attached to them and some farmers plough using tractors. In most of the places, the seed sowing is carried out by scattering the seeds over the required area.

Leveling of soil is carried out by buffalo or oxen or a two-wheel tractor using harrows and leveling boards. These techniques are carried out on wet soil and require seven to eight days for a two-wheel tractor and twelve days using draft animals for leveling per hectare of land. The other method of leveling the soil is by using a four-wheel tractor, here it takes about eight hours to level one hectare of land.

These methods have the disadvantages of increased labor force; tractors can be expensive; and a tractor's work rate depends on the tractor's capacity and the amount of soil on which it works. Poorly maintained tractors can cause environmental pollution; a well trained and experienced person is required for maintenance and driving of the tractor.

1.1 Overview

The robotic systems play an immense role in all sections of societies, organization and industrial units. When it is solar powered it will make the module eco friendly.The basic idea in this study is to develop a mechanized device that helps in on-farm operations like seeding/seed sowing at pre-designated distances and depths with all applicable sensors for controlling humidity, temperature.

This system has two main sections, monitoring station and control station, which are inter-communicated using/aided by the wireless Wi-Fi communication technologies. The control station as well as robotic station possesses the amenities which are soil moisture sensor, seed dispenser, and seed storage, robotic system with motors, Arduino microcontroller, and power supply.

The microcontroller is the brain of this system, which can dedicate the order of suggestions received to all the networks, and sensible factors processed by their corresponding embedded programs. Robotic mechanisms are played by their internal motors and motor drivers that drive the motors in desired directions. The Wi-Fi wireless protocol used for signal transmitting and receiving functions. The ADC is an approximation analog to digital converter and helps in processing of analog factors in the microcontroller.

Here the one will monitor the robot and send the signal. According to the received signal the robot will move in the direction and it will place the seed on the field for a specified distance.

Solar panel is used for an independent power source which will be connected to a battery.

AUTOMATIC IRRIGATION SYSTEM (EXISTING SYSTEM)

The irrigation process used for cultivation of crops in order to supply the required amount of water to them during inadequate rainfall can be automated. Though irrigation technique varies depending on soil type, water availability and type of crop. An automatic system can be developed using micro-controllers which can adapt to any type of irrigation method with a main objective to cut down the man power once and for all after its installation. Some of such systems which differ in their circuits, components used and their way of working are elaborated here.

Automatic Irrigation System Based on Soil Moisture Sensing

In this system, an 8051 microcontroller is used to control and coordinate the entire process of irrigation. The required power of 5v is given by a supply circuit that contains a transformer, bridge rectifier circuit and a voltage regulator. The soil moisture content is measured by using two metallic rods. These metallic rods are inserted in the soil and their output is given to an OP-AMP IC which acts as a comparator and compares the sensed value with the fixed value. The output of this OP-AMP is given to the 8051 controller which ON (or) OFF the submersible pump of the motor through a relay driver circuit.

Solar Powered Auto Irrigation System

This system is an enhancement of the above mentioned system .Here the power required to drive the entire system is obtained by harnessing solar energy by using photovoltaic cells. The moisture content of the soil is determined by inserting two stiff copper wires in the soil which output is given as input to
OP-AMP IC -the comparator. The output of comparator is given as input to 8051 which decides whether the motor to be ON (or) OFF and implement it through driver circuit

GSM Based Automatic Irrigation System

In this system, a GSM modem is used for indicating the Status of the irrigation system. Here, the soil moisture is sensed by a sensor whose output is given as input to 8051 microcontroller. Depending on the result of the soil moisture sensor, the motor is switched ON or OFF by 8051 through the motor driver circuit or relay. The status of the motor is indicated to the farmer through the SMS by the GSM module. Similarly the farmers can control the irrigation system through an SMS.

Drawbacks of Present Farming Techniques

In the present Indian farms the farmer has to spray the pesticides manually. The manual spraying makes them easily susceptible to hazardous diseases mostly like air borne and water borne. The process of pesticide spraying involves large amounts of human labor thus making more humans prone to diseases. There is no other alternative to manual spraying in Indian open farms.

Over usage of pesticides can cause degradation in soil. This happens mostly because the farmer hires labor for the work and the labor is unskilled.

Until now the technologies used in farms are outdated and the present farming needs revolutionary techniques of farming.

2. Literature survey

Agriculture has a rich history in India and the country holds the second position in farm output globally. In 2013, agriculture and allied sectors accounted for 13.7% of India's GDP, and around 50% of the workforce depended on farming. However, the contribution of agriculture to India's GDP has been steadily declining as the country has shifted its focus away from farmers. Despite this, agriculture remains the largest sector and plays a significant role in the social fabric of India.

The expansion of automobile industries, mills, and factories in India has brought benefits in terms of job opportunities and products. However, it has also led to environmental pollution, posing a serious challenge to global warming. The impacts of global warming, such as changes in climate patterns, have adversely affected agricultural crops. This is particularly concerning for India, where 50% of the population relies on agriculture. One striking example is the drought that occurred in the Vidarbha area of Maharashtra. The government's response to such crises has often been delayed, leaving many farmers to suffer, and tragically, some have even resorted to suicide.

The uncertain changes in our environment, driven by the greenhouse effect and global warming, have disrupted the required climatic conditions for certain seasonal crops. Industries have contributed to the pollution of rivers by discharging harmful chemicals into them. Insufficient watering and temperature variations have hindered the growth of horticultural plants. To address these challenges, greenhouses have emerged as a solution. Greenhouses allow farmers to create an artificial environment that maintains the necessary temperature, humidity, and light conditions for optimal crop growth.

Various greenhouse systems are available in the market today, designed to meet the specific needs of users. However, a significant issue is the lack of effective monitoring of greenhouse systems over long distances. Currently, users must continuously observe and check the functioning of these systems. There is a need for an efficient monitoring mechanism to remotely track and regulate the climate conditions inside greenhouses.

- **IoT based solar powered Agribot for irrigation and farm monitoring: Agribot for irrigation and farm monitoring.**

Agriculture plays a significant role in India's GDP, but it faces challenges related to water scarcity and high labor costs. One potential solution to address these issues is the automation of agricultural tasks, which promotes precision agriculture. This research paper focuses on the design and development of an IoT-based solar-powered Agribot that automates irrigation tasks and allows for remote farm monitoring.

The Agribot is built using an Arduino microcontroller and utilizes solar power when not actively engaged in irrigation. During the irrigation process, it follows a predetermined path within the farm and collects data on soil moisture content and temperature at regular intervals. This data is locally processed at each sensing point to determine the need for irrigation, and the farm is watered accordingly. Additionally, the Agribot acts as an IoT device, transmitting the collected sensor data to a remote server through a Wi-Fi connection.

At the remote server, the raw data undergoes signal processing operations such as filtering, compression, and prediction. This processed data is then presented to the user through an interactive interface, allowing them to access the analyzed data statistics based on their specific requirements and requests.

- **Automated seed sowing agribot using arduino**

The discovery of agriculture marked a significant milestone in the progression towards civilized societies. Continuous advancements in agricultural tools have been key to improving agricultural practices. This project focuses on developing a system that aims to minimize labor costs and reduce the time required for digging and seed sowing operations in agriculture, using solar energy to power the agribot.

The main objective of this system is to harness solar energy through the use of solar panels. The captured solar energy is then converted into electrical energy, which is utilized to charge a battery. The battery, in turn, provides the necessary power to drive a shunt wound DC motor. To facilitate the movement and navigation of the robot in the field, ultrasonic and digital compass sensors are incorporated into the system. These sensors are operated through a Wi-Fi interface, which can be controlled via an Android application. This reduces the reliance on human labor.

The seed sowing and digging robot is designed to traverse various ground contours and perform the tasks of digging, sowing seeds, and covering the ground. The paper provides detailed information about the complete installation of the agribot, encompassing both the hardware and software components.

Date of Conference: 6-8 April 2016

Date Added to IEEE *Xplore*: 24 November 2016

Authors:

Saurabh Umarkar

Electronics and Telecommunication Department, Government College of Engineering, Aurangabad, Maharashtra, India

Anil Karwankar

Electronics and Tele-communication Department, Government College of Engineering, Aurangabad, Maharashtra, India

- **Agribot — A multipurpose agricultural robot**

Agribot is a specially designed robot that serves agricultural purposes, aiming to reduce the labor required from farmers while increasing efficiency and precision in farming tasks. The primary functions it performs include ploughing the field, sowing seeds, and covering them with soil. The robot operates autonomously, and it also offers the flexibility of switching to the ploughing system as needed.

To control the operations of the robot, a PSoC (Programmable System on Chip) controller, developed by Cypress Semiconductor in the United States, is utilized. This controller acts as the brain of the Agribot, coordinating and managing its various functions. With the PSoC controller, the robot can execute its tasks with accuracy and reliability, providing a more efficient alternative to traditional manual labor in agriculture.

Date of Conference: 16-18 Dec. 2011

Date Added to IEEE *Xplore*: 26 January 2012

Authors:

Akhila Gollakota

Birla Institute of Technology and Science, Hyderabad, Campus, Hyderabad 500 078, India

M. B. Srinivas

Birla Institute of Technology and Science, Hyderabad, Campus, Hyderabad 500 078,

- **Sensor and vision based autonomous AGRIBOT for sowing seeds**

The use of autonomous agriculture robots holds great promise in the field of precision agriculture. This research paper introduces a sensor and vision-based agricultural robot prototype specifically designed for seed sowing operations. The robot has the ability to navigate across various agricultural lands while simultaneously performing the seed sowing task.

To achieve navigation and localization, the robot is equipped with onboard sensors and a vision system. These components, combined with vision-based approaches, enable the robot to navigate accurately. The robot's self-awareness of its position is determined through the use of global and local maps generated by a Global Positioning System (GPS) and an onboard vision system connected to a personal computer.

The paper also presents a precision seed metering and sowing mechanism that relies on sensor-based technology. The proposed robot serves as a micro planter, primarily focused on sowing seeds at predetermined intervals within the field. The robot's dimensions are 26.5 × 18.5 × 19.65 mm (length × width × height). Additionally, a suspension system has been incorporated to ensure vehicle stability and prevent toppling during motion.

Date of Conference: 1-2 Aug. 2017

Date Added to IEEE *Xplore*: 21 June 2018

authors:

Palepu V. Santhi

Department of Electrical, Electronic and Computer Engineering, University of Pretoria, South Africa

Nellore Kapileswar

Department of Electrical, Electronic and Computer Engineering, University of Pretoria, South Africa

Vijay K. R. Chenchela

Department of Electrical, Electronic and Computer Engineering, University of Pretoria, South Africa

C H Venkata Siva Prasad

Department of Electronics and Communication System, Dr. M.G.R Univesity, India

- **Agricultural aid to seed cultivation: An Agribot**

Machine intelligence is a rapidly advancing technology that has found applications in various fields of engineering and technology. The agricultural sector is gradually incorporating robots, and AgriBots are expected to play a crucial role in performing challenging and laborious agricultural tasks. They are seen as the inevitable future of agriculture.

This research paper introduces an innovative idea to effectively cultivate vast areas of uncultivated or barren land. It addresses a pressing issue faced by farmers engaged in hill farming, where fatalities due to falling from heights are a significant concern. The proposed solution aims to mitigate such risks through technological intervention. Additionally, it seeks to enable cultivation in remote areas, promote increased green cover, and support farmers operating in harsh environments.

The Agricultural Aid to Seed Cultivation (AASC) robot is proposed as an unmanned aerial vehicle equipped with a camera, digital image processing unit, and seed cultivation unit. A quadcopter is selected as the aerial vehicle for its independence from the ground's form and shape, allowing it to navigate with high mobility and reliability. This research explores a new technology suitable for various forms of remote farming, offering potential benefits for agriculture as a whole.

