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Design and Development of the Plow-Seed-Spray

Rihan Pathan[1], Pujarini Samal[2], Mitali Mohanty[3], Prof. Gayatri Mohanty[4]
[1, 2, 3]*Bachelor of Technology in Agricultural Engineering, Gandhi Institute for Technology (GIFT), Bhubaneswar, Odisha Biju Pattnaik University of Technology*
[4]*Assistant Professor, Department of Agricultural Engineering, Gandhi Institute For Technology, Bhubaneswar*

Abstract: ***Agricultural mechanization is a crucial factor in enhancing productivity, reducing manual labor, and ensuring precision in farming operations. This project presents the design and development of a multifunctional autonomous agricultural robotthat integratesploughing, seed sowing, and spraying operationsinto a single, intelligent system. At the heart of this innovation is the Arduino UNO R3 microcontroller, which serves as the primary control unit, enabling real-time automation and coordination of various agricultural tasks. The system is equipped with DC motors, ultrasonic sensors, relays, and specialized tools such as cultivators, seed dispensers, and water/chemical sprayers, providing a comprehensive solution for modernized farming. The key advantage of this robot lies in its autonomous navigation capabilitiesfacilitated byultrasonic sensorsand anobstacle avoidance system, allowing it to function seamlessly in varied agricultural terrains. By leveraging sensor-based automation, the machine can intelligently maneuver through the field, detect obstacles, and adjust its operations accordingly, thereby minimizing operational disruptions and enhancing efficiency. Furthermore, the integration of precision seeding and controlled spraying mechanisms ensures optimal seed placement and precise application of fertilizers or pesticides, reducing wastage and promoting sustainable farming practices. The deployment of this technology aims to bridge the gap between traditional farming methods and modern mechanized solutions, addressing key challenges such as labor shortages, inefficient resource utilization, and inconsistent yield quality. Extensive testing and validation procedures are conducted to evaluate the robot's efficiency in different field conditions, ensuring its adaptability and effectiveness. This multipurpose agricultural robot – plough seed spray , presents a groundbreaking step towards smart farming, offering an affordable, scalable, and adaptable solution for both small-scale and large-scale farmers. With the increasing demand for mechanized farming practices, this autonomous system not only contributes to improving agricultural productivity but also aligns with global efforts toward precision agriculture and sustainable farming. The research underscores the transformative potential of integrating automation in agriculture, paving the way for the widespread adoption of intelligent robotic systems in modern farming.***

I. INTRODUCTION

Agricultural mechanization is a key driver of modern farming practices, enabling higher productivity, efficiency, and sustainability. In Odisha, agriculture remains the backbone of the economy, employing a significant portion of the population. However, traditional farming methods still dominate, leading to labor-intensive operations, lower yields, and inefficiencies in farm management. The introduction of mechanized solutions, particularly multifunctional machinery for ploughing, seeding, and spraying, can revolutionize agricultural practices in the state. The diverse agro-climatic conditions of Odisha, ranging from coastal plains to hilly terrains, demand adaptable and efficient mechanized solutions to optimize farming operations. Small and marginal farmers, who form the majority, often face challenges in accessing high-end farm equipment due to cost constraints and fragmented landholdings. The integration of affordable, multifunctional agricultural machinery can bridge this gap, enhancing productivity while reducing dependency on manual labor. The male-to-female mechanization ratio in the state is estimated to be around **80:20**, meaning that approximately 80% of mechanized farming activities are carried out by men, while only 20% involve women. The development of a multifunctional agricultural machinecapable ofploughing, seeding, and spraying has the potential to significantly reduce the gender disparity in mechanization in Odisha. By addressing accessibility, usability, and affordability concerns, this innovation can empower women farmers and enhance their participation in modern farming practices. This study focuses on the design and development of an innovative agricultural machine tailored for Odisha's farming landscape. By combining ploughing, seeding, and spraying functionalities in a single unit, this machine aims to improve operational efficiency, minimize input costs, and support sustainable farming practices. The research explores the engineering design, material selection, and field performance of the machine, ensuring its adaptability to the diverse soil and crop conditions of the region. By promoting mechanization in Odisha's agricultural sector, this innovation has the potential to increase crop yields, reduce labor dependency, and contribute to the overall economic growth of the state.

