A
Project Report
On

DESIGN AND DEVELOPMENT OF MULTIPURPOSE AGRICULTURAL EQUIPMENT

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING

by

Mr. Aadinath Kale
Mr. Abhishek Lambe
Mr. Bhavesh Talokar
Mr. Shubham Khandare
Mr. Sumit Avhale

under the guidance of

Prof. N. B. Borkar

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon-444203 (M.S.)
(Recognised by AICTE, accredited by NBA, New Delhi, NAAC, Banglore & ISO 9001:2000)
www.ssgmce.ac.in

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Certificate

This is to certify that the project report entitled **"Design and Development of Multipurpose Agricultural Equipment"** is hereby approved as a creditable study carried out and presented by

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in manner satisfactory to warrant of its acceptance as a pre-requisite in a partial fulfillment of the requirements for the degree of Bachelor of Engineering in Mechanical Engineering of Sant Gadge Baba Amravati University, Amravati during the **Session 2022-23.**

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Acknowledgement

It is our utmost duty and desire to express gratitude to various people who have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement and help provided to us by then. There are a number of people who deserve recognition for their unwavering support and guidance throughout this report.

We are highly indebted to our guide **Prof. N. B. Borkar** for his guidance and constant supervision as well as for providing necessary information from time to time. We would like to take this opportunity to express our sincere thanks, for his esteemed guidance and encouragement. His suggestions broaden our vision and guided us to succeed in this work.

We are sincerely thankful to **Dr. S P Trikal** (HOD, Mechanical Department, SSGMCE, Shegaon), and to **Dr. S B Somani** (Principal, SSGMCE, Shegaon) who always has been kind to extend their support and help whenever needed.

We would like to thank all teaching and non-teaching staff of the department for their cooperation and help. Our deepest thank to our parents and friends who have consistently assitted us towards successful completion of our work.

- **Projectes**

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Abstract

In India there are 70% people dependent on agriculture. Farmer use the various equipment for performing the operation like spraying, grass cutting and fertilizer by semiautomated and manually operated system. These both the technique required more effort and it causes health issue.

So we design and development of a multipurpose automated agriculture equipment utilizing a Bluetooth module with a hopper for fertilizer, spraying, and grass cutting. The objective of this project is to enhance the efficiency and productivity of agricultural practices by incorporating automation technology. The equipment consists of a robust chassis with wheels for mobility, powered by an electric motor. It is equipped with a hopper for storing fertilizers, a spraying mechanism, and a grass-cutting attachment. Additionally, a Bluetooth module is integrated into the system to enable wireless communication with a smartphone or a central control unit. The Bluetooth module allows the user to remotely control and monitor the equipment. Through a dedicated mobile application, the user can set parameters such as the amount of fertilizer to be dispensed, the spraying pattern, and the cutting height. Real-time feedback from sensors on the equipment, such as soil moisture sensors and obstacle detection sensors, can be displayed on the mobile application, providing valuable information for decision-making. The hopper is designed to hold a significant amount of fertilizer, ensuring uninterrupted operation for extended periods. The spraying mechanism utilizes adjustable nozzles to enable precise and controlled application of pesticides or herbicides. The grass-cutting attachment incorporates a high-speed rotating blade for efficient cutting of grass. The development of this multipurpose automated agriculture equipment offers several advantages. It reduces the labor-intensive tasks associated with traditional agriculture practices while improving accuracy and efficiency. The remote control and monitoring capability provided by the Bluetooth module enhances convenience and enables intelligent decision-making. Furthermore, the integration of the hopper, spraying mechanism, and grass-cutting attachment into a single equipment simplifies the farming process, resulting in cost savings and increased productivity.

Keywords— Hopper, Spraying, Grass Cutting, Microcontroller and Bluetooth Module

Contents

List of Abbreviations and Symbols

Symbol/Abbreviation	Name
PMDC	Permanent Magnet
rpm	Rotation per minute
MCU	Microcontroller unit
mm	millimeter
α	Angular acceleration
W	Watt
N	Newton

List of Figures

CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1 Overview

Agricultural robot which is based on electronic and mechanical (Mechatronics) platform that perform advance agriculture process. To develop a machine capable of performing operation like automatic grass cutter and fertilization, pesticide spraying, we have developed an electromechanical vehicle which is steered by DC motor to drive wheels. The farm is cultivated by the automated system, depending on the crop considering particular row and specific columns. This project controlled by remotely with the help of mobile.

In the current generation most of the countries do not have sufficient skilled man power specifically in agricultural sector and it affects the growth of developing countries. So, it's a time to automate the sector to overcome this problem. In India there are 70% people dependent on agriculture. So, we need to study agriculture. Innovative idea of our project is to automate the process of grass cutting and spraying pesticide, fertilization. To reduce the human effort and increase the yield. The spraying of firm and fertilization of plant is automatically done by using dc motor. The distance between the two seeds are controlled and varied by using microcontroller. When the robot reaches the end of the field, we can change the direction with the help of remote switches. The whole process is controlled by Bluetooth. Spraying of firm and fertilization of plant is our day to day life is done by tractor in farms. But it requires more time & the man power shortage is faced continuously. The main requirement of automation is to reduce man power in our country; the buzzword in all industrial firms generally involves electrical, electronic component as well as mechanical Part. Automation saves a lot of tedious manual work and speeds up the production processes.

[3]Agriculture is a crucial aspect of the world's economy as it provides food for the ever-growing population. However, in farming involves various activities such as planting, weeding, fertilizing, spraying, and grass cutting. Traditionally, farmers have relied on manual labor to carry out these activities, which is not only time-consuming but also inefficient. In recent years, technological advancements have revolutionized the agricultural sector, with the introduction of automated equipment.

These machines have made farming easier, cost-effective, and more efficient. We will discuss the design and development of an automated multipurpose agriculture equipment that includes fertilizing, spraying, and grass cutting. The automated multipurpose agriculture equipment is designed to carry out various farming activities, making it a versatile tool for any farmer. [4]The machine has three main features; fertilizing, spraying, and grass cutting, which can be manually controlled or operate in a semi-automatic mode. The fertilizing feature is designed to distribute fertilizers evenly across the farm, ensuring that crops receive the right amount of nutrients for optimal growth. The spraying feature, on the other hand, is designed to carry out crop protection, weed control, and disease prevention activities. The grass cutting feature is designed to maintain the lawn, ensuring that it is well-trimmed and neat. The machine can be remotely controlled, making it easy for farmers to operate it from a distance. Additionally, it is equipped with sensors that help detect any obstacles within the farm and automatically adjust its movement to avoid collision or damage. The population is continuously increasing the crop production also has to increase this can be done by using multipurpose machines to save time and money. In INDIA the availability of skilled labor, water resources, crop monitoring is effecting the agriculture field so to overcome this a special purpose machines has to be used. Development of multipurpose machines helps in safe handling and improve accuracy. Development of agriculture multipurpose machines saves labor cost, saves energy and improve quality and accuracy. Fertilizer and pesticide spraying robots can carry large storage reservoirs, be operated safely and even autonomously, and be deployed at a fraction of the cost compared to the traditional methods. In fact, it is estimated that fertilizer and pesticide spraying by agricultural robots can reduce labor requirements. The microcontroller which is use in multipurpose agriculture equipment is Arduino is platform that is user-friendly, inexpensive, and open-source. It can be easily programmed using the Arduino IDE software and has a wide range of compatible sensors and accessories. The farmers spray fertilizer manually by using hands for which more efforts are required. It is harmful for health and time consuming. [8]Semi-automatic methods use a combination of manual and automated processes to perform operations. These methods are more efficient and accurate than fully manual methods, but they still require human intervention and oversight. In fertilizer application, semi-automatic methods involve the use of specialized equipment designed to apply fertilizer precisely and evenly across