Date of Conference: 29-30 April 2016

Date Added to IEEE *Xplore*: 16 January 2017

Authors:

Tanupriya Choudhury

Dept. of Computer Science & Engineering, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, India

Arashdeep Kaur

Dept. of Computer Science & Engineering, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, India

Utsav Singh Verma

Dept. of Computer Science & Engineering, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, India

3. Objectives of the project work

The objective of this paper is to present a robotic model which easily operates agriculture operations.

- Now a days it is necessity of automation in agricultural field to reduce the farmers efforts & labor cost
- To perform all operations. Like digging seed sowing at a single time hence increasing production & saves time.
- The farmer can operate the robot very easily.
- Design and model the multipurpose agricultural robot which can perform the agricultural operation.
- To fabricate the multipurpose agricultural robot.
- To build a software so that multipurpose agricultural robot can be operated using a mobile phone.

3.1 Motivation

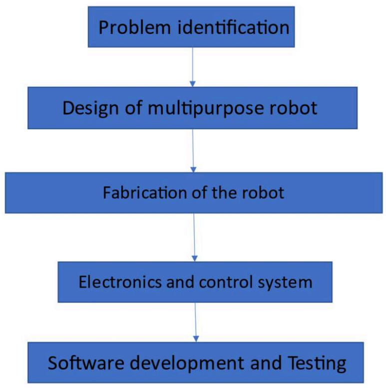
The central principle of this project is to explore the efficacy of agricultural applications. The focus of the major application is self-governing robot navigation.

This is achieved by addressing the following research objectives.

1. Explore the role of features to improve the detection accuracy.
2. Development of agricultural yield and reduction of human work.
3. Develop a sensor model to be used as a measurement model.

The challenges in remote access to smart irrigation have been addressed. With the development of technology, in the last two decades, various smart irrigation systems (SIS) are developed that work with no or minimal human intervention. Though SIS is very promising, it does not get popularity due to two challenges: - (1) As the smart irrigation system works in a remote location, providing power to it is very difficult. (2) Due to remote Installation of SIS, the farmer can't track its operation and remain ignorant of the condition of the farm. This paper addresses the listed challenges. The contributions of the paper are listed: (1) for remote power supply, a solar panel based system is proposed. (2)For remote information transformation, an Internet of things (IoT) based solution is proposed. A prototype has been prepared to validate the proposed model.

4. Methodology



1) 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

labor-intensive ploughing, time-consuming seeding, manual spraying of water, and the need for sand leveling.

2) 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 leveling of sand.

3) 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 stainless steel (SS) 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 leveling. Arduino was selected for coding purposes.

4) 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 leveling apparatus were integrated into the design, providing robust functionality.

5) 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.

6) 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 leveling depth.

7) Testing and Optimization:

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 leveling efficiency. Based on the results, necessary optimizations were made to improve the robot's performance.

8) Performance Evaluation:

The performance of the multipurpose agricultural robot was evaluated based on parameters such as efficiency, accuracy, time savings, and ease of use. Comparisons were made with traditional manual methods to determine the advantages offered by the robot.

9) Safety and Environmental Considerations:

Safety measures were implemented to ensure the robot's safe operation, including emergency stop mechanisms and obstacle detection sensors. Environmental considerations were also addressed by optimizing water usage and reducing chemical spraying through precise control.

10) Conclusion and Future Recommendations:

The report concludes with an assessment of the agricultural robot's effectiveness in addressing the identified challenges. Future recommendations may include incorporating advanced technologies such as machine learning for crop analysis and automation of additional agricultural tasks.

By following this revised methodology, the development and evaluation of the multipurpose agricultural robot were successfully conducted, showcasing its potential to revolutionize farming practices and increase efficiency in agricultural operations. The use of SS material for the frame/chassis ensured durability, while Arduino facilitated coding and software development for seamless control of the robot.

4.1. Algorithm

STEP1. – At first we declared the variables as global variables while initializing the pin numbers. STEP2. – In the setup section we have pins as output.

STEP3. – We have given low values in the starting phase.

STEP4. – In the void loop section we have called four functions which we have written below one by one.

STEP5. – First robot move function for the movement of the robot. STEP6. – Second robot stop function for stopping the robot.

STEP7. – Third digging for digging action. STEP8. – Fourth robot seeding for seeding action. STEP9. – These all functions will repeat in a loop.

4.2. Proposed Methodology

System requirements specification is to specify in detail the system components, both hardware and software, which are needed for the system implementation, along with operational requirements, as anticipated from the system.

The whole system of the robot works with the battery. The robot requires a 12V battery to operate the system. The base frame consists of four wheels connected to four arms and the rear wheel is driven by a dc motor. One end of the frame cultivator is driven by a dc motor which is made to dig the soil. The seeds are dropped through a drilled hole on the shaft by the linked mechanism with dug soil processing. A leveler is made to close the seeds. Bluetooth technology through smart phones is used to control the entire operation of robots for ploughing, seeding and irrigation systems.

The Heart of the proposed system is microcontroller, Wi-Fi module, DC motors relays are interfaced to the microcontroller to provide various operations like ploughing, seeding, leveling and water spraying. The entire mechanism of the system is controlled by Bluetooth module from Android smart phone. The wireless communication of Bluetooth technology enables the robot to move in four directions as front, back, right and left. Various commands can be used to move robot into forward, reverse, stop, left, and right. The microcontroller in the proposed model enables various functions in the field according to the commands received from smart phone.

Agriculture robots can perform operations like automatic ploughing, seed sowing, and water sprinkling. The qualitative development of this project is a request for a system which minimizes the working cost and reduces the time for digging tasks and these entire tasks run by battery source. Also, we can adopt solar energy systems. Development aim of this system is that these devices can act atomically on agricultural operations. Nowadays farmers pay a lot of money for machines that help them to decrease labour and increase income of crops but efficiency and profit are less. Hence automation is the ideal solution to decrease all the failures by development of machines that perform one operation and automating to increase the income on a large value.

The assembly of the robotic system is built using a high torque DC motor, communication module, relay driver circuit, Battery package, microcontroller which is shown in block diagram.

When a DC motor is started, the vehicle moves along the particular columns of ploughed land for digging and sowing the seeds and its movement is controlled by remote guiding device. The remote control transmitter and receiver is shown in the block diagram.

This system has two main sections, robot section and control section, which are intercommunicated by using communication technologies. The control section as well as robotic section possesses via ploughing unit, seed dispenser, and seed storage, robotic system with motors, microcontroller, and power supply.

The microcontroller is the brain of this system, which gives the order of suggestions received to all the networks, and sensible factors processed by their corresponding embedded programs. Robotic mechanisms run by their internal motors and motor drivers that drive the motors in desired directions.

5. CALCULATION

● Cutter

Power of motor (cutter):

P=V*I

P=12*1.3

P=15.6 watts

For Torque:

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

15.6=(2*3.1414*1000*T)/(60)

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

T=0.1432 Nm

● Selection of motor(wheels)

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)

P = 90*0.15

P = 13.5 watts

P = power(watts)

W = force(weight)

V = Velocity

● 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(watts)

N = Speed(rpm)

T = Torque

- **Volume of tank**

V=pi*r*r*h

V=(3.14*60*60*165) mm^3 r = Radius of tank

V=1.8 litres h = height of tank

- **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

- **Flow rate of nozzle**

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

Q=0.79 lit/min (experimentally checked) Q = Flow rate of nozzle(gpm)

Q=0.21 gpm (converted) D = Nozzle diameter(inch)

0.21=28.9*0.11*0.11*sqrt(P) P = Pressure at nozzle(psi)

P=0.36

- **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

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)

6. Electronic Tools used for the project work

This section gives details of the hardware components required for the system implementation and deployment. Agricultural robot requires the following hardware components:

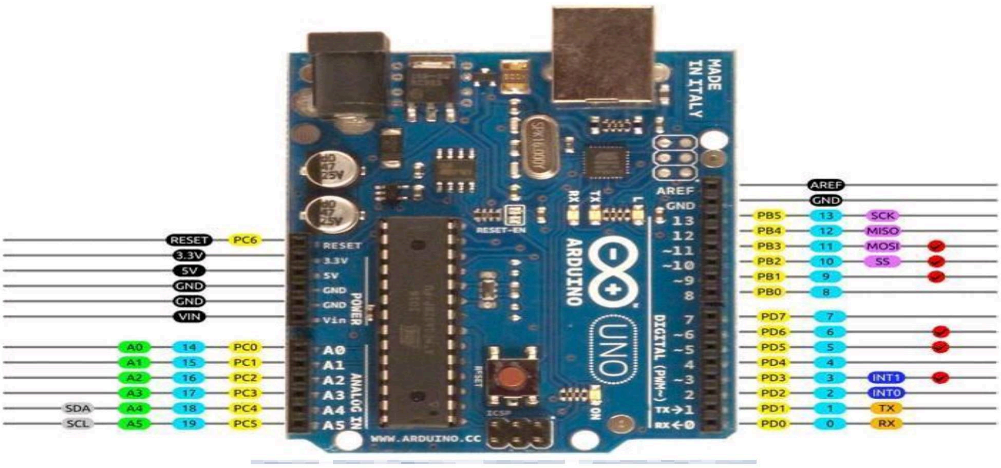
1. Arduino Uno

2. DC motor

3. H bridge

4. L293d motor driver

6.1. Arduino Uno



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 boards are available in preassembled form or by designing the kits with respect to different applications like microcontroller which builds digital devices and objects that can control and sense objects in the digital world. FIGURE shows the Arduino board and pin diagram respectively.

The different types of Arduino Uno are (a) Arduino Nano, (b) Arduino Pro Mini, (c) Arduino Mega and

(d) Arduino Due.

6.2. ARDUINO UNO SPECIFICATION

The Arduino UNO microcontroller here used is an ATmega328P; it is a 8-bit AVR family microcontroller.

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.

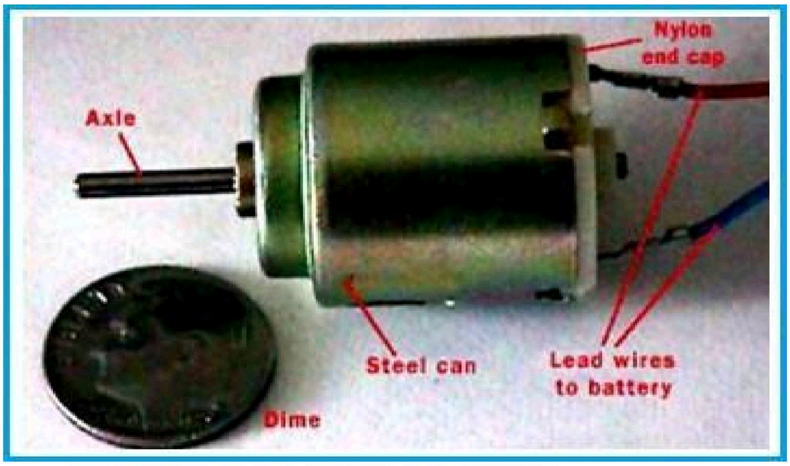
40 µA of DC current for the input and output pins. 50 mA DC current on 3.3V pin.

It used 32 Kb of flash memory. It uses 2Kb SRAM.

It uses EEPROM.

It uses16MHz frequency clock speed.

6.3. DC MOTORS



Almost every mechanical movement that can be seen is caused by an AC (alternating current) or DC (direct current) electric motor. Let us start by looking at the overall plan of a simple two-pole DC

electric motor.

A simple motor has six parts, as shown in the diagram below:

1. **Armature or rotor**
2. **Commutator**
3. **Brushes**
4. **Axle**
5. **Field magnet**
6. **DC power supply**

6.4. 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, as the motors terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively discontinued from the circuit. A h bridge is a set of 4 switches that are assembled in such a way that an arbitrary load impedance is decoupled from a direct current power rail and ground. These switches can then be used to control the direction of current running from the dc source to ground in either direction across the connected impedance.