A. *Ploughing*

Ploughing is a fundamental agricultural practice in Odisha, a state where farming is the primary livelihood for a significant portion of the population. The process involves turning over the soil to prepare it for sowing, ensuring better aeration, weed control, and nutrient mixing. Moreover, it allows for the even distribution of organic matter and fertilizers, ensuring that crops receive adequate nutrition. Preparing a fine seedbed through ploughing enhances seed germination and ultimately improves yield quality. In areas with water stagnation issues, ploughing assists in improving soil drainage, preventing crop damage due to excess moisture.

There are several types of ploughing practiced across Odisha. Conventional ploughing is widely used by small and marginal farmers, where traditional wooden or iron ploughs are pulled by oxen or tractors to break and loosen the soil. Deep ploughing is employed in areas where the soil tends to compact, ensuring better aeration and root penetration, which is particularly useful for crops like paddy and pulses. In the hilly regions of Odisha, contourploughing is essential to prevent soil erosion by following the natural slopes of the land. Ridgeand furrow ploughing is used in regions with high rainfall, allowing better drainage and improved water retention for crops like maize and vegetables. Additionally, zero-tillageploughing is slowly gaining traction as an environmentally sustainable method, where farmers avoid excessive soil disturbance to retain moisture and organic matter.Odisha's varied terrain necessitates different approaches—flatlands allow for deep mechanized ploughing, whereas sloped or hilly areas require specialized contour ploughing techniques to maintain soil structure and fertility.

In this context, the development of a multifunctional agricultural machine capable of ploughing, seeding, and spraying can significantly enhance farming efficiency in Odisha**.** This innovative machine automates ploughing, reducing the dependency on manual labor and ensuring uniform soil preparation. With adjustable depth control, farmers can switch between shallow and deep ploughing, catering to different soil types and crop needs. The integration of seeding and spraying mechanisms further eliminates the need for multiple operations, allowing for seamlessland preparation in a single pass. Additionally, the machine is designed to adaptto Odisha's diverse farming conditions, operating efficiently across different soil types and terrains.

B. *Seeding*

Seeding is a crucial stage in agricultural production, directly impacting crop growth, yield, and overall farm efficiency. In Odisha, where agriculture is largely dependent on small and marginal farmers, seeding operations still rely on traditional manual methods, which are labor-intensive, time-consuming, and often inefficient. Farmers in many regions broadcast seeds manually, leading to uneven seed distribution, poor germination rates, and inefficient use of seeds.One of the biggest advantages of using a multifunctional machine for seeding is that it integrates multiple operations, performing ploughing, seeding, and spraying simultaneously. In traditional methods, these steps are carried out separately, requiring multiple rounds of labor and machinery, increasing costs and time. However, with this integrated machine, farmers can achieve a single-pass operation, significantly reducing the time required for land preparation and ensuring better seed establishment. Additionally, the spraying function of the machine ensures that fertilizers or pesticides are applied right after seeding, improving nutrient absorption and protecting young seedlings from pests or diseases.

C. *Spraying*

Spraying is a critical aspect of modern agriculture, ensuring that crops receive essential nutrients, pesticides, and herbicides to protect against pests, diseases, and weeds. In Odisha, where farming is often challenged by unpredictable weather, soil fertility issues, and pest infestations, effective spraying techniques can significantly enhance crop health and yield. However, traditional spraying methods in Odisha are often inefficient, with farmers relying on manual knapsack sprayers, which are time-consuming, labor-intensive, and prone to uneven application. The multifunctional agricultural machine, integrating ploughing, seeding, and spraying, can transform the spraying process by ensuring efficient, uniform, and targeted application of fertilizers, pesticides, and herbicides **.** This machine automates spraying, reducing dependencyon manual labor and ensuring better coverage with minimal wastage. By integrating spraying with ploughing and seeding, farmers can apply fertilizers and pesticides at the most effective growth stages**,** enhancing early plant development and protecting crops against potential threats.