a given area. These machines may be equipped with sensors that measure soil moisture, temperature, and nutrient levels to tailor the application rate to specific needs. The operator may also adjust the equipment manually to account for variations in terrain or other factors. In grass cutting, semi-automatic methods involve the use of motorized lawnmowers equipped with features like automated height adjustment and self-propulsion. The operator can set the height of the mower blades and direct the machine as needed, while the automated systems ensure a consistent and uniform cut. In spraying applications, semi-automatic methods involve the use of specialized equipment designed to apply pesticides, herbicides, or other chemicals accurately and efficiently. So it will help farmers to reduce the labor cost and increase the overall efficiency.

1.2 Motivation

Now a day we have lack of man power. Energy required for this machine is less as compared with tractors or any agricultural instrument pollution is also a big problem which is eliminated by using battery. a manual farm consumes more time & leads to more pollution. So, it is a time to automate the process of spraying and grass cutting. Another is also need is to increase high speed of operation.

Agriculture is demographically the broadest economic sector and plays a significant role in the overall economy of India. For the growth of Indian economy, mechanization is necessary. The main purpose of mechanization in agriculture is to improve the overall productivity and production. Planting is conventionally done manually which involves both animate (humans and draught animals), this result in higher cost of cultivation and delay in planting. The main purpose of this paper is to compare between conventional method and new proposed machine which can perform number of simultaneous operations. So to increase the productivity and to reduce the human effort we design the multipurpose agriculture farming equipment.

Figure 1.1 Manually Operated Machine

1.3 Problem Statement

- In spraying process lots of health issue arises such stinging eyes, rashes, blisters, blindness, nausea, dizziness, diarrhea and death due to direct contact of pesticide.

- In grass cutting process, there is lots of problem occurs while cutting, human casualties occurs during manual grass cutting.

- The cost required for manually, semi-automated farming equipment is more because every operation require individual equipment so it's costly for farmer.

- There are lots of human casualties occurs in several area of agriculture while spraying due to direct human intervention with pesticide, insecticide.

1.4 Objective

- To make an efficient spraying process with the help of remote operating system due to this less contact occur with pesticide so human casualties reduce.

- To design an effective and adjustable grass cutting process so we can adjust it as per the height of grass so it is easy to cut.

- To make a one-time Investment equipment for farmer which perform all three operations, so no individual cost is require.

- To make an automatically work spraying process where less contact of human occurs and all spraying process work automatically with the help of node MCU.

CHAPTER 2

LITERATURE SURVEY

CHAPTER 2

LITERATURE SURVEY

1) **D.A. Made, Sunday Mihai, [2013]** In this research paper author has mentioned importance of mechanization in agricultural by giving examples. The conclusion from the paper was need of multifunctional single axel vehicle for pre and post harvesting. We have taken this as base for our research and further production of our multifunctional agricultural vehicle.
2) **V.K. Tiwari, A. Ashok Kumar, Satya Prakash Kumar, Brijesh Narre [2012]** In this research papers author have done case study on farm mechanization in west Bengal as being part of India it gives clear status about availability and progress in India. This ensured us to take right steps compared to current steps.
3) **F.A. Adamo, B. G. Jamun and B. Babangida [2014]** In this paper authors draws our attention towards the performance factor of a power tiller. Among those demand for light weight power tiller was sought out most Fuel efficiency and field capacity such parameters are also discussed. We take those points in consideration while designing a sustainable multifunctional agricultural vehicle.
4) **Md. Didarul Islam Sujon, Rumman Nasir, 2018.** In this paper wheel control using relay switching and Arduino programming. It perform ploughing seeding operation Ultrasonic sensors on three sides of the robot one at front, one at right, one at left side which detect obstacles. It's fully autonomous that's farmer is not required to be present on the field.
5) **Mahesh R. Punekar.et.al**, **2017**High precision pneumatic planters have been developed for many verities of crops, for a wide range of seed sizes, resulting to uniform seeds distribution along the travel path, in seed spacing. The basic function of sowing operation is to sow the seed and fertilizer in rows at required depth and to maintain the distance between the seeds and provide proper compaction over the seed.
6) **Swetha Set**al In this machine solar panel is used to capture solar energy and then it is converted into electrical energy which in turn is used to charge 12V battery, which then gives the necessary power to a shunt wound DC motor. This

power is then transmitted to the DC motor to drive the wheels. And to further reduction of labor dependency, IR sensors are used to maneuver robot in the field. Here 4 post sensors are used to define the territory and robot senses the track length and pitch for movement from line to line

7) **K. Karthikeyam, S. Shyam Sundar, 2017** This Multi-Utility Agriculture Vehicle works on the concept Rotary motion gets converted into linear motion. It has the manual type mechanism. It's design for small farming upto 4 to 5 acre. In this vehicle spraying, ploughing, seed sowing, operations are performed.
8) **Dr. C.N. Saklhale** This review paper focus on the basic problems faced by farmers i.e. seed sowing, fertilizer spraying, cultivation and digging and motivating the idea for design of a machine which would use an engine for much faster and efficient working.
9) **Dhiraj N. Kumbhare** Author suggests that the machine proposed will reduce cost and save time for spraying fertilizers efficiently on the crops at specific intervals. It also provides a safety factor for humans from the effects of chemical fertilizers and it also helps in reducing the human interference in the process.
10) **Siddharth Kshirsagar** This research paper focus on designing a machine which would be able to perform spraying operation more efficiently using pump driver linkage mechanism.
11) **R. Joshua et.al. Says in the Technical Magazine** - An Agriculture Implement" that "Energy - demand" is one the major thread for our country. Finding solutions, to meet the "Energy -demand" is the great challenge for Social Scientist, Engineers, Entrepreneurs and Industrialist of our Country. According to them, Applications of Non-conventional energy is the only alternate solution for conventional energy demand. Now-a-days the Concept and Technology employing this Non-conventional energy becomes very popular for all kinds of development activities. One of the major areas, which finds number applications are in Agriculture Sectors. Solar energy plays an important role in drying agriculture products and for irrigation purpose for pumping the well water in remote villages without electricity.

CHAPTER 3

SCOPE OF PROJECT

CHAPTER 3

SCOPE OF PROJECT

The scope of the project for performing various operation as given below.

Scope

1. Multipurpose, can perform various operations such as spraying, fertilizing and grass cutting application.
2. The implement of scientific farming with our equipment will lead to higher yield and work better in farm.
3. It is easily operated than semi-automated and manually operated machine.
4. Number of workers required for this multipurpose equipment is reduced excessively, which in turn reduces labor charges.
5. Variable with dimensions and farming specifications.
6. Adopted Advanced farming and Precision farming technology.
7. Our equipment is completely flexible for easy assembly and disassembly. Scope for future work by increasing the equipment strength and quality to its peak, we can have multipurpose agricultural equipment for life time usage.