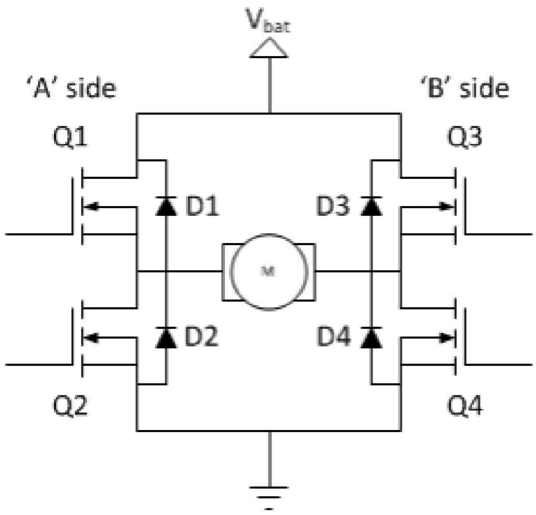
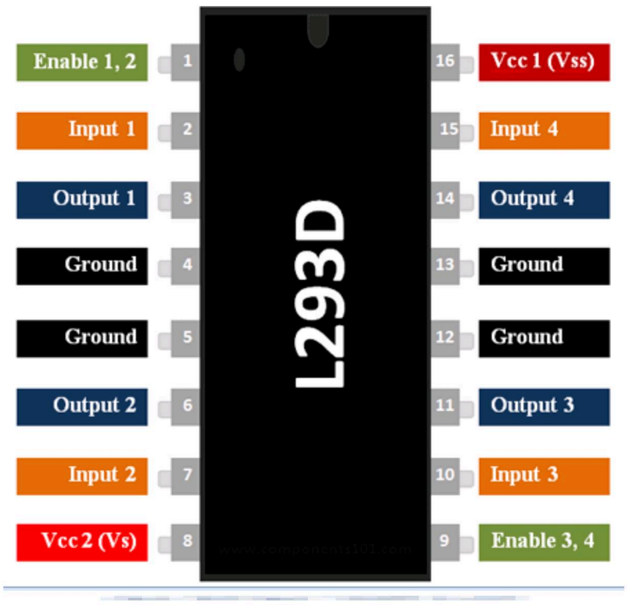


Figure:Circuit diagram of H Bridge

6.5. 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. So if you have motors which has operating voltage less than 36V and operating current less than 600mA, which are to be controlled by digital circuits like Op-Amp, 555 timers, digital gates or even Micron rollers like Arduino, PIC, ARM etc.. This IC will be the right choice for you.

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.

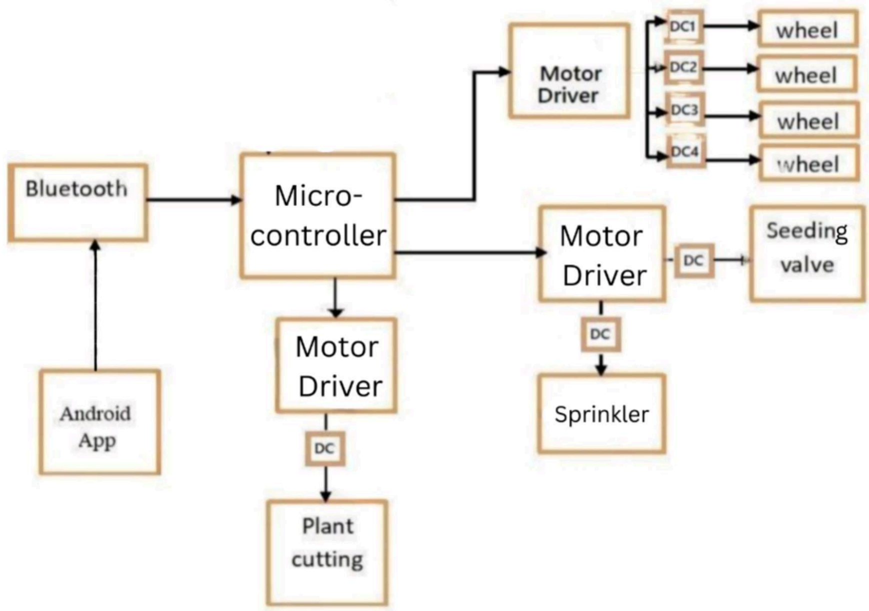


Figure 6 ELECTRONIC PART BLOCK DIAGRAM

- **Flowchart show how our robot is controlled using bluetooth device :**

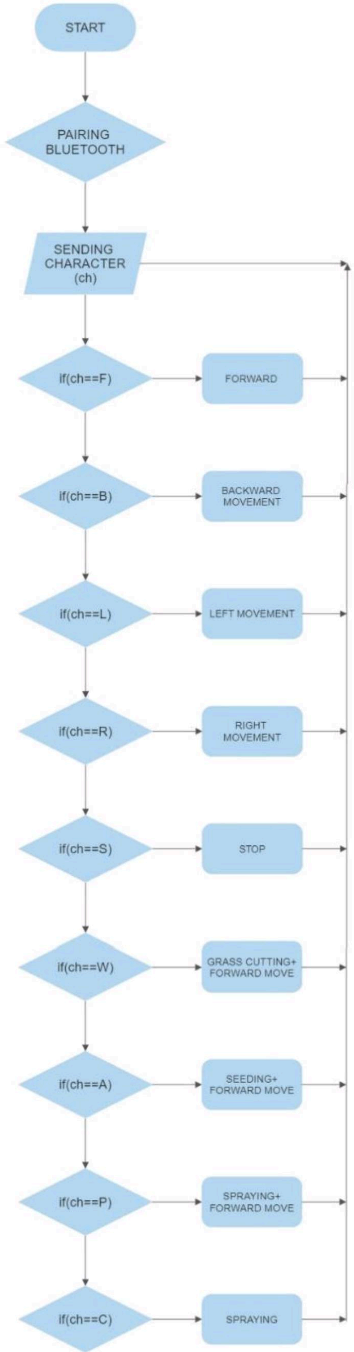


Figure 7 ALGORITHM FLOWCHART

7. Design

Designing a mechanical component for a project involves a systematic process that includes several stages. Here is a detailed overview of the steps involved in designing a mechanical component:

Project Requirements and Specifications:

● Clearly define the functional requirements of the component. Understand its purpose, intended application, and the problem it aims to solve.

● Specify the operational conditions, such as temperature, pressure, loads, and environmental factors that the component will encounter.

● Identify any constraints or limitations, such as size restrictions, material compatibility, and cost considerations.

Concept Generation:

● Brainstorm and generate multiple design concepts that could fulfill the requirements.

● Consider different approaches, mechanisms, and configurations to achieve the desired functionality.

● Sketch rough ideas, make preliminary drawings, and evaluate the feasibility and practicality of each concept.

Preliminary Design:

● Select the most promising concept and refine it further.

● Develop detailed drawings or use computer-aided design (CAD) software to create 2D or 3D models of the component.

● Determine the approximate dimensions, shape, and major features of the component.

Material Selection:

● Choose the appropriate material for the component based on its requirements and specifications.

● Consider factors such as mechanical properties (strength, stiffness, toughness), corrosion resistance, thermal properties, and cost.

- Research available materials and consult material databases and specifications to make an informed decision.

Structural Analysis:

- Perform structural analysis using finite element analysis (FEA) or other simulation techniques.
- Evaluate the component's strength, stiffness, and durability under expected loads and operating conditions.
- Identify potential stress concentrations, deflections, and failure points.
- Modify the design if necessary to ensure structural integrity and safety.

Detailed Design:

- Refine the component's design based on the analysis results and feedback from stakeholders.
- Consider factors such as manufacturability, assembly, and maintenance during the design process.
- Incorporate proper clearances, tolerances, and surface finishes to ensure functional and aesthetic requirements are met.
- Create detailed drawings with dimensions, tolerances, and other necessary specifications.

Design for Manufacturing:

- Consider the chosen manufacturing process (e.g., machining, casting, molding, additive manufacturing) for producing the component.
- Optimize the design for ease of manufacturing, minimizing complexity and cost without compromising functionality.
- Take into account factors such as material availability, manufacturing tolerances, and desired production quantities.

Prototyping and Testing:

- Build prototypes of the component to validate the design and evaluate its performance.

- Conduct tests to verify functionality, structural integrity, and durability.
- Identify any issues or areas for improvement and make necessary design modifications.

Documentation and Communication:

- Create comprehensive documentation that includes technical drawings, assembly instructions, BOMs, and any other relevant information.
- Clearly communicate the design specifications to stakeholders, including manufacturers, assembly teams, and quality control personnel.

Iterative Refinement:

- Continuously review and refine the design based on feedback, testing results, and any changing project requirements.
- Iterate the design process as necessary to optimize the component's performance, manufacturability, and overall quality.

Throughout the design process, collaboration and effective communication with team members, experts, and stakeholders are essential. Regularly seek input, consider different perspectives, and incorporate feedback to ensure a successful outcome for the mechanical component in your project.