II. OBJECTIVE

The main purpose of this task is to design, develop, and make a special farm vehicle exclusively for the essential services of send sowing, ploughing, and water irrigation. The desired machine should have a ploughing mechanism for effective soil preparation, a seed tank with a controlled release system to ensure uniform seeding and a water irrigation component that will optimize seed germination.

In focusing only on these fundamental aspects, the project tries to provide an automated solution to farmers hence increasing efficiency while minimizing human intervention in terms of manual labor during ploughing, seed sowing or water application in agricultural fields and economic developed for future.

PROBLEM STATEMENT

Energy Dependency: Traditional farming machines rely heavily on fossil fuels, leading to increased operational costs and environmental pollution.
Multiple Equipment Requirement: Farmers need separate equipment for ploughing, seeding, and spraying, which is expensive and time-consuming.
Small and Marginal Farmers' Limitation: Most small-scale farmers cannot afford multiple machines or handle complex maintenance.
Manual Labor Shortage: Many rural areas are facing a shortage of skilled labor, especially during peak farming seasons.
Inefficiency and Time Consumption: Manually switching between tasks or using

SOLUTION

Solar Energy Utilization: Reduces reliance on fossil fuels and provides a sustainable power source.
Integrated Mechanism: Modular or foldable attachments for each operation that can be controlled via a simple interface.
Compact Design: Designed to be cost-effective and suitable for small-scale farming.
Automation Options: Potential integration with microcontrollers or sensors to

ADVANTAGES.

EcoEco-Friendly:-Friendly: ZeroZeroemissionsemissionsduedueto thetotheuseuseof solarofsolarpowerpower..
CostCost-Effective:-Effective: ReducesReducesfuelfuelandandequipmentequipmentcostscostsby by integratingintegratingthreethreefunctionsfunctionsinto oneintomachineonemachine..
TimeTime-Saving:-Saving: EnablesEnablesfarmersfarmersto ct**o**completemultiplemultipletaskstasksin ainsingleasinglerun,run,icreasing productivityincreasing. productivity.
UserUser-Friendly:-
Friendly: SimplifiedSimplifiedcontrolscontrolsmakemakeitusableitusableevenevenforforfarmersfarmerswithwithminimal technicalminimalknowletechnical knowledge.
Reduced Labor Dependency: Automation and machine integration reduce the need for manual labor

III. REVIEW OF LITRATURE

1) The paper titled "Design and Fabrication of Multi-Purpose Agricultural Machine" presents the development of an automated farming device to assist small-scale farmers. The machine integrates ploughing, seed sowing, fertilizer spreading, and water sprinkling functionalities, controlled via IoT (Internet of Things) using the Blynk app. Designed using CATIA V5 and fabricated with mild steel, the model operates on battery-powered motors and utilizes relay circuits, Node MCU, and gear drives for automation. The project aims to reduce labour, improve efficiency, and minimize costs in agricultural practices. Future improvements include larger-scale implementation, solar power integration, and AI-based autonomous operation. (Prof et al., 2024)

2) The paper titled "Solar Operated Multipurpose Agriculture Machine" presents a solar-powered agricultural vehicle designed to perform multiple functions such as seed sowing, water spraying, and grass cutting using IoT-based control. It utilizes a crystal-based solar panel, a DC motor, and motion transmission mechanisms like chain-sprocket and worm gear to operate efficiently. The lightweight machine (10-15 kg) is suitable for small farms, reducing labour costs by performing the work of four labourers. Future improvements include higher capacity batteries, high-RPM motors, and the addition of ploughing functionality. (Asiva Noor Rachmayani, 2015)