CHAPTER 4

METHODOLOGY

CHAPTER 4

METHODOLOGY

To make this machine we discuss all the point which are required for this like selection of motor, Identification of Material, Operating machine, Tools and Accessories and the required electronic device. So we make our strategy according to the below information

4.1 Performing Operation

The multipurpose agriculture equipment is used to reduce human effort in this equipment we perform operation like grass cutter, cultivator, spraying, fertilization.

These all equipment's are adjustable if any equipment is not for use that time it can be easily remove for that time.

This model which perform all operation work on Wi-Fi module and motor drive with the help of battery.

In past due to spraying there are number of health issue casualties created so to avoid such problem this equipment avoid direct contact with human body.

In this equipment we use the grass cutter and it operated by PMDC motor having 3000rpm with 6AH.

There are two hoppers with two motor present in this equipment for proper spreading of fertilization.

In this prototype we use 5 litre tank for spraying operation.

These all equipment's are mounted on frame and the material is used as iron.

4.2 Calculation

Calculation for rear wheel motor

Mass of sprayer = 5kg

Mass of fertilizer = 10kg

Mass of grass cutter = 5kg

Mass of frame = 10kg

Net Mass of vehicle: - 30 Kg

Weight: - 30*10= 300 N

Weight on each wheel= 150 N

Radius of Wheel: - 23 cm = 0.23 m

Width of wheel = 10 cm = 0.1 m

Moment of inertia along diameter

$= 1/4mr^2+1/12ml^2+mr^2$

$= 2.6\ Kgm^2$

Initial Angular Velocity = 0 rad/sec

Assume velocity = 10 km/hrs.

$\omega = V/r = 12.17 rad/sec$

Angular acceleration= Change in angular velocity/Change in time

$= 12.07/5$

$= 6.27\ rad/sec^2$

Torque= $I*\alpha$

$= 2.6*2.414$

$= 6.27$ N-m

Assume Torque= 10 N-m

Speed revolution = $60* \omega/2 \pi$

$= 60*12.07/2 \pi$

$= 115.26$ rpm

Power = $2 \pi NT/60$

$= 2 \pi*115.26*10/60$

$= 120.59$ W

For Factor of Safety

Torque = 20N-m = 101 kg cm

Power = 200W

Powered required for two rear motor

P = 2*200 = 400W

Calculation for Hopper Motor

Weight on Motor= 10kg

Weight = 10 * 9.81 = 98.1 N

Speed = 10 RPM

Radius = 0.15m

T = Weight * Radius

= 100 * 0.15

T = 15 N-m-

$P = 2\pi NT/60$

$P = 2\pi * 10* 15/60$

Power = 105W

Powered required for hopper two motor

P = 2*105 = 210W

4.3 Project Planning

The task has been allotted us in the starting of August 13 so, we have start information collection from the start the information from internet up to the middle of August. The information collection from various garage & industries are begins up to the start of Sept13.The material collection begins from same period from market and workshop and end up to third decade of Sept. The project pre – designing also end up to second decade Oct the second presentation is held up in same period & at the end of Nov. we start up the fabrication processes. The Diwali vacation is completely spending in the searching of code & the third presentation is successfully completely at the end of February. The fabrication is successfully in the April 14 ending and also the final testing also successful and after that we started to make a report on it. Overall till at the middle of April, the task is almost completed.

4.4 Monthly Schedule

	Project Identification	Literature review	Design & Analysis	Planning	Fabrication	Testing	Submission
Aug							
Sep							
Oct							
Nov							
Dec							
Jan							
Feb							
Mar							
April							

4.5 Materials

Sl. No.	PARTS	Qty.	Material
1	Frame	-	Iron
2	Dc motor		12v dc
3	Battery	1	Lead acid
4	Bearings	8	Steel
5	Fertilizer	1	-
6	Dc pump	1	-
7	Wheel	4	Polymer
8	Blade	1	Steel
9	Water tank	-	Plastic

CHAPTER 5

COMPONENT USED IN PROJECT

CHAPTER 5

COMPONENTS USED IN PROJECT

5.1 Frame

A **frame** is often a structural system that supports other components of a physical construction and iron frame that limits the construction's extent. Frame is back bone of the equipment. It is made of Iron. All the sub-parts in the equipment are mounted in the frame. It is the rigid structure that forms a skeleton to hold all the major parts together.

In the frame, fertilizer assembly is mounted in center of frame and grass cutter is attach at the front end of frame and steering mechanism is also attach to frame.

Frame Size

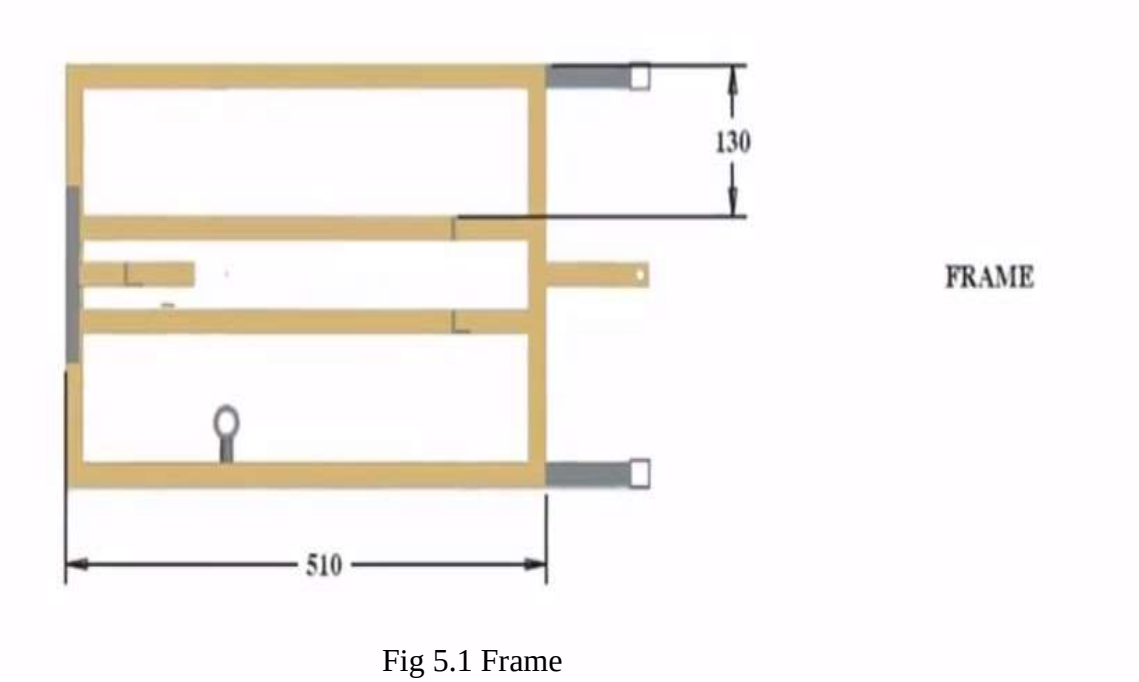

Fig 5.1 Frame

5.2 Type dc Motor

- Motor type -PMDC MOTOR, 3000 rpm for grass cutting operation.
- Motor type- PMDC MOTOR, 1900 rpm for rear wheel and four bar mechanism.
- Operating Voltage - 3 to 12v.
- Weight - 30g

- An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left-hand rule.
- When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

Fig 5.2 PMDC Motor

5.3 Lead Acid Battery

12-volt dc 9 amp current

Lead acid batteries are the most common large-capacity rechargeable batteries. They are very popular because they are dependable and inexpensive on a cost-per-watt base.