MATERIAL SELECTION

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

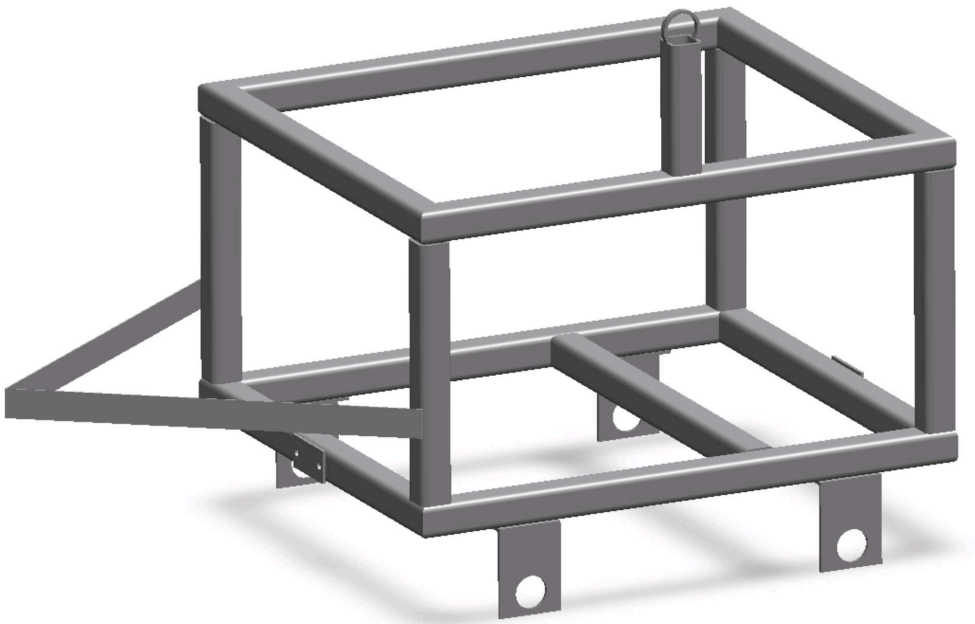


Figure 8 FRAME

Figure 9 LEFT WHEEL

Figure 10 RIGHT WHEEL

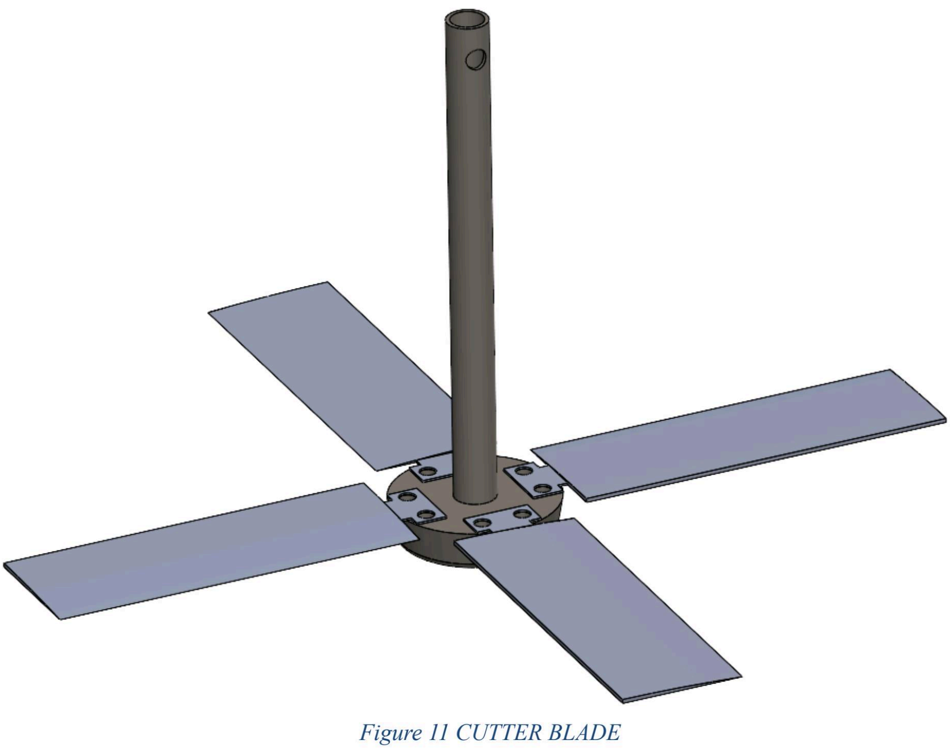


Figure 11 CUTTER BLADE

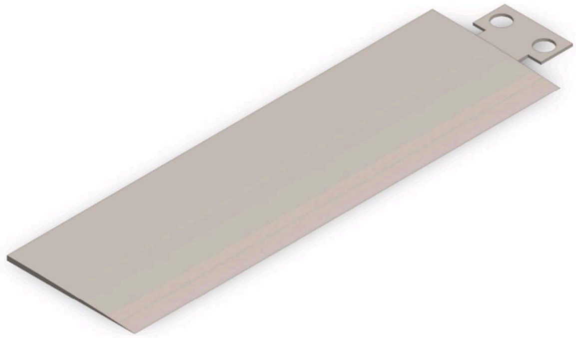


Figure 12 BLADE

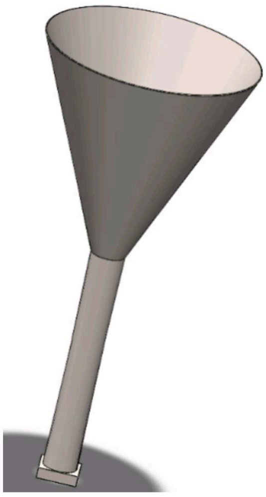


Figure 13 FUNNEL

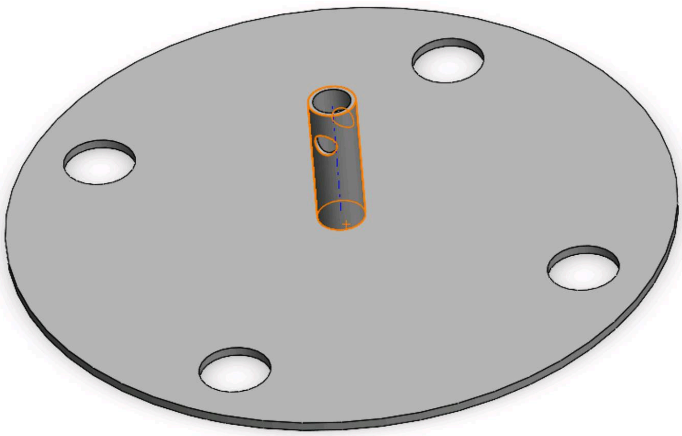


Figure 14 SEEDING DISC

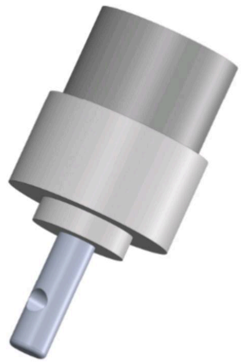
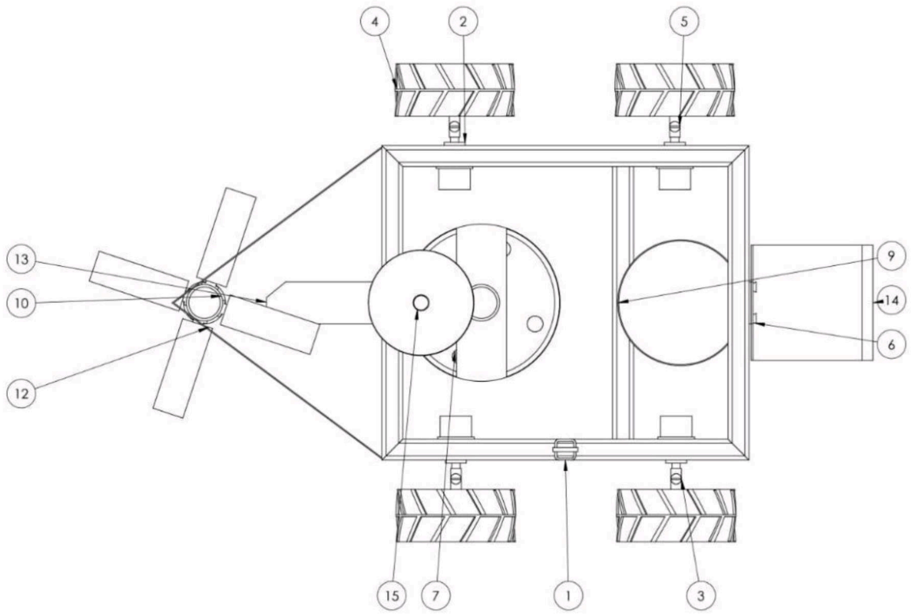


Figure 15 DC MOTOR 12V



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

Figure 16 LABELLED DIAGRAM OF ROBOT

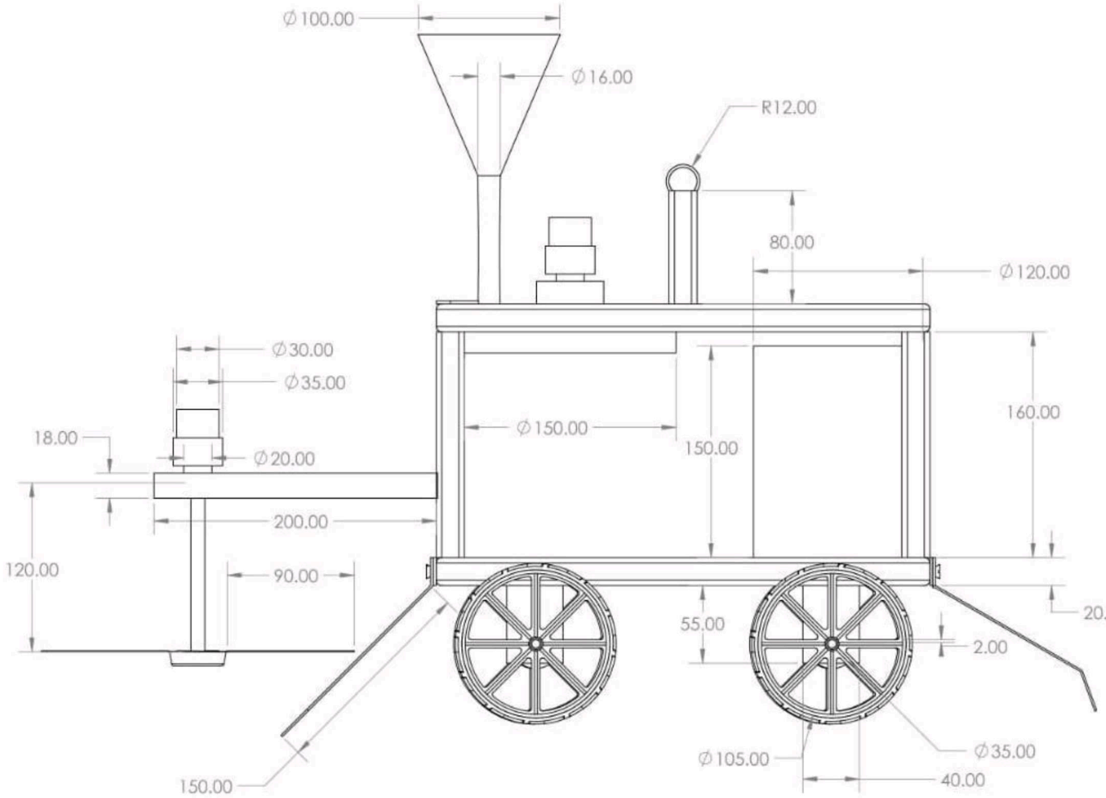


Figure 17 FRONT VIEW WITH DIMENSIONS

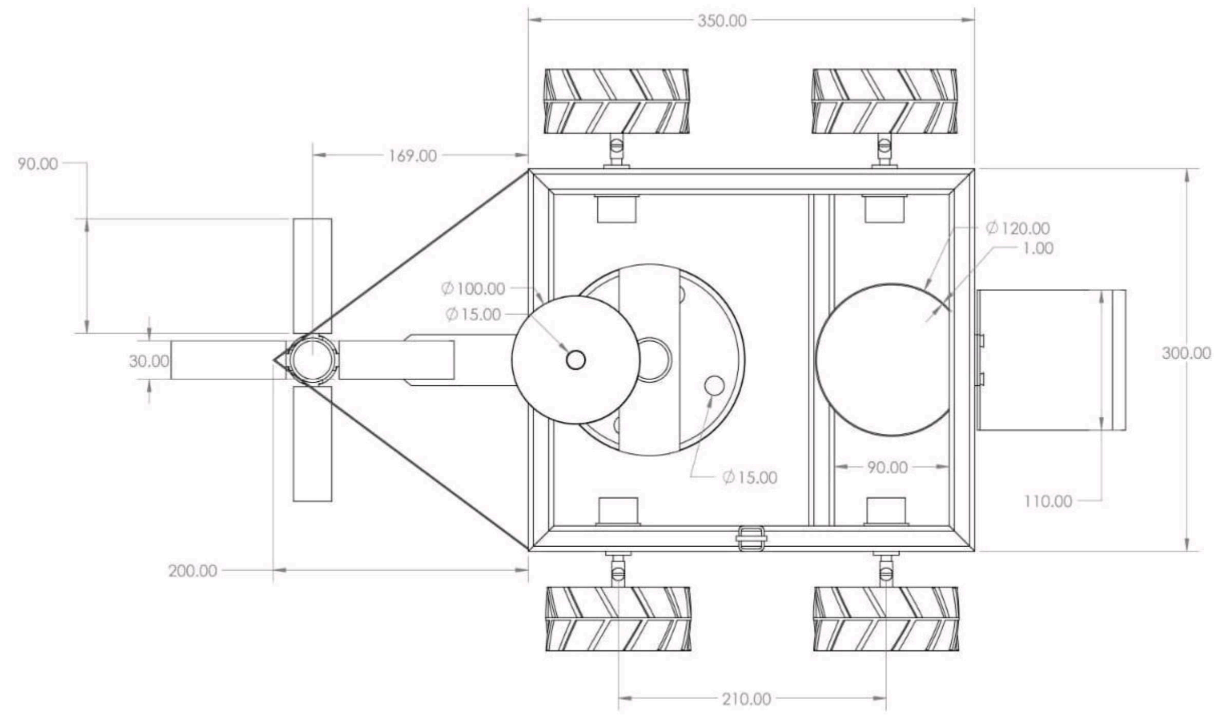


Figure 18 TOP VIEW WITH DIMENSIONS

Figure 19 AGRICULTURAL ROBOT ASSEMBLY 3D MODEL

8. Operations

8.1 Sprinkling

The mechanism of working of sprinkling in an agribot using a submersible pump and brass nozzle involves several components and steps. Here's a general outline of how it typically works:

Submersible Pump: A submersible pump is a water pump that is designed to be submerged in water. It is usually placed inside a water source, such as a well, pond, or water tank. The pump is responsible for drawing water from the source and supplying it to the sprinkler system.