3) The paper "Multipurpose Agriculture Machine" discusses the development of a cost-effective and efficient agricultural device for small-scale farmers. The machine integrates ploughing, seed sowing, and water sprinkling into a single unit to reduce labour costs and increase productivity. It is powered by a 12V battery and a torque motor, with chain-sprocket and gear mechanisms for power transmission. The design, modelled in SolidWorks, aims to enhance precision, efficiency, and affordability for resource-limited farmers. Future improvements include higher capacity batteries and enhanced automation to further optimize farming operations. (Prof et al., 2024)

4) The paper "Multipurpose Agriculture Machine" discusses the development of a cost-effective and efficient agricultural device for small-scale farmers. The machine integrates ploughing, seed sowing, and water sprinkling into a single unit to reduce labour costs and increase productivity. It is powered by a 12V battery and a torquemotor, with chain-sprocket and gear mechanisms for power transmission. The design, modelled in SolidWorks, aims to enhance precision, efficiency, and affordability for resource-limited farmers. Future improvements include higher capacity batteries and enhanced automation to further optimize farming operations. (Prof et al., 2024)

5) The paper "Multipurpose Agriculture Machine" presents the design and fabrication of a low-cost, compact, and efficient agricultural machine aimed at small-scale farmers. The machine integrates key farming operations such as digging, seed sowing, and soil covering into a single automated system, reducing labour costs and improving productivity. It utilizes a rotary tiller (rotavator), power transmission mechanisms, and a chain-sprocket system for efficient operation. The study concludes that the machine enhances farming efficiency by 17% compared to traditional methods, making it an affordable and effective alternative for mechanized agriculture. (Dwarakesh et al., 2023)

6) The paper "Multipurpose Agriculture Machine" presents an advanced automated farming device that integrates multiple agricultural tasks such as ploughing, seeding, harvesting, spraying, and cultivation into a single machine. It employs sensors, imaging technologies, and automation to analyse soil conditions and optimize farming practices. The machine is designed for efficiency, sustainability, and cost-effectiveness, reducing labour while improving crop yield. By utilizing renewable energy sources, optimized fuel consumption, and eco-friendly practices, it promotes sustainable agriculture. This innovative approach enhances productivity, resource management, and environmental conservation in modern farming.

7) The paper "Multipurpose Agriculture Machine" focuses on developing a cost-effective and efficient agricultural device to assist small and marginal farmers. The machine integrates tilling, sowing, spraying, weeding, and harvesting into a single unit, reducing labor costs and dependence on expensive or rented machinery. Designed to be lightweight, versatile, and easy to operate, it enables farmers to perform multiple tasks efficiently. The study emphasizes affordability, flexibility, and improved productivity, aiming to modernize small-scale farming and enhance agricultural sustainability (Prof et al., 2024)

8) The paper "Design and Fabrication of Multipurpose Agricultural Machine" focuses on developing a cost-effective and efficient farming device to assist small- scale farmers. The machine integrates soil digging, seed sowing, water spraying, and land leveling into a single unit, reducing reliance on expensive farm equipment. It is designed to replace manual labor and traditional animal-driven farming with mechanized automation, improving productivity. The study highlights potential future enhancements, such as wireless technology, sensor integration, and solar power utilization, to further optimize agricultural operations.

9) The paper "Multipurpose Agriculture Machine: Applications and Uses" discusses the development of a low-cost, multi-functional farming device designed for small-scale farmers. The machine integrates digging, seed sowing, cultivation, and spraying operations using a 24cc engine for digging and a 12V battery-powered motor for spraying, while sowing and cultivation are manually operated. It aims to replace traditional labor-intensive methods, making farming more efficient and affordable. Future enhancements include sensor integration, wireless control, and solar power for increased automation and sustainability.