Lead acid batteries are built with a number of individual cells containing layers of lead alloy plates immersed in an electrolyte solution, typically made of 35% sulphuric acid (H2SO4) and 65% water. Pure lead (Pb) is too soft and would not support itself, so small quantities of other metals are added to get the mechanical strength and improve electrical properties. The most common additives are antimony (Sb), calcium (Ca), tin (Sn) and selenium (Se). When the sulphuric acid comes into contact with the lead plate, a chemical reaction is occurring and energy is produced.

Fig 5.3 Lead Acid Battery

(1) Low cost

(2) Long life

(3) High reliability

(4) High overall efficiency

(5) Low discharge

(6) Minimum maintenance

5.4 Washer Motor

To deliver the water for spraying operation at desired Pressure of 2.4 bar min.This motor will supply water from tank to nozzle at required pressure.

Fig 5.4 Washer Motor

Pump Type	Centrifugal
Voltage	12V / 24V
Pressure	2.4 bar min.
Discharge	1700ml per minute
Current	7.0 Amp max.
Operating Temperature	-40ºc to +80ºc
IP	IP67
Connector	Water proof connector

5.5 Sprayer

A **sprayer** is a device used to spray a liquid. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors.

5.5.1 Spraying Nozzle

A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe.

A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy. The diameter of the nozzle depend on the application of use in farm.

Fig 5.5.1 Nozzles

5.5.2 Sprayer Tank

A fertilizer tank is a container for storing water. Water tanks are used to provide storage of water for use in many applications, drinking water, irrigation agriculture, fire suppression, agricultural farming, both for plants and livestock, chemical manufacturing, food preparation as well as many other uses. Water tank parameters include the general design of the tank, and choice of construction materials, linings.

Fig 5.5.2 Spraying Tank

5.6 Hopper

Hopper is a large pyramidal or cone shaped container used in industrial processes to hold particular matter such as fertilizer. Mostly hoppers are made up of MDF sheet having 12mm thickness. Size 230*230*280mm.

Hopper is used for the fertilizing purpose in farm.

The hopper mechanism is mounted on the frame and fertilizer are dropped through this hopper. This hopper mechanism is work with the help of four bar chain mechanism.

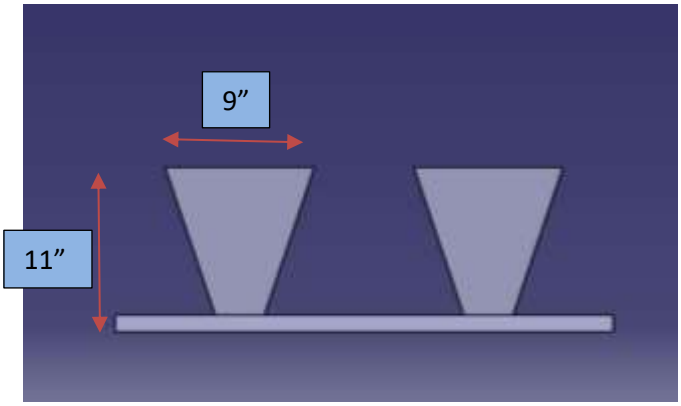

Fig 5.6 Hopper

5.7 Node MCU

The NodeMCU 3266 is a development board based on the ESP8266 Wi-Fi module. It is designed to provide a convenient and easy-to-use platform for the Internet of Things (IoT) and home automation projects. The NodeMCU 3266 board features a 32-bit microcontroller, 4 MB flash memory, and 80 MHz clock speed, making it powerful enough to handle complex automation tasks.

For use in automated agriculture equipment, the NodeMCU 3266 board can be integrated with various sensors and actuators to monitor different parameters such as soil moisture, temperature, humidity, light intensity, and more. It can also be connected to other devices and platforms via Wi-Fi to enable remote monitoring and control.

The NodeMCU 3266 board can run on different Arduino development environments such as Arduino IDE, MicroPython, and Lua scripting language, providing flexibility and ease of use for developers and engineers. With its compact size, low cost, and powerful capabilities, the NodeMCU 3266 board is an ideal choice for designing automated agricultural systems that can improve crop yield.

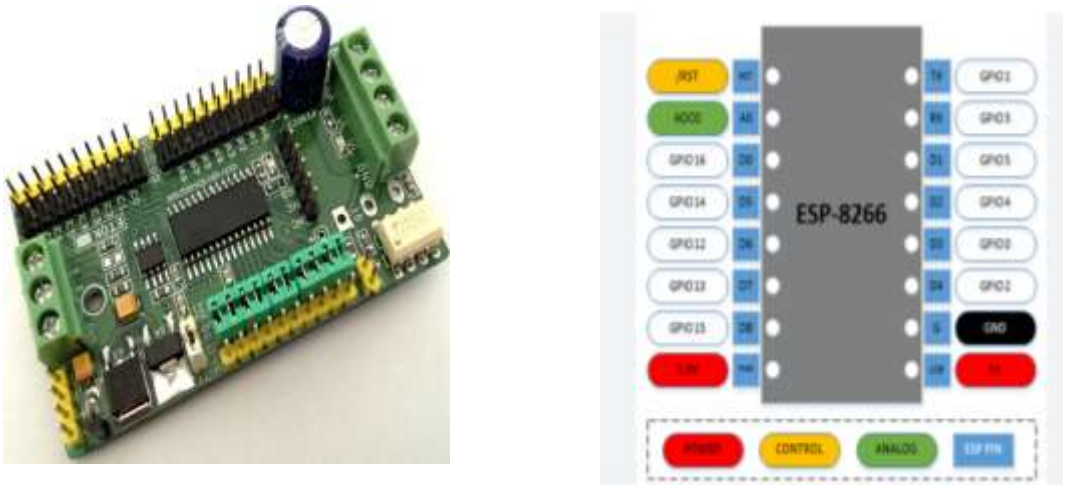

Fig 5.7 Node MCU

5.8 Motor Drive

The L298N chip contains two standard H-bridges capable of driving a pair of DC motors, making it ideal for building a two-wheeled robotic platform.

The L298N motor driver has a supply range of 5V to 35V and is capable of 2A continuous current per channel, so it works very well with most of our DC motors.

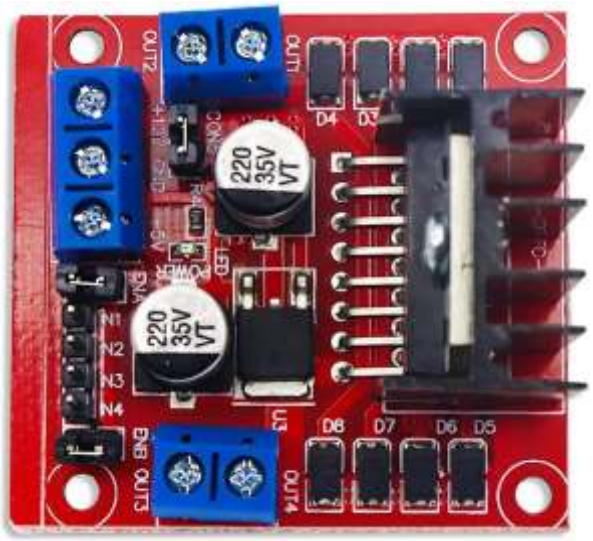

Fig 5.8 Motor Drive

- **Technical Specifications**

Here are the Specification:

Motor output voltage	5V – 35V
Motor output voltage (Recommended)	7V – 12V
Logic input voltage	5V – 7V
Continuous current per channel	2A
Max Power Dissipation	25W

5.9 Wheel

Wheel is a circular object that revolves on an axle and is fixed below a vehicle or other object to enable it to move over the ground.