Water Intake: The submersible pump has an intake or suction mechanism that allows it to draw water from the source. This intake may consist of a filter or strainer to prevent debris from entering the pump and clogging it.

Pumping Mechanism: The submersible pump is equipped with a motor that drives an impeller, which is a rotating component with blades or vanes. As the impeller rotates, it creates a centrifugal force that pushes water outwards, increasing the pressure and creating a flow of water.

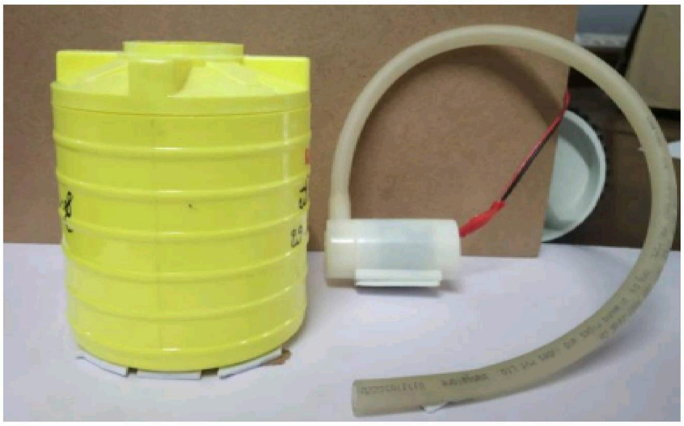


Figure 20 PUMP

Water Delivery: The pump is connected to a network of pipes or hoses that transport water from the pump to the agribot's sprinkler system. These pipes are typically made of durable materials such as PVC or HDPE to withstand the water pressure and ensure efficient water delivery.

Control Mechanism: The agribot is equipped with a control system that regulates the

operation of the submersible pump and the sprinkler system. This control mechanism may include sensors to detect soil moisture levels or timers to schedule watering sessions.
Brass Nozzle: At the end of the sprinkler system, there is a brass nozzle. The nozzle helps to shape the water flow into a spray pattern, controlling the distance and coverage area of the water being sprayed. Brass is a common choice for nozzles due to its durability and resistance to corrosion.
Sprinkler System: The sprinkler system consists of a series of pipes or hoses with strategically placed sprinkler heads. These sprinkler heads are designed to disperse water in a specific pattern, such as a circular, rectangular, or fan-shaped spray. The submersible pump supplies pressurized water to the sprinkler system, which is then released through the brass nozzle.

Figure 21 SPRINKLER

Operation: When the agribot is activated or when the control system determines that watering is necessary, the submersible pump is turned on. It draws water from the source, pressurizes it, and delivers it through the pipes or hoses to the sprinkler system. The water is then released through the brass nozzle, creating a spray that irrigates the crops or plants.
It's important to note that the specifics of the mechanism may vary depending on the design of the agribot and the sprinkler system being used. However, the basic principle of using a submersible pump to draw water and a brass nozzle to spray it remains consistent in most setups.

8.2 Seed sowing

The seed sowing mechanism in an agribot using a funnel, DC motor, and seeding plate typically involves the following steps:

Funnel: Attach a funnel to the agribot in a position that allows seeds to be dropped into the desired planting area. The size and shape of the funnel depend on the specific requirements of the agribot and the seeds being sown.

Seeding Plate: Design a seeding plate that holds and dispenses the seeds. The seeding plate is typically a circular or rectangular plate with small holes or compartments to hold individual seeds. The size and number of holes or compartments depend on the seed size and planting density requirements.

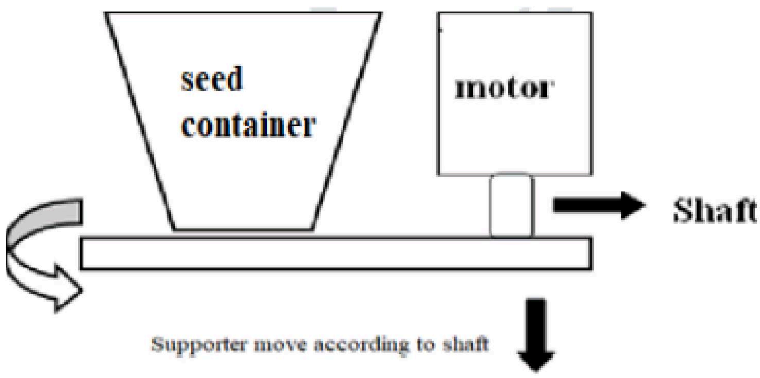


Figure 22 SEED DISPENSING MECHANISM

DC Motor: Connect a DC motor to the seeding plate. The motor provides the necessary rotational motion to dispense the seeds from the plate through the funnel. Make sure the motor is securely attached to the agribot to prevent any vibrations or movements that may affect the seeding process.

Seed Dispensing Mechanism: Connect the seeding plate to the DC motor shaft using a suitable coupling or mounting mechanism. Ensure that the plate is properly aligned with the funnel opening to allow smooth seed transfer.

Motor Control: Connect the DC motor to a motor control circuit or microcontroller that regulates the motor's speed and direction. This control mechanism allows you to adjust the speed at which seeds are dispensed from the seeding plate. The motor can be programmed to rotate the plate continuously or intermittently based on the desired seed spacing.

Seed Loading: Load the seeds into the seeding plate through the holes or compartments. Make sure to handle the seeds carefully to avoid any damage or contamination.

Operation: Start the agribot and activate the DC motor. As the motor rotates, the seeding plate dispenses the seeds through the funnel into the planting area. The rate of seed dispersal can be adjusted by controlling the motor speed or the intermittent operation of the motor.

It's important to note that the specific design and implementation of the seed sowing mechanism may vary depending on the agribot's design, the type of seeds being sown, and other factors. Professional engineering expertise is recommended to ensure a safe and effective implementation.

8.3 Cutting

The cutting mechanism in an agribot using two cutter blades and a DC motor typically involves the following steps:

Cutter Blades: Select two sharp cutter blades that are suitable for the type of vegetation or crops being cut. The blades should be durable and capable of providing a clean and precise cut. The size and shape of the blades depend on the specific requirements of the agribot and the vegetation being targeted.

Mounting the Blades: Attach the two cutter blades to a suitable cutting assembly on the agribot. The blades can be mounted parallel to each other or in a configuration that suits the cutting requirements. Ensure that the blades are securely attached and properly aligned to prevent any wobbling or misalignment during operation.

DC Motor: Connect a DC motor to the cutting assembly. The motor provides the rotational motion to drive the cutter blades. Make sure the motor is securely attached to the agribot to prevent any vibrations or movements that may affect the cutting process.

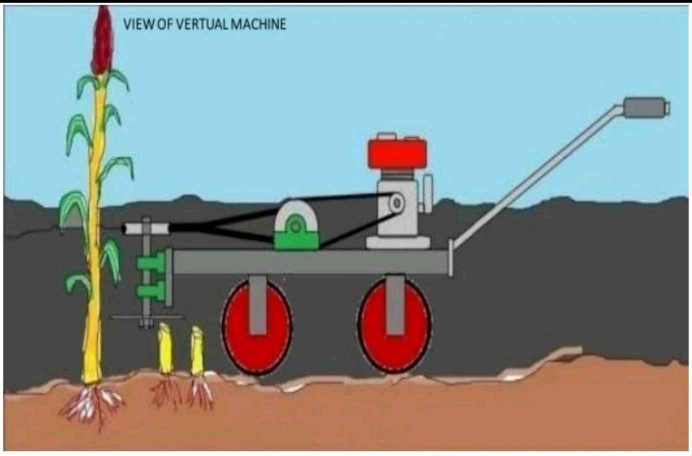


Figure 23 GRASS CUTTER

Motor Control: Connect the DC motor to a motor control circuit or microcontroller that regulates the motor's speed and direction. This control mechanism allows you to adjust the speed and direction of the cutter blades based on the cutting requirements. The motor can be programmed to rotate the blades at a specific speed and in the desired direction.

Operation: Start the agribot and activate the DC motor. As the motor rotates, the cutter blades move in a cutting motion. The vegetation or crops that come into contact with the blades are cut. The agribot can be guided along the desired path to ensure efficient and accurate cutting.

Safety Measures: Ensure that proper safety measures are in place to protect the operator and bystanders during operation. This may include installing guards or shields around the cutter blades to prevent accidental contact.

It's important to note that the specific design and implementation of the cutting mechanism may vary depending on the agribot's design, the type of vegetation being cut, and other factors. Professional engineering expertise is recommended to ensure a safe and effective implementation.

8.4 Ploughing

Ploughing is the process in which the earth/soil turns before sowing.

The process of ploughing happens with the help of a ploughing blade. In this process the vehicle's job is to pull the blade against the soil and hence the soil creates a furrow.

The amount of ploughing force depends on mainly 3 characteristics:
- Soil resistance
- width of furrow required
- depth of furrow required

Figure 24 PLOUGHING

The soil resistance is the resistance offered by the soil to the blade, and this depends on the soil to be as ploughed as different soil have different texture, moisture content etc.
Here we are taking loamy soil as it is the most commonly used soil in Indian agriculture.
The loamy soil has a soil resistance of 2000-10000 N/m², which we are then averaging out to 6000 N/m².
Now comes the width and depth of the soil.

Soil Resistance: The soil resistance factor represents the resistance encountered by the plough in the soil. It depends on soil type, moisture content, compaction, and other soil properties. The specific resistance is typically denoted as R and measured in Newtons per square meter (N/m^2).

Area: The area of the ploughing surface represents the size of the area being ploughed. It is typically denoted as A and measured in square meters.

Robot Weight: The weight of your agricultural robot prototype is denoted by W and measured in kilograms (kg). The weight contributes to the downward force applied to the plough and affects its ability to overcome soil resistance.

Soil Conditions: The properties of the soil, such as cohesion, shear strength, moisture content, and compaction, affect the resistance encountered during ploughing. Soil conditions can vary, and accurate measurements or estimations are essential for calculating the ploughing force.

Plough Design: The design and geometry of the plough used by your robot can influence the force required for ploughing. Different plough designs have varying cutting angles, shapes, and mechanisms that affect the resistance encountered and the force needed.

By considering these factors and using appropriate equations or models, you can estimate the ploughing force required for your agricultural robot prototype. It's important to note that ploughing force calculations can be complex and may require field testing or validation to ensure accuracy in real-world conditions.

8.5 Levelling

Flat inclined plate used for this purpose. When the robot starts moving forward, the even surface has up’s and down’s leveler will make all the area to flat surface.

Leveling equipment attachment: Once the mapping and analysis are complete, the robot is equipped with the necessary leveling tools. These tools can include blades, rakes, or other implements suitable for the specific terrain and leveling requirements.

Figure 25 LEVELING

Leveling process: As the robot moves through the field, it activates the leveling equipment to perform the necessary operations. This can involve cutting down high spots, filling in low areas, removing debris or rocks, and smoothing the soil surface.