10) This paper provides a summary of the various types of seed sowing equipment innovations. The primary goal of the sowing operation is to place the seed and seedlings in rows at the desired depth and seed-to-seed spacing, cover the seeds with soil and compact the soil over the seed. To achieve optimal yields, the recommended row to row spacing, seed rate, seed to seed spacing, and seed placement depth vary from crop to crop and for different agro-climatic conditions. Seed sowing devices play an important role in agriculture.(H. P. Girish Kumar and D. Ramesh)

11) In this Research paper they have been discuss about the field faces some problems such as how to minimize the losses, how to increase productivity and how to minimize cost .In India, two types of agricultural methods are used, manual method (conventional method) and mechanize type method. In Manual method they are working with those equipment's was tedious and laborious. Mechanization involves the use of a hybrid device between the power source and the work. This hybrid device usually transfers motion, such as rotary to linear, or provides sample of mechanical advantages. There are variety of machines are available for almost every task in agriculture. Beginning with preparing land to the harvesting of crop and further process can be done by machines. This machines not only easier way to do this task but also very efficient. The agriculture machineries that are used now days are costlier and cannot be afforded by most of farmer with rural backgroundwhich will be of multiple use and especially will be of low cost (Kirtane, 2024).

IV. SYSTEM DESIGN AND COMPONENT

A. *Material Used*

1) Hardware Requirements

a) Arduino UNO R3 Microcontroller
b) Bluetooth Module
c) LCD Display
d) Wheel
e) DC Motors
- Motor Driver IC
- Plough
- Relay

f) Spray System
g) Solar Panel
h) Ultrasonic Sensor
i) Multi-change Seed Sower
j) PCB (Printed Circuit Board)
k) Power Supply Components
l) Batter
m) Pipe
n) Pump
o) Nozzle
p) HP-05 Module

2) Software Requirments

a) Mobile Phone
b) Eagle
c) proteus
d) Arduino id
e) Bluetooth controller

B. *Solar Power System*

The solar panels convert sunlight into direct current (DC) electricity. This DC power is either used immediately to operate DC motors/pumps or stored in the battery for later use. The solar power system in this project is designed to supply clean and renewable energy to drive the various components of the multipurpose agricultural machine, including ploughing, seeding, and spraying operations.

The system comprises three main components:

1) Solar panel
2) Battery
3) Charge controller

a) Solar Panel

It is the power generation unit of the set up, this solar panel consists of 16 electro volatile cells connected together to form a solar panel. Solar panel in the plough seed spray is responsible to generate power for working of the whole set up. A solar panel works on the photovoltaic effect - a process by which solar energy (sunlight) is converted directly into electricity. Solar panels are made up of many photovoltaic (PV) cells. When sunlight (photons) hits these cells, it excites the electrons in the semiconductor material (usually silicon). The energy from the photons knocks electrons loose from their atoms, creating electron-hole pairs. An internal electric field in the PV cell pushes these free electrons toward the front surface of the cell, creating a flow of electric current (DC - Direct Current).Metal contacts on the top and bottom of the PV cell collect the flowing electrons and transfer them into the external circuit to power electrical devices

Fig 1: Solar panel

b) Battery

It is the power house of the unit. A battery connected to a solar panel serves as an energy storage device. It stores the electrical energy generated by the solar panel during sunlight hours and provides consistent power to drive the motor when needed, including times when sunlight is not available (during cloudy weather).When sunlight hits the solar panel, it converts solar energy into DC electricity using the photovoltaic effect. The DC electricity produced flows into a charge controller, which regulates the voltage and current to safely charge the battery. The battery stores this energy as chemical energy. When the motor needs to run (e.g., in a solar vehicle or pump), the battery discharges its stored energy. It converts the stored chemical energy back into electrical energy, supplying DC power to the motor. The motor then converts this electrical energy into mechanical energy to perform work (like rotating the motor or turning wheels of plough and seeder)