In this vehicle wheels are made of polymer material. Wheel are connected with DC motor and front wheel rotate 60 degree with the help of rack and pinion steering mechanism. The rear wheel which are connected to DC motor and this rear wheel are operated with the help of Node MCU**.** The diameter of the wheel should be 460mm.

Fig 5.9 Wheel

CHAPTER 6

DESIGN & FABRICATION

CHAPTER 6

DESIGN

6.1 2-D Modeling

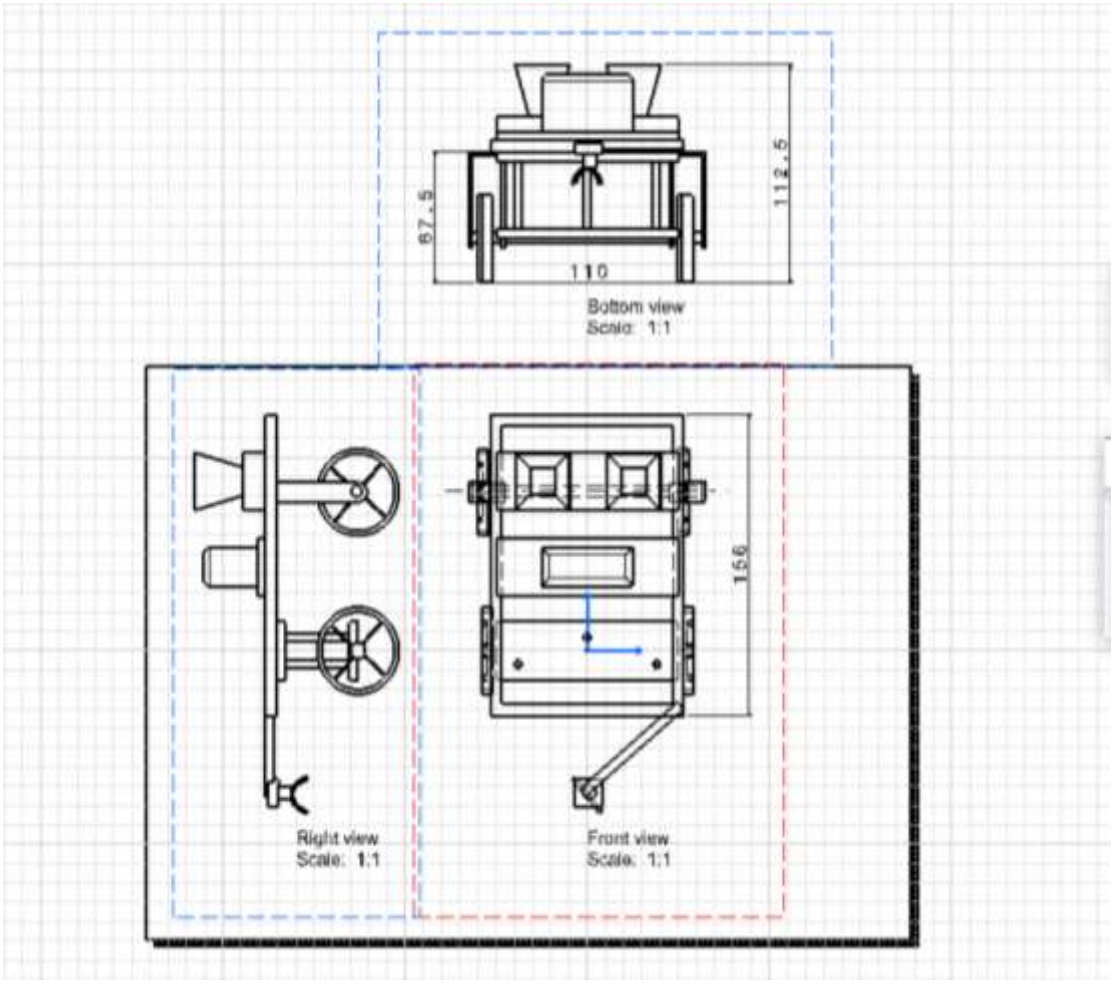

Fig 6.1.1 Front Top and Side View

6.2 3-D Modeling

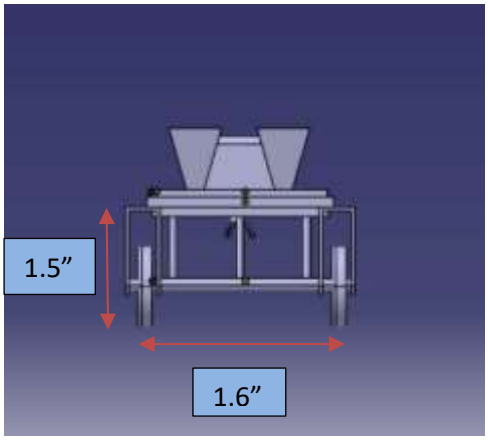

Fig 6.2.1 Front View

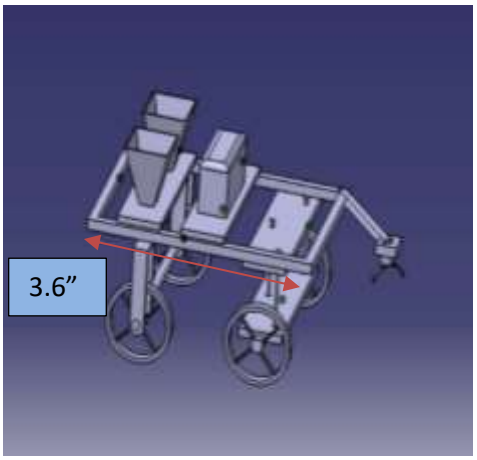

Fig 6.2.2 Isometric View

Fig 6.3.3 Actual Model

Material = Iron

Length = 3.6” = 1098mm

Width = 1.6” = 488mm

Height = 1.5” = 557mm

6.3 Fabrication

The fabrication process of a farming equipment typically involves several steps, including:

1. Design: The first step is to design the frame using welding and drilling process. This involves creating a rectangular type frame and other operations components and specifying its dimensions, materials, and other features.

2. Material selection: Once the design is complete, the next step is to select the appropriate materials for the frame and other operations. This may include iron, wooden material, or other metals depending on the application and requirements.

3. Cutting: The iron bar are cut to size using a manual iron cutting machine and the wooden sheets are cut in carpentry shop with proper dimensions.

4. Drilling: For fitting of other wooden material component the drilling process is done, so at proper dimension the hole is created so that wooden components are easily attached to frame and the main purpose is that the components become adjustable by the use of nut bolt.