9. Fabrication

Fabrication refers to the process of creating or manufacturing something, typically in a workshop or factory setting. It involves transforming raw materials or components into finished products through various techniques and processes. Fabrication can be applied to a wide range of industries, including metalworking, electronics, textiles, plastics, and more.

In metal fabrication, materials such as steel, aluminum, or copper are cut, shaped, and assembled to create structures or components. Techniques such as cutting, welding, bending, and machining are commonly used in metal fabrication processes.

Electronic fabrication involves the assembly and manufacturing of electronic components and circuits. This includes processes like printed circuit board (PCB) fabrication, where electronic components are mounted onto a PCB using surface mount technology (SMT) or through-hole technology (THT). Other processes in electronic fabrication may include soldering, wire bonding, and encapsulation.

Textile fabrication encompasses the production of fabrics and textiles through processes like weaving, knitting, and sewing. These techniques involve the interlacing of yarns or threads to create textiles used in clothing, upholstery, and various other applications.

Plastic fabrication involves the shaping and forming of plastic materials to create products or components. Techniques used in plastic fabrication include injection molding, blow molding, extrusion, and thermoforming. These processes allow for the creation of a wide range of plastic products, from bottles and containers to automotive parts and consumer goods.

Overall, fabrication processes require skilled workers, specialized machinery, and a thorough understanding of materials and manufacturing techniques. It plays a crucial role in various industries, enabling the production of products that meet specific design requirements and functional needs.

9.1 BASE FABRICATION:

Diagram shows the length, description of the rod and quantities. First, here we will cut the rod as per our requirement.

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

Figure 26 LENGTH AND DESCRIPTION OF THE ROD USED FOR MAKING THE BASE OF THE ROBOT

Let's discuss about arc welding

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.

In arc welding, an electric current is passed through an electrode, creating an arc between the electrode and the base metal being welded. The intense heat generated by the arc melts the base metal and forms a weld pool. As the electrode is consumed, it also acts as a filler material, providing additional metal to reinforce the weld joint.

There are several types of arc welding, including:

Shielded Metal Arc Welding (SMAW): Also known as stick welding, SMAW employs a coated electrode that releases a protective layer of flux during the welding process. The flux shields the weld pool from atmospheric contamination, while the electrode's metal core serves as the filler material.

Gas Metal Arc Welding (GMAW): Commonly referred to as MIG (Metal Inert Gas) or

MAG (Metal Active Gas) welding, GMAW uses a continuous solid wire electrode that is fed through a welding gun. A shielding gas, either inert (such as argon or helium) or active (such as carbon dioxide), is also supplied to protect the weld pool.

Gas Tungsten Arc Welding (GTAW): Also known as TIG (Tungsten Inert Gas) welding, GTAW uses a non-consumable tungsten electrode to generate the arc. A separate filler rod may be added to the weld pool, if needed. A shielding gas, usually argon, is used to protect the weld area from atmospheric contamination.

Flux-Cored Arc Welding (FCAW): FCAW is similar to GMAW, but it uses a tubular wire electrode filled with flux instead of a solid wire. The flux generates a shielding gas when it reacts with the heat of the arc, protecting the weld pool.

Arc welding offers several advantages, including versatility, portability, and the ability to weld a wide range of metals and thicknesses. However, it requires proper safety precautions, such as protective gear, adequate ventilation, and knowledge of welding techniques to ensure quality welds.

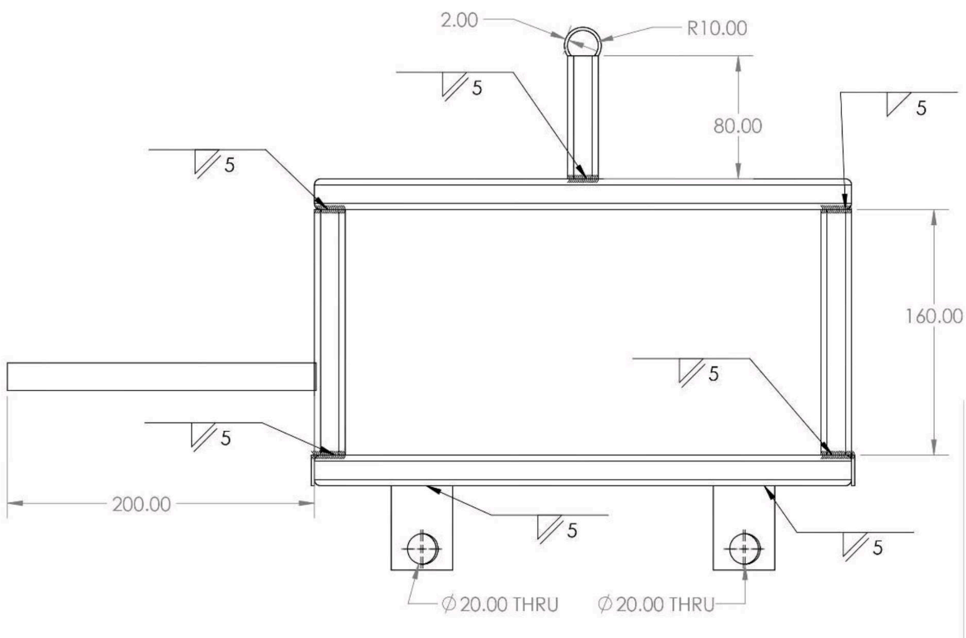


Figure 27 FRONT VIEW OF BASE

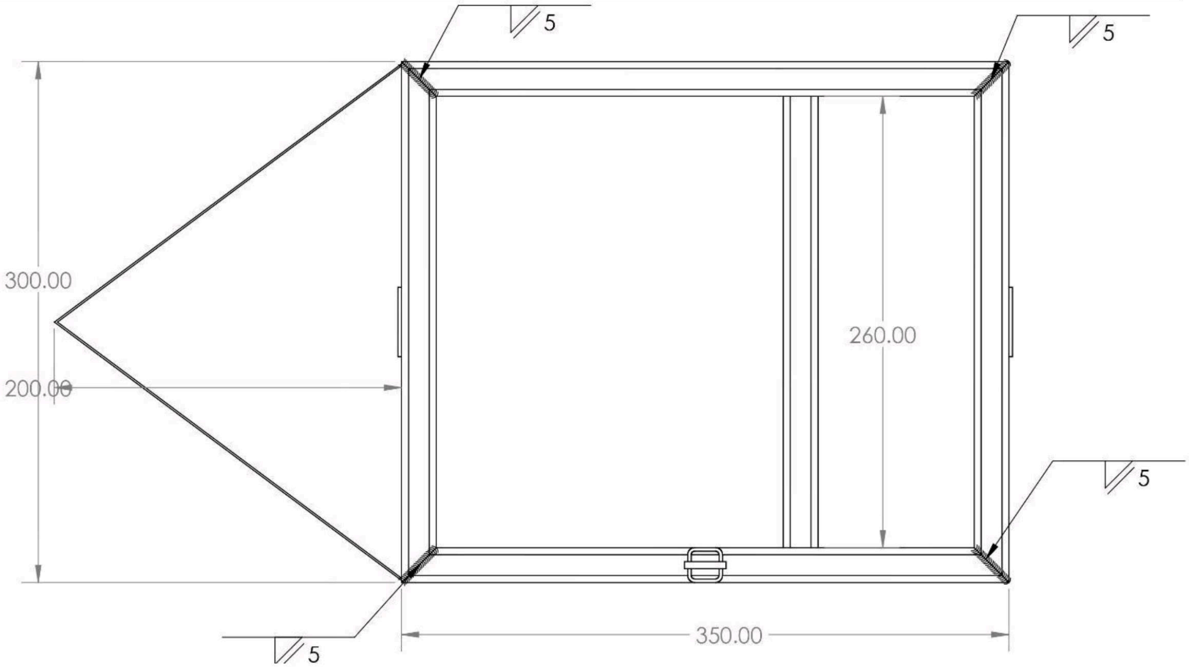


Figure 28 TOP VIEW OF BASE

Next diagram shows how the base is fabricated using arc welding. The diagram shows the description of welding as flat arc welding with 5 mm radius.


Figure 29 FABRICATION OF THE BASE

9.2 FABRICATION OF SEEDING DISC:

Let's discuss about drilling machine first

A drilling machine, also known as a drill press, is a machine tool used to create cylindrical holes in various materials such as metal, wood, plastic, and composites. It is a versatile tool found in workshops, manufacturing facilities, construction sites, and even homes.

Key components and features of a drilling machine include:

Base: The foundation of the drilling machine that provides stability and support.

Column: A vertical pillar attached to the base that houses the motor and guides the movement of the drilling head.

Drilling Head: The upper section of the machine that contains the spindle, motor, and controls. The drilling head can be raised or lowered along the column.

Spindle: The rotating shaft that holds the cutting tool, such as a drill bit or a hole saw. The spindle is driven by a motor, and its speed can often be adjusted to accommodate different materials and drilling requirements.

Table: A flat surface attached to the base that provides a platform for positioning and securing the workpiece. The table can often be tilted or rotated to enable angled or precise drilling.

Chuck: A mechanism located at the end of the spindle that holds the drill bit or cutting tool securely in place.

Depth Stop: A device that allows the operator to set a specific drilling depth, ensuring consistent and accurate hole depths.

Using a drilling machine typically involves the following steps:

Workpiece Preparation: The workpiece is secured on the table or clamped in a suitable fixture to prevent movement during drilling.

Selection of Drill Bit: A drill bit of the appropriate size and type is chosen based on the desired hole diameter and the material being drilled.

Setting Speed and Depth: The drilling machine's speed is adjusted according to the material being drilled, and the depth stop is set to control the drilling depth.

Positioning and Alignment: The drilling head is positioned above the desired drilling location on the workpiece, and alignment aids, such as layout lines or center punches, can be used for accuracy.

Drilling Operation: The motor is activated, and the drill bit is fed into the workpiece using the handle or lever provided. The operator applies moderate pressure while ensuring the drill bit remains perpendicular to the work surface.

Completion and Removal: Once the desired hole depth is reached, the drill bit is retracted, and the motor is switched off. The workpiece can then be removed from the machine.

Drilling machines offer precision, efficiency, and versatility in creating holes of various sizes and depths. They are available in different sizes and configurations, ranging from small benchtop models to large floor-standing industrial machines.