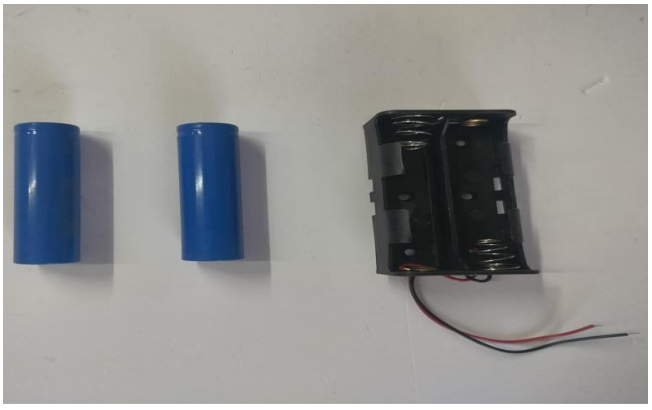

Fig 2: battery

c) Charge Controller

Type: MPPT (Maximum Power Point Tracking) for efficiency

Function: Regulates voltage and current from solar panels to prevent battery overcharging or deep discharge. It also optimizes power flow to the battery.

C. Arduino Uno

The Arduino Uno is the central control unit of the setup. It is a microcontroller board based on the ATmega328P, which is responsible for processing input signals from sensors and executing control commands to various components. In the plough seed spray system, the Arduino Uno coordinates actions such as activating the motor, controlling the sprayer, and managing data from sensors. It operates by executing a pre-programmed code stored in its memory, allowing real-time automation and intelligent operation of the whole setup. The board includes digital and analog input/output pins for interfacing with other devices.

Fig 3: Arduino UNO

D. DC Motor

The DC motor in the plough seed spray setup is used to convert electrical energy into mechanical motion. It operates on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a force (Lorentz Force). When powered, the motor's rotor turns, which drives mechanical parts of the setup such as wheels or the plough mechanism. The speed and direction of the motor can be controlled using PWM (Pulse Width Modulation) signals from the Arduino, enabling precise motion control in agricultural operations.

Fig 4: DC Motor

E. Ploughing Mechanism

1) Objective of Ploughing Unit

To loosen the soil and remove weeds.

To prepare the soil for better seed germination and root development. To make uniform furrows for seeding.

2) Components of the Ploughing Unit

Component
Rotary Blades/Tines Mounting Frame
DepthControl Mechanism
Wheels/Support
Description
Sharp, curved metal blades that dig into the soil.
Holds the motor and blade assembly. Madeof mild steel for strength and durability.
Adjustable lever or screw that controls how deep the blades go into the soil.
Helps in balancing and controlling the forward movement during operation.

3) Working Principle

Power Supply: Solar panels charge a battery during daylight hours.
Motor Drive: When ploughing mode is selected, the DC motor receives power from the battery.
Rotation: The motor rotates the shaft to which blades or tines are fixed.
Soil Tillage: As the machine moves forward, the rotating blades cut into the soil, turning it and creating furrows.

4) Types of Ploughs Used (based on project size)

Single Tyne Plough: Suitable for lightweight machines; uses a single blade to dig narrow furrows.

5) Advantages

Operates on renewable energy (no fuel cost). Suitable for small landholders.
Easy to maintain and operate.
Reduces manual labor and increases efficiency.

Fig 5: Cultivator

F. Seeding Mechanism

The seeding mechanism in your project is responsible for accurately placing seeds intothe soil after ploughing. It must ensure uniform spacing and depth, which are critical for good crop growth.This mechanism is particularly useful for small and medium-scale farmers, as it reduces seed wastage, labor requirements, and ensures uniform planting, which collectively contribute to improved crop yields and overall farm productivity using clean, solar energy.