5. Welding: The iron bar are join with each other with the help of arc welding to form a rectangular frame.

6. Finishing: The frame and other material is then cleaned, polished, and painted or coated to provide protection against corrosion and wear.

7. Assembly: Finally, the various components of the frame and wooden material are assembled together to create the finished product.

Overall, the fabrication process of a frame and the other material joining requires a combination of skilled craftsmanship and modern technology to produce a high-quality product.

6.4 Parts

The project consists of following parts:-

- Frame
- Wheel- 04 No.
- Dc dry battery.
- PMDC MOTOR
- Battery
- Washer pump
- Pesticide Tank- 5-liter Capacity
- Nozzle- 01No.
- Hopper- 02No.

CHAPTER 7

WORKING PROCEDURE

CHAPTER 7

WORKING PROCEDURE

Base frame is made for the Machine with 4 wheels connected each with the PMDC motors. Two motors has 60 rpm which is connected to rear wheel. At the front side of frame grass cutter is present which is operated with the help of PMDC motor having 3000 rpm. Water tank is attached in the frame to sprayer at the end of the process through spray pump. The capacity of sprayer tank is 5 liter and the spraying process is works with the help of washer motor.

At the middle of frame two hoppers are mounted which is work with the help of four bar chain mechanism and the power is supply by motor.

Battery is mounted on chassis near to hoppers and motor is activated by battery. Two motor driver are present in this system to control all PMDC motor.

The system uses a Bluetooth module as a medium to transmit signals between the android based phone and to the Bluetooth. The node much now processes the data sent by Bluetooth module and checks for user commands. On recognizing direction commands sent by user (Forward/Backward), the microcontroller sends signals to appropriate driver IC's. The driver IC's now operate motors to achieve the desired movement of the automobile as sent by microcontroller.

Using Bluetooth, farmer can control motion of the vehicle forward, Left, right and stop.

Water pump ON/OFF and grass cutter is controlled by remotely using mobile app.

7.1 Individual Procedure of Each Operations

1. **Steering Mechanism**: The steering of this equipment is based on rack and pinion mechanism and it is used for turning operation that is left and right movement. In this steering mechanism 100 rpm motor is used and this operation is fully automated by using Bluetooth module and it is controlled by webpage on smartphone. It is automated by node MCU.

Fig 7.1.1 Rack & Pinion Steering Mechanism

Fig 7.1.2 Operating Button for Mechanism

From above figure the rack and pinion steering mechanism is work on the basic of bluethooth module which have to open in android then the rack and pinion move left and rigth direction by clicking the button RIGHT and LEFT which have show in fig 7.2.1.

2. **Sprayer**: This sprayer is used to spray pesticide, insecticide etc. in this prabha washer motor is used for spraying operation and range of spraying is about 15-20 cm. It is also automatically operated by using Bluetooth module with the help of node MCU. This spraying operation is useful for less human contact so human casualties reduced.

Fi

Fig 7.1.3 Sprayer

Fig 7.1.4 Operating Button for Sprayer

This spraying system is automated on the basis of Node MCU in which the spraying system is ON or OFF by Clicking the button MOTOR-1 which have shown in fig 7.1.4.

3. **Grass cutter**: It is used to cut various size grass and it is adjustable grass cutter with the help of cutter blade and it is attached to front side of frame. It is also automatically operated with the help of node MCU. The motor used in grass cutter is PMDC motor whose rpm is 3000.

Fig 7.1.5 Grass Cutter

Fig 7.1.6 Operating Button for Grass cutter

In this grass cutting operation the grass will be cut at the height of 1.5” i.e 300mm in farm and it work automatically by using the Node MCU. If the MOTOR-2 is ON then the operation is work and the it is OFF then the operation will stop by clicking this button.

4. **Fertilizer spreader**: This operation done with the help of hopper, it is used to drop various fertilizer through both hopper. In this operation four bar chain mechanism is used and it is also fully automatic which work with the help of Bluetooth module.

Fig 7.1.7 Fertilizer Spreader

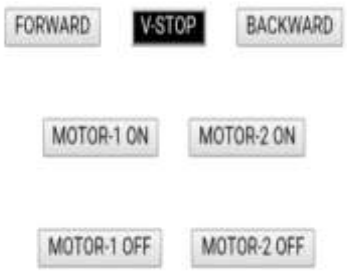

Fig 7.1. Operating Button for Fertilizer

Fertilization spreader will work on two motor which is connected to the four bar chain mechanism. The both motor ON or OFF by clicking the above button.