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

Figure 30 HOLE TABLE

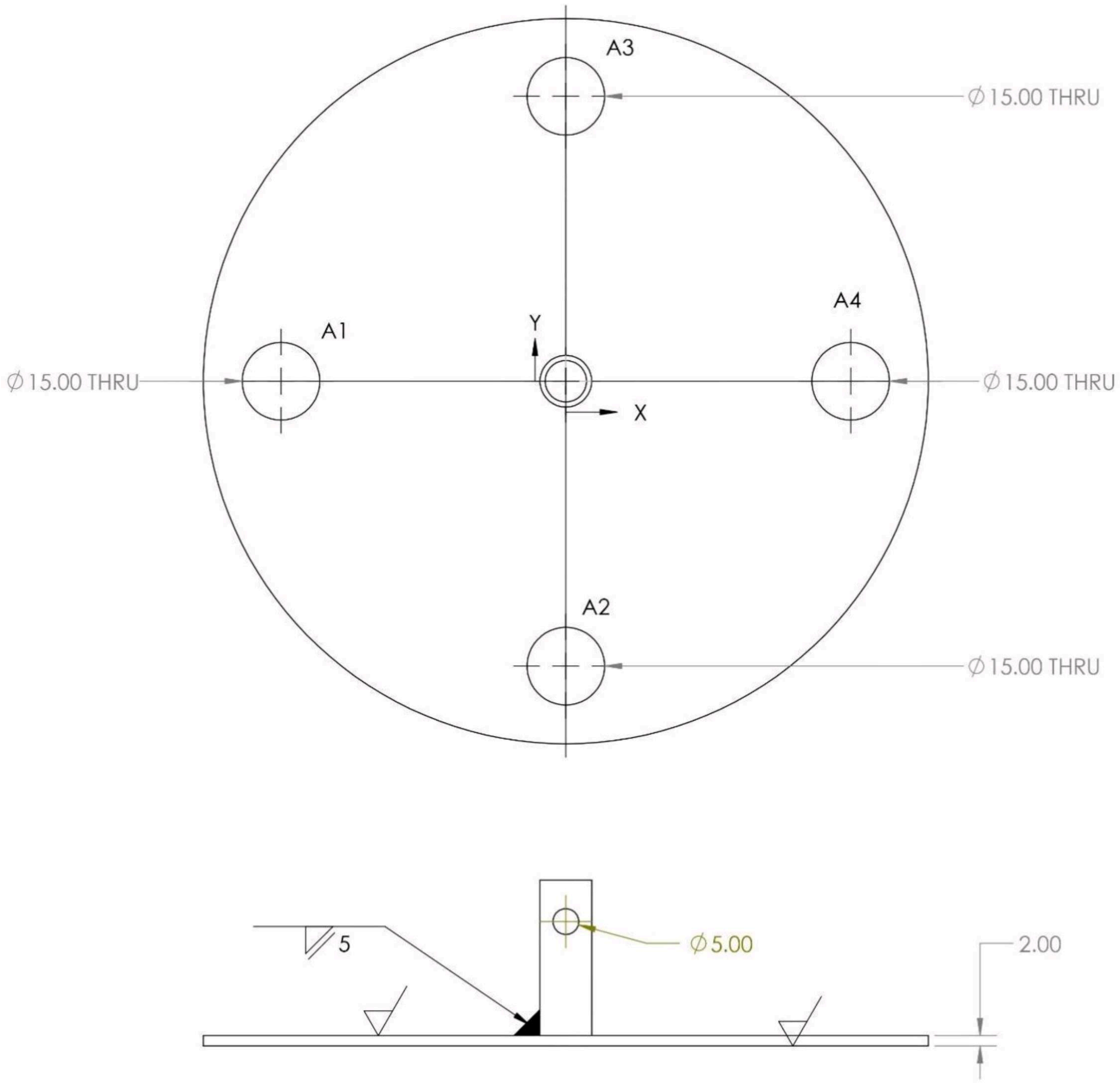


Figure 31 SEEDING PLATE FABRICATION

9.3 Fabrication of funnel :

The process of bending sheet metal involves shaping it into a desired angle or form. Bending is a common operation in sheet metal fabrication and is performed using specialized machines called press brakes. The sheet metal bending process requires skill and experience to achieve accurate and precise bends. Additionally, advanced techniques like air bending, bottoming, or coining can be employed to achieve specific bending results based on the desired design and material properties.

First step is the material selection which is mild steel. Then according to the required dimension, the sheet metal is cut. Then comes the bending process with that the edge is joined using arc welding as shown in figure no 23. After the fabrication of funnel, a long tube is attached to funnel using arc welding so that the seed will fall from the rotating disc at certain time intervals.

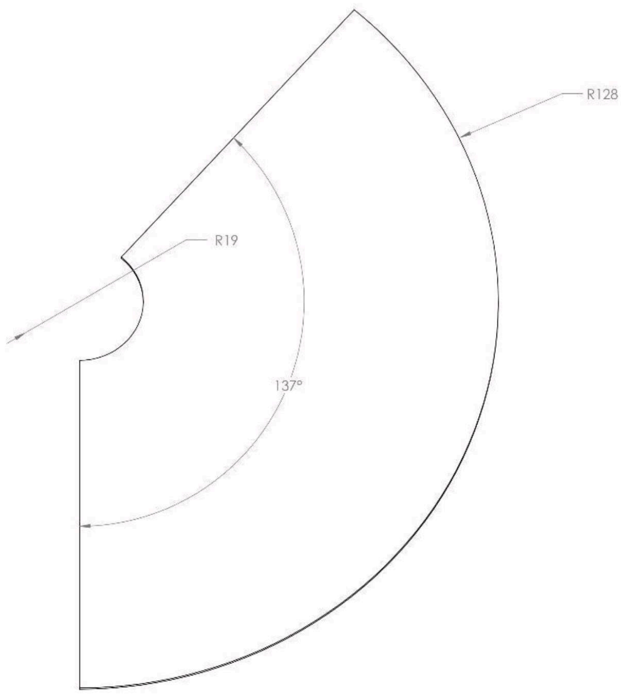


Figure 32 FLATTEN SHEET METAL

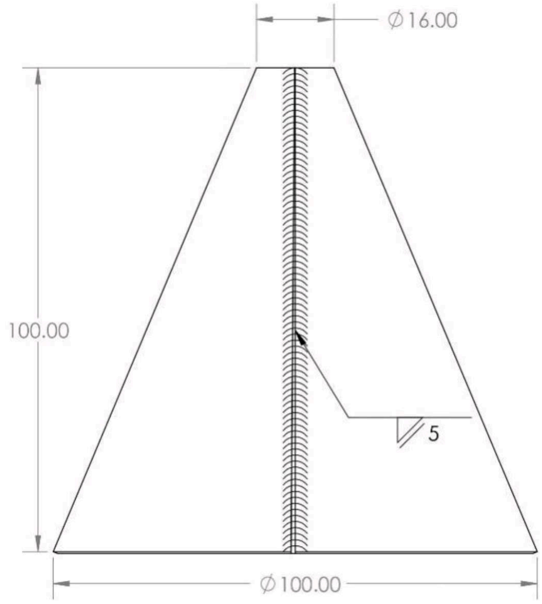


Figure 33 FUNNEL WITH WELDING

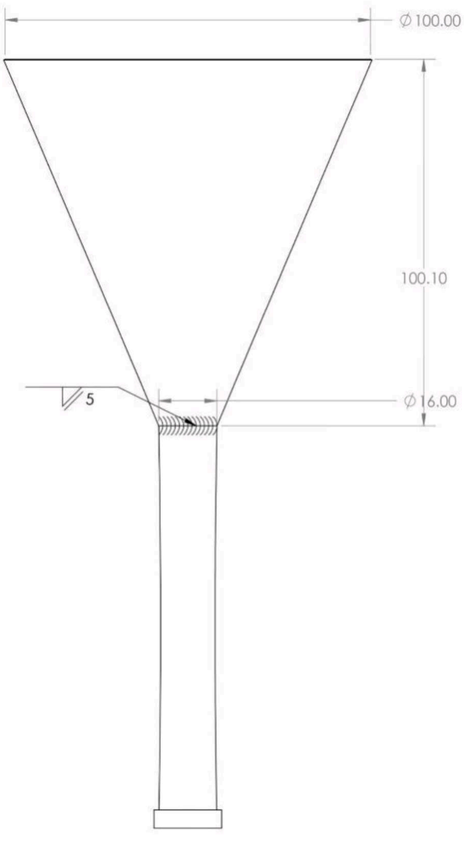


Figure 34 FUNNEL WITH LONG TUBE

Figure 35 FINAL FABRICATION

10. RESULT :

Results Increased efficiency and productivity:
An agricultural robot can automate various tasks such as seeding, planting, spraying, harvesting, and weed control. By replacing manual labor, the robot can operate continuously, reducing time and labor requirements, and increasing overall efficiency and productivity in farming operations.

Precision and accuracy:

Agricultural robots can incorporate advanced sensing technologies, such as GPS, computer vision, and machine learning algorithms. These technologies enable precise navigation, targeted application of fertilizers and pesticides, selective harvesting, and accurate data collection. The robot's ability to perform tasks with high precision and accuracy can optimize crop yields and minimize resource wastage.

Labor savings and cost reduction:

With the use of an agricultural robot, the reliance on manual labor can be reduced. This can address labor shortages, particularly in regions facing demographic shifts or challenges in hiring agricultural workers. By automating tasks, farmers can save on labor costs and allocate resources more efficiently.

Time optimization:

Agricultural robots can operate continuously, regardless of weather conditions or time of day. They can work during nighttime or adverse weather when human labor is limited. This flexibility in scheduling tasks can help farmers optimize their time and maximize the use of available resources.

Environmental benefits: Agricultural robots can contribute to more sustainable farming practices. By precisely applying fertilizers and pesticides, they can minimize overuse and reduce environmental pollution. Additionally, through the integration of sensors and data analytics, robots can aid in monitoring soil conditions, plant health, and water usage, allowing for targeted and efficient resource management.

Adaptability and versatility: A multipurpose agricultural robot can be designed and configured to perform various tasks, making it adaptable to different stages of the farming cycle or different crop types. Its versatility allows farmers to use the same platform for multiple applications, offering flexibility and cost-effectiveness.

It's important to note that the successful design and fabrication of a multipurpose agricultural robot requires thorough research, testing, and collaboration with farmers and agricultural experts. Factors like terrain, crop types, and local farming practices need to be considered to ensure the robot's functionality and integration into existing agricultural systems.

11. Applications/Advantages/Limitations

ADVANTAGES

i. Reduces the number of labors required for agricultural activity.

ii. Due to its quick action time will be saved.

iii. Agribot are able to work in any environmental condition.

iv. The robots can work without sleep so they can work 24/7/365. Protection against harmful effects of chemicals .

The advantage of this solar powered multi-function Agri-robot is that it does not require any fuel or petrol to work, as it works on solar energy.

APPLICATIONS

- Robot has a rotor which will cut the unwanted grasses while moving and also level the ground.
- The robot also has a digger to dig the vegetables from the ground.
- The AgriBot also has a water sprinkler to pour water on seeds.

12. Conclusions

In conclusion, the design and fabrication of multipurpose agricultural robots offer significant opportunities to revolutionize farming practices. These robots have the potential to increase efficiency, productivity, and sustainability in agriculture. By automating tasks such as seeding, planting, spraying, harvesting, and weed control, agricultural robots can reduce labor requirements, optimize resource utilization, and improve crop yields.

The future of agricultural robots lies in advancements in sensing and perception, autonomous navigation, multi-functionality, human-robot interaction, energy efficiency, data integration, and environmental sustainability. Further research and development in these areas will enable robots to better perceive and understand the agricultural environment, navigate autonomously, perform multiple tasks, collaborate with human operators, and contribute to sustainable farming practices.

Collaboration between researchers, engineers, farmers, and industry stakeholders is crucial for driving innovation in the design and fabrication of agricultural robots. By working together, we can develop robots that are not only efficient and effective but also user-friendly, safe, and adaptable to different farming practices.

In summary, the design and fabrication of multipurpose agricultural robots hold great promise in transforming agriculture by increasing productivity, optimizing resource management, and promoting sustainable farming practices. Continued efforts and advancements in this field will shape the future of farming and contribute to global food security and environmental stewardship.

13. Future Scope:

The design and fabrication of multipurpose agricultural robots present numerous opportunities for future work and advancements. Here are some potential areas of focus for future research and development:

Advanced sensing and perception:
Enhancing the robot's ability to perceive and understand the agricultural environment is crucial. Research can be directed towards improving sensors, such as cameras, LiDAR, and hyperspectral imaging, to enable more accurate detection of crops, pests, diseases, and environmental conditions. Additionally, the integration of machine learning and artificial intelligence techniques can enable the robot to make informed decisions and adapt to changing conditions in real-time.

Autonomous navigation and path planning:
Developing advanced algorithms for autonomous navigation is essential for agricultural robots. Future work can focus on improving obstacle detection and avoidance, path planning in complex and dynamic environments, and efficient trajectory generation. By enhancing the robot's ability to navigate autonomously, it can operate safely and effectively in various field conditions.