1) Objective of Seeding Mechanism

To place seeds at consistent depth and distance and reduce seed wastage.
To make the process automatic and labor-saving, powered by solar energy.

2) Component

Seed Hopper
Seed Metering
A container that holds seeds. Usually made of plastic or light metal.
Controls the flow of seeds. Common types: fluted roller, cell-type plate, or perforated drum.

3) Advantages

Solar-powered: No manual seed dropping or diesel-powered machines. Uniform planting improves germination and yield.
Reduces labor and increases accuracy
Portable and suitable for small landholdings

Fig 6: Seed metering mechanism

G. Spraying Mechanism

The spraying unit in the solar-based multipurpose agriculture machine is responsible for the controlled and uniform application of liquid pesticides, fertilizers, or herbicides across the cultivated field. This unit consists of a chemical tank (typically made of lightweight plastic or stainless steel) that stores the spraying solution, a low-voltage electric pump powered by the solar-charged battery, and a series of spray nozzles, specifically 2mm in diameter, selected for producing fine, consistent droplets. When the machine is operated in spraying mode, the electric pump draws the liquid from the tank and pushes it through the pipeline toward the nozzles, which are strategically placed to ensure even coverage across the crop rows.

The 2 mm nozzle size is chosen for its ability to produce fine mist-like spray, which is suitable for small to medium crop canopies. This nozzle ensures that the chemicals are dispersed over a wide area without creating large droplets that may lead to runoff or over application. It also helps reduce chemical usage by minimizing waste and ensuringthat only the targeted areas are sprayed. The nozzle design and spacing play a crucial role in coverage efficiency, and the pressure generated by the pump ensures a steady and uninterrupted flow of liquid during operation.To further enhance precision, the spraying system may include a valve or switch mechanism that allows the operator to start or stop the flow as needed. In addition, the entire unit is mounted on a frame or boom that keeps the nozzles at the correct height above the ground or crop canopy. This spraying setup is lightweight, energy-efficient, and environmentally friendly, and it reduces both labor costs and human exposure to harmful chemicals—making it highly suitable for small farmers aiming to adopt sustainable and solar-powered farming practices.

Fig 7: Spraying Mechanism

H. Sensor

Sensors are the input detection devices used in the system to monitor various parameters such as soil moisture, obstacle presence, or environmental conditions. These sensors send real-time data to the Arduino Uno, which processes the information to make decisions like starting/stopping the motor or activating the sprayer. Types of sensors used may include IR sensors, ultrasonic sensors, or soil moisture sensors, each serving a specific purpose in automating the field operations.

Fig 8: Sensor

I. LED Display

The LED display is the visual output unit of the system. It shows important information such as system status, sensor readings, battery level, and operational messages. Connected to the Arduino Uno, the display helps the operator monitor the setup's functioning in real time. It enhances user interaction and aids in troubleshooting or manual override if needed.

Fig 9: Led Display

V. WORKING OPERATION

The automated plow seeding machine integrates several key components to efficiently perform farming tasks. The solar panel converts sunlight into electricity, powering the system sustainably. A battery stores this energy to run the machine even in low-light conditions.At the core, an Arduino Uno microcontroller processes inputs and controls various operations. DC motors drive the wheels and mechanisms, enabling movement and actuation of tools like the plough, which tills the soil for seeding.Sensors, such as soil moisture or obstacle detectors, provide real-time feedback to the Arduino, helping the machine make decisions like when to plant or avoid obstaclesA seed drill is connected to ensure precise planting, controlling the depth and spacing of seeds for optimal growth. The sprayer, equipped with a nozzle, distributes water, pesticides, or fertilizers evenly over the soil or plants, enhancing efficiency and reducing waste.An LED display shows vital information like battery status, sensor readings, and operational alerts for easy monitoring.Together, these components make a smart, autonomous plow seeding machine that reduces manual labor, increases planting accuracy, and operates in an eco-friendly manner—ideal for small to medium-scale farming