7.2 Block Diagram.

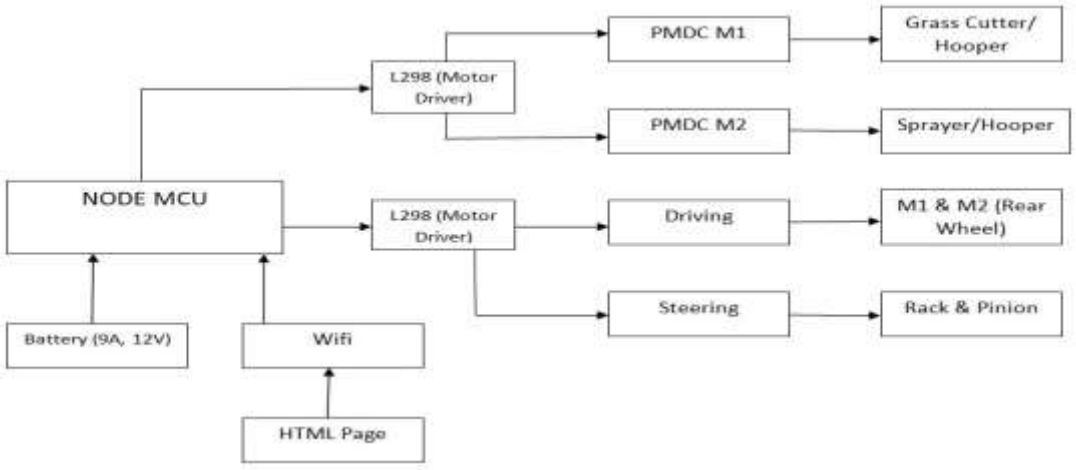

Fig 7.2 Block Diagram

7.3 Program Code

```
#include < WiFi.h>

#include <Web Server.h>


#define INBUILT_LED


const char* ssid = "AgriMachine";

const char* password = "yourpassward"; /

IPAddress local_ip(192, 168, 1, 1);

IPAddress gateway(192, 168, 1, 1):

IPAddress subnet(255, 255, 255, 0);


ESP8266WebServer server(8.0);


int machine_mode = 0; // set machine working mode (0 = stop)


int motr1 = 0;

int motr2 = 1;

int motr3 = 2;

int motr4 = 3;


int motr5 = 5;

int motr6 = 6;

void setup(){


  pinMode(motr 1, OUTPUT);
```

```
digitalWrite(motr1, LOW);
pinMode(motr2, OUTPUT);
digitalWrite(motr2, LOW);
pinMode (motr3, OUTPUT);
digitalWrite(motr3, LOW);
pinMode(motr 4, OUTPUT);
digitalWrite(motr4, LOW);

pinMode(motr5, OUTPUT);
digitalWrite(motr5, LOW);
pinMode(motr 6, OUTPUT);
digitalWrite(motr6, LOW);
Serial.begin(9600);
Serial.println("Multitasking_Agricultural_Robotic_Machine");
pinMode(INBUILT_LED, OUTPUT);
digitalWrite(INBUILT_ LED, HIGH);
machine_control(); // Stop machine

// WiFi.mode(WIFI_AP);
  WiFi.softAP(ssid, passward);
  WiFi.softAPConfig(local_ip, gateway, subnet);
 delay(100);

server.on("/", HTTP_GET, handle_OnConnect);
server.on("/allstop", HTTP_GET, handle_allstop);
server.on("/ledon", HTTP_GET, handle_ledon);
server.on("/ledoff", HTTP_GET, handle_ledoff);
```

```
  server.on("/steering left", HTTP_GET, handle_steeringleft);
  server.on("/steeringright", HTTP_GET, handle_steeringright);
  server.on("/steeringstop", HTTP_GET, handle_steering stop);
  server.on("/vehicleforward", HTTP_GET, handle_vehicle forward);
  server.on("/vehicle backward", HTTP_GET, handle_vehiclebackward);
  server.on("/vehiclestop", HTTP_GET, handle_vehiclestop);
  server.on("/motoroneon", HTTP_GET, handle_motoroneon);
  server.on("/motorone off", HTTP_GET, handle_motoroneoff);
  server.on("/motortwoon", HTTP_GET, handle_motortwo on);
  server.on("/motortwooff", HTTP_GET, handle_motortwooff);

  server.onNotFound(handle_NotFound);
  server.begin();
  Serial.println("NodeMCU web server started.");
  }

void handle_OnConnect() {
  machine_mode = 0;
  Serial.println("Client connected");
  server.send(200, "text/html", SendHTML()):
}

void handle_NotFound() {
  machine_mode = 0;
  Serial.println("Page error");
  server.send(404, "text/plain", "Not found");
}
```

```
void handle_allstop() {
  machine_mode = 0;
  Serial.println("MACHINE Halted");
  server.send(200, "text/html", SendHTML());
}

void handle_ledon() {
  machine_mode = 1;
  Serial.println("Turn on LED...");
  server.send(200, "text/html", SendHTML());
}

void handle_ledoff() {
  machine_mode = 2;
  Serial.println("Turn off LED...");
  server.send(200, "text/html", SendHTML()):
}

void handle_steeringleft() {
  machine_mode = 3;
  Serial.println("Steering to Left...");
  server.send(200, "text/html", SendHTML());
}

void handle_steeringright() {
  machine_mode = 4;
```

```
  Serial.println("Steering to Right...");
  server.send(200, "text/html", SendHTML());
}
void handle_steeringstop() {
  machine_mode = 5;
  Serial.println("SteeringStop...");
  server.send(200, "text/html", SendHTML());
}
void handle_vehicleforward() {
  machine_mode = 6;
  Serial.println("Vehicle Forwarding...");
  server.send(200, "text/html", SendHTML());
}
void handle_vehiclebackward() {
  machine_mode = 7;
  Serial.println("Vehicle Backwarding...");
  server.send(200, "text/html", SendHTML());
}
void handle_vehiclestop() {
  machine_mode = 8;
  Serial.println("Vehicle Stopped...");
  server.send(200, "text/html", SendHTML());
}
void handle_motoroneon() {
  machine_mode = 9;
  Serial.println("Motor one On...");
  server.send(200, "text/html", SendHTML());
```

```
}
void handle_motoroneoff() {
  machine_mode = 10;
  Serial.println("Motor one Off...");
  server.send(200, "text/html", SendHTML());
}
void handle_motortwoon() {
  machine_mode = 11;
  Serial.println("Motor two On...");
  server.send(200, "text/html", SendHTML());
}
void handle_motortwooff() {
  machine_mode = 12;
  Serial.println("Motor two Off...");
  server.send(200, "text/html", SendHTML()):
}

void machine_control() {

  switch (machine_mode) {

    case 0:  // Stop every output of machine

      digitalWrite(motr 1, LOW);
      digitalWrite(motr2, LOW);
      digitalWrite(motr3, LOW);
      digitalWrite(motr4, LOW);
```

```
digitalWrite(motr5, LOW);
digitalWrite(motr6, LOW);
digitalWrite(INBUILT_LED, HIGH);
break;
case 1: // Turn On LED
digitalWrite(INBUILT_LED, LOW);
break;
case 2: // Turn Off LED
digitalWrite(INBUILT_ LED, HIGH);
break;
```

For Steering Mechanism

```
case 3: // Steering To LEFT
digitalWrite(motr1, LOW);
digitalWrite(motr2, HIGH);
break;
case 4: // Steering To RIGHT
digitalWrite(motr1, HIGH);
digitalWrite(motr 2, LOW);
break;
case 5: // Steeing STOPPED
digitalWrite(motr1, LOW);
digitalWrite(motr2, LOW);
break;
```

For Motion of Vehicle

```
case 6: // Vehicle Forward
digitalWrite(motr3, HIGH);
```

```
    digitalWrite(motr 4, LOW);
    break;

  case 7: // Vehicle Backward
    digitalWrite(motr3, LOW);
    digitalWrite(motr4, HIGH);
    break;

  case 8: // Vehicle Stopped
    digitalWrite(motr3, LOW);
    digitalWrite(motr4, LOW);
    break;

  case 9: // Motor one On
    digitalWrite(motr5, HIGH);
    digitalWrite(motr6, LOW);
    break;

  case 10: // Motor one Off
    digitalWrite(motr 5, LOW);
    digitalWrite(motr6, LOW);

    break;
   }
 return;
}
// output HTML web page for user
```

```
String SendHTML() {
String html = "<!DOCTYPE html>\n";
html += "<html>\n";
html += "<head>\n";
html += "<title>Multitasking Agricultural Robotic Machine</title>\n";
html += "<meta name=\"viewport\" content=\"width=device-width, initial-
scale=1\">\n";
html += "</head>\n";
html += "<body>\n";
html += "<div align=\"center\">\n";
html += "<h1>Multitasking Agricultural Robotic Machine</h1>\n";
html += "<br>\n";
html += "<formmethod=\"GET\">\n";
html += "<input type=\"button\" value=\"LED ON\"
onclick=\"window.location.href='/ledon'\">      ";
html += "<input type=\"button\" value=\"LED OFF\"
onclick=\"window.location.href='/ledoff'\">\n";
html += "<br><br><br>\n";
html += "<input type=\"button\" style =\"background-color:red;color:white\"
value=\"ALL STOP\" onclick=\"window.location.href='/allstop'\">\n";
html += "<br><br><br>\n";
html += "<input type=\"button\" value=\"LEFT\"
onclick=\"window.location.href='/steeringleft'\">     &n
bsp";
html += "<input type=\"button\" value=\"S-STOP\"
onclick=\"window.location.href='/steeringstop'\">     &
nbsp";
html += "<input type=\"button\" value=\"RIGHT\"
onclick=\"window.location.href='/steeringright'\">\n";
html += "<br><br><br>\n";
```

```
 html += "<input type=\"button\" value=\"FORWARD\"
onclick=\"window.location.href='/vehicleforward'\">     
 ";

 html += "<input type=\"button\" style=\"background-color:black;color:white\"
value=\"V-STOP\"
onclick=\"window.location.href='/vehiclestop'\">     &n
bsp";

onclick=\"window.location.href='/vehiclebackward'\">\n";

 html += "<br><br><br>\n";
```