Multi-functionality and modularity:
Designing agricultural robots that can perform multiple tasks and be easily reconfigured for different applications would be valuable. Future work can explore modular designs that allow farmers to add or remove modules depending on the specific needs of their farming operations. This would increase the versatility and cost-effectiveness of the robots.

Human-robot interaction and collaboration:
Agricultural robots should be designed to work alongside human operators or farmworkers. Future research can focus on developing intuitive and user-friendly interfaces, as well as collaborative control systems that enable seamless interaction between humans and robots. This would facilitate easier adoption and integration of

robots into existing farm workflows.

Energy efficiency and power management:
Improving the energy efficiency of agricultural robots is crucial for extended operation in the field. Future work can explore energy harvesting techniques, advanced battery technologies, and efficient power management systems. This would allow robots to operate for longer durations without frequent recharging or refuelling.

Data integration and analytics:
Integrating data collected by agricultural robots with existing farm management systems and databases can provide valuable insights for decision-making. Future work can focus on developing standardized data formats, interoperability, and analytics tools to facilitate data integration and analysis across different platforms and sensors.

Environmental sustainability:
Continued efforts can be made to develop agricultural robots that contribute to sustainable farming practices. This includes minimizing soil compaction, optimizing resource utilization, reducing chemical inputs, and integrating renewable energy sources. Future work can explore innovative technologies and methodologies to ensure robots contribute to environmentally friendly farming practices.

Overall, future work in the design and fabrication of multipurpose agricultural robots should focus on improving capabilities, usability, efficiency, and sustainability to meet the evolving needs and challenges of modern agriculture. Collaboration between researchers, engineers, farmers, and industry stakeholders is essential to drive innovation in this field.

14. References

[1] K. Lakshmisudha, S. Hegde, N. Kale, S. Iyer, “Smart Precision Based Agriculture Using Sensors”, International Journal of Computer Applications (0975- 8887), Volume 146, No.11, pp.36-38, 2011.

[2] M. Ramu, CH. R. Prasad, "Cost effective atomization of Indian agricultural system using 8051 microcontroller", International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 7, pp. 2563-2566, 2013.

[3] Naga RohitGunturi, “Micro Controller Based Automatic Plant Irrigation System”, International Journal of Advancements in Research & Technology, Volume 2, pp.1436-1439, Issue 4, 2013.

[4] S. R. Nandurkar, V. R. Thool, R. C. Thool, “Design and Development of Precision Agriculture System Using Wireless Sensor Network”, IEEE International Conference on Automation, Control, Energy and Systems (ACES), 2014.

[5] M.K.Gayatri, J.Jayasakthi, G.S.Anandamala, “Providing Smart Agriculture Solutions to Farmers for Better Yielding Using IoT”, IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, 2015

[6] M. Dwarkani, R. Ram, S. Jagannathan, R. Priyadharshini, “Smart Farming System Using Sensors for Agricultural Task Automation”, IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, 2015.

[7] D. Chaware, A. Raut, M. Panse, A. Koparkar, "Sensor Based Automated Irrigation System", International Journal of Engineering Research & Technology (IJERT), vol. 4, no. 05, pp. 33-37, 2015.

[8] R. Jain, S. Kulkarni, A. Shaikh, A. Sood, "Automatic Irrigation System for Agriculture Field Using Wireless Sensor Network (WSN)", International Research Journal of Engineering and Technology (IRJET), vol. 3, no. 04, pp. 1602- 1605, 2016.

[9] N. Gondchawar, R.S.Kawitkar, "IoT Based Smart Agriculture", International Journal of Advanced Research in Computer and Communication Engineering, Vol.5, Issue 6,
pp.838-842, June 2016.

[10] https://www.robotshop.com/media/files/pdf/arduinomega2560datasheet.pdf

[11] https://randomnerdtutorials.com/guide-for-soil-moisturesensor-
yl-69-or-hl-69-with-the-arduino/

[12] https://www.hackster.io/igorF2/solar-charged-batterypowered-
arduino-uno-645d89 [13]http://www.mtsystem.ru/sites/default/files/documents/sim800_
hardware_design_v1.09.pdf

[14] Sunitha .M, "Seeding Robot", The Intl. Conf. on Information, Engineering, Management and Security 2014 (ICIEMS 2014).

15. Appendix Code

```
int robot1=3;
int robot2=2; int robot3=4; int robot4=5; int digging1=9; int digging2=8;
int seeding1=10; int seeding2=11;

void setup() { Serial.begin(9600);
pinMode(robot1,OUTPUT);//pins as output pinMode(robot2,OUTPUT);
pinMode(robot3,OUTPUT); pinMode(robot4,OUTPUT);

pinMode(digging1,OUTPUT); pinMode(digging2,OUTPUT);

pinMode(seeding1,OUTPUT); pinMode(seeding2,OUTPUT);

digitalWrite(robot1,LOW);//assinging pins to low values. digitalWrite(robot2,LOW);
digitalWrite(robot3,LOW); digitalWrite(robot4,LOW); digitalWrite(digging1,LOW);
digitalWrite(digging2,LOW); digitalWrite(seeding1,LOW); digitalWrite(seeding2,LOW);
}

void loop() { robot_move(); delay(1000); robot_stop(); delay(1000); robot_digging();
delay(1000); robot_seeding(); delay(1000);
void robot_move(){ digitalWrite(robot1,LOW);//movement of robot
digitalWrite(robot2,HIGH); digitalWrite(robot3,HIGH); digitalWrite(robot4,LOW);
}

void robot_stop(){
digitalWrite(robot1,LOW);//for stopping the movement of robot
digitalWrite(robot2,LOW);
digitalWrite(robot3,LOW); digitalWrite(robot4,LOW); delay(1000);
}

void robot_digging(){ digitalWrite(digging1,HIGH); digitalWrite(digging2,LOW);
delay(2000); digitalWrite(digging1,LOW); digitalWrite(digging2,LOW); delay(1000);
```

```
digitalWrite(digging1,LOW); digitalWrite(digging2,HIGH); delay(2000);
digitalWrite(digging1,LOW); digitalWrite(digging2,LOW); delay(1000);
}

void robot_seeding(){
digitalWrite(seeding1,HIGH);//high and low assignment for movement of seed platform
digitalWrite(seeding2,LOW);
delay(1000); digitalWrite(seeding1,LOW);// for stopping digitalWrite(seeding2,LOW);
delay(1000);
}
```

Design and Fabrication of Multipurpose Agricultural Robot

ORIGINALITY REPORT

35%	33%	14%	17%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.jetir.org Internet Source	4%
2	www.irjet.net Internet Source	4%
3	nevonprojects.com Internet Source	3%
4	businessdocbox.com Internet Source	3%
5	www.ijritcc.org Internet Source	2%
6	www.slideshare.net Internet Source	1%
7	asianssr.org Internet Source	1%
8	www.ijraset.com Internet Source	1%
9	www.coursehero.com Internet Source	1%

10	ijrest.net Internet Source	1 %
11	Submitted to Australian College of Kuwait Student Paper	1 %
12	Submitted to Institute of Research & Postgraduate Studies, Universiti Kuala Lumpur Student Paper	1 %
13	www.researchgate.net Internet Source	1 %
14	www.ermt.net Internet Source	1 %
15	Submitted to Pandit Deendayal Petroleum University Student Paper	1 %
16	oaijse.com Internet Source	<1 %
17	www.irjmets.com Internet Source	<1 %
18	www.ijcrt.org Internet Source	<1 %
19	www.ijirset.com Internet Source	<1 %
20	ajourneywithtime.weebly.com Internet Source	<1 %

21	Submitted to University of Canada in Egypt Student Paper	<1 %
22	www.kscst.iisc.ernet.in Internet Source	<1 %
23	www.ijert.org Internet Source	<1 %
24	vdocuments.site Internet Source	<1 %
25	www.ijsr.net Internet Source	<1 %
26	Palepu V. Santhi, Nellore Kapileswar, Vijay K. R. Chenchela, C H Venkata Siva Prasad. "Sensor and vision based autonomous AGRIBOT for sowing seeds", 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), 2017 Publication	<1 %
27	jmss.a2zjournals.com Internet Source	<1 %
28	Submitted to Monash University Student Paper	<1 %
29	www.ijresm.com Internet Source	<1 %
30	ieeexplore.ieee.org	

Internet Source

<1 %

31	docplayer.net Internet Source	<1 %
32	Tanupriya Choudhury, Arashdeep Kaur, Utsav Singh Verma. "Agricultural aid to seed cultivation: An Agribot", 2016 International Conference on Computing, Communication and Automation (ICCCA), 2016 Publication	<1 %
33	geca.ac.in Internet Source	<1 %
34	sajcd.org.za Internet Source	<1 %
35	jxzzjc.lnpu.edu.cn Internet Source	<1 %
36	odr.chalmers.se Internet Source	<1 %
37	1library.net Internet Source	<1 %
38	www.rrce.org Internet Source	<1 %
39	Submitted to Engineers Australia Student Paper	<1 %

rawe2020.in

40	Internet Source		<1 %
41	Submitted to Liverpool John Moores University	Student Paper	<1 %
42	chipwired.com	Internet Source	<1 %
43	Submitted to The Scientific & Technological Research Council of Turkey (TUBITAK)	Student Paper	<1 %
44	ijsart.com	Internet Source	<1 %
45	www.ijser.org	Internet Source	<1 %
46	"Conference Organization", 2014 Fifth International Conference on Signal and Image Processing, 2014	Publication	<1 %
47	Pawan S. Dalvi, Pravin R. Kale, Shubham S. Khalate, Dhirajkumar D. Jogekar, Shrikant D. Mangate. "Design and Power Quality Analysis of Solar LED Tower", 2019 Global Conference for Advancement in Technology (GCAT), 2019	Publication	<1 %
48	jcreview.com	Internet Source	<1 %

49	Submitted to University of Philadelphia - Jordan Student Paper	<1 %
50	dailymayvesinh.com Internet Source	<1 %
51	www.ijste.org Internet Source	<1 %
52	www.iosrjournals.org Internet Source	<1 %
53	modelearth.org Internet Source	<1 %
54	www.cnbctv18.com Internet Source	<1 %
55	Submitted to Coventry University Student Paper	<1 %
56	Pratibha S. Dodake, Anil R. Karwankar. "Image based classification of normal and special people using constrained local model", 2016 International Conference on Communication and Signal Processing (ICCSP), 2016 Publication	<1 %
57	Submitted to Visvesvaraya Technological University Student Paper	<1 %
58	vdocuments.mx Internet Source	

		<1 %
59	iarjset.com Internet Source	<1 %
60	www.ijrte.org Internet Source	<1 %
61	Kakelli Anil Kumar, Aju. D. "An Internet of Thing based Agribot (IOT- Agribot) for Precision Agriculture and Farm Monitoring", International Journal of Education and Management Engineering, 2020 Publication	<1 %
62	de.slideshare.net Internet Source	<1 %
63	ijsret.com Internet Source	<1 %
64	www.kuet.ac.bd Internet Source	<1 %
65	www.mdpi.com Internet Source	<1 %
66	Submitted to Western Mindanao State University Student Paper	<1 %
67	docplayer.me Internet Source	<1 %

68	download.atlantis-press.com Internet Source	<1%
69	idoc.pub Internet Source	<1%
70	pdfcoffee.com Internet Source	<1%
71	www.ijcaonline.org Internet Source	<1%
72	www.ijitee.org Internet Source	<1%
73	www.seeedstudio.com Internet Source	<1%
74	www.yumpu.com Internet Source	<1%
75	"Schedule", 2016 Biennial International Conference on Power and Energy Systems: Towards Sustainable Energy (PESTSE), 2016 Publication	<1%
76	Saurabh Umarkar, Anil Karwankar. "Automated seed sowing agribot using arduino", 2016 International Conference on Communication and Signal Processing (ICCSP), 2016 Publication	<1%