For Performing Two Operation

```
 html += "<input type=\"button\" value=\"MOTOR-1 ON\"
onclick=\"window.location.href='/motoroneon'\">     &
nbsp";

 html += "<input type=\"button\" value=\"MOTOR-2 ON\"
onclick=\"window.location.href='/motortwoon'\">\n";

 html += "<br><br><br>\n";

 html += "<input type=\"button\" value=\"MOTOR-1 OFF\"
onclick=\"window.location.href='/motoroneoff'\">     &
nbsp";

 html += "<input type=\"button\" value=\"MOTOR-2 OFF\"
onclick=\"window.location.href='/motortwooff'\">\n";

 html = "</form>\n";

 html += "</div>\n";

 html += "</body>\n";

 html += "<html>\n";

 return html;

}

void loop() {

 server.handleClient();

 machine_control();

}
```

7.4 Web Page

Fig 7.4 HTML Web Page

This web page open in an android by connecting to Wi-Fi Module. First there are two button i.e. Led ON and Led OFF if the Led is ON then the system is ready and if the Led is OFF then the system is not ready. By using this web page there are three operation will be control. At a time only two operation will be work in farm. This web page control all the action which have to perform in farm. Suppose we have to perform the cutting and spraying at a time then this will be controlled by clicking Button Motor-1 & Motor-2. Simultaneously the forward and backward motion of machine also control by clicking Button Forward and Backward. In this way all the equipment's are control by android.

CHAPTER 8

APPLICATION RESULT& ADVANTAGES

CHAPTER 8

APPLICATION

8.1 Application

These types of multipurpose agriculture machines have a wide range of applications in the fields like**,**

- It is applicable in agricultural for grass cutting operation.

Applicable for agricultural areas are given below. It can be used to spraying the following crops

- Ground nut
- Soyabean
- Gram
- Vegetables, etc.,

- It can be used as a fertilizer in agriculture
  - Cotton plants
  - Soyabean plants
  - Turmeric plants

8.2 Result

We take trial of each operation on the field and noted the result for each operation like spraying, grass cutting and fertilization in tabular form as shown in below.

For Sprayer

To calculate the area covered by a single nozzle, we need to know the spray width and spray distance. From this we can calculate it:

Area = $\boldsymbol{\pi} * \left(\frac{\boldsymbol{Diameter}}{\mathbf{2}}\right)^{\mathbf{2}}$

Trail	Diameter of sprayer (m)	Distance from nozzle orifice (m)	Angle (deg)	Covered Area
1	0.06	0.53	20	0.314
2	0.06	0.14	50	0.314

Fertilizer: - the flow rate of fertilizer from equipment can be estimated using the following formula,

Flow rate = $Application \frac{Rate}{area}$

Flow rate refers to the amount of fertilizer being applied per unit of time. It is typically measured in gallons per minutes or pounds per minutes.

Application rate refers to the desired amount of fertilizer to be applied per unit area. It is usually measured in pounds per acre or gallons per acre.

Trail	Desired Application Rate (kg)	Flow Rate (kg/min)	Area (Acer)
1	5	15	0.33
2	10	15	0.66

Grass cutter: - To calculate the amount of grass cut by a grass cutter, we can use the formula:

Amount of grass cut = Area covered * Height of grass cut

Where,

Area covered refers to the total area covered by the grass cutter during the cutting process. It is generally measured in square units.

Height of grass cut represents the height at which the grass is being cut. It is typically measured in the same units as the height of the grass.

Trail	Area covered $(m)^2$	Height Of Grass cut (m)	Amount of Grass cut (m^3)
1	0.30	0.05	0.013
2	0.50	0.10	0.05

Discussion

This project presents a comprehensive solution to address the challenges faced by farmers in performing multiple agricultural operations. The equipment's integrated functionalities, adjustable design, remote operation capability, safety features, and durable construction make it a valuable asset for enhancing productivity and reducing labor-intensive tasks in the agriculture sector.

8.3 Advantages

- It can adjust the various parts as per the requirement of operation.
- Simple in design & construction.
- Rechargeable batteries.
- Reduced human effort
- During spraying operation as its automatic operated so there is less human contact due to this it reduce casualties.
- Helps in encouraging the youth to join farming and attract more people to work and live in rural areas.

CHAPTER 9

CONCLUSION & FUTURE SCOPE

CHAPTER 9

CONCLUSION

9.1 Conclusion

The implementation of multipurpose automated agriculture equipment offers numerous benefits for farmers. By combining functionalities such as fertilizer application, grass cutting, and spraying, this equipment enables farmers to enhance their productivity and efficiency significantly. Not only does it save farmers around 10 to 20% of their time and money spent on labor, but it also proves to be particularly advantageous for those who cannot afford expensive farming equipment. Additionally, the ease of operation by a single person makes it a practical solution for various farming operations.

To fully realize the advantages of this technology, it is crucial to promote its adoption and make it available to farmers at an affordable price. By doing so, more farmers will have access to these advanced agricultural tools, leading to increased efficiency and sustainability in the farming sector. The potential for a 20% improvement in efficiency through the utilization of multipurpose automated agriculture equipment highlights the significance of this trend for the future of agriculture. By embracing this technology, farmers can optimize their operations, reduce costs, and contribute to a more sustainable and productive agricultural field.

FUTURE SCOPE

9.2 Future Scope

1) Increased accuracy and precision: Precision is one of the main benefits of automated agricultural equipment, and this is anticipated to get even better in the future. In order to more accurately apply the right amount of fertilizer, pesticide, or herbicide, sensors and software can be used to analyses soil quality and moisture levels as well as identify pests and diseases.

2) Greater autonomy: It is probable that multipurpose automated agricultural equipment will become more independent as the technology for autonomous vehicles advances. Not only will this make them simpler to use, but it will also lessen the demand for human labor and raise agricultural safety.

3) Data analytics integration: Multipurpose automated agriculture machinery may gather a lot of information about the farm and crops, such as yield, soil quality, and weather, among other things. Farmers may enhance efficiency and productivity by integrating data analytics tools to assist them make more educated decisions about when and how to apply fertilizers, insecticides, and herbicides.

4) Lessened environmental impact: Precision spraying technology, a decrease in the quantity of chemicals needed, and careful cutting and tillage can all be used by multipurpose automated agriculture equipment to lessen the environmental impact of farming. There will probably be additional advancements in this field in the future, with tools that are even more effective and sustainable.

CHAPTER 10

BILL OF MATERIALS

CHAPTER 10

BILL OF MATERIALS

10.1 Material Cost: This is a cost table of material used in our project.

SR NO	PARTICULAR	RATES IN RS	QTY	COST IN RS
1.	MAIN FRAME	500/pc	4 NOS	2000/-
2.	PMDC MOTOR	180/pc	6 NOS	1080/-
3.	Battery	1200/pc	1 NOS	1200/-
4.	Blade cutter	200/pc	1 NOS	200/-
5.	Node MCU	419/-	1 NOS	419/-
6.	Wheel	250/-	4 NOS	1000/-
7.	Motor driver	340/-	2 NOS	680/-
8.	Water tank	50/-	1 NOS	50/-
9.	Prabha washer motor	500/-	1 NOS	500/-
10.	Miscellaneous Cost	-	-	2000/-

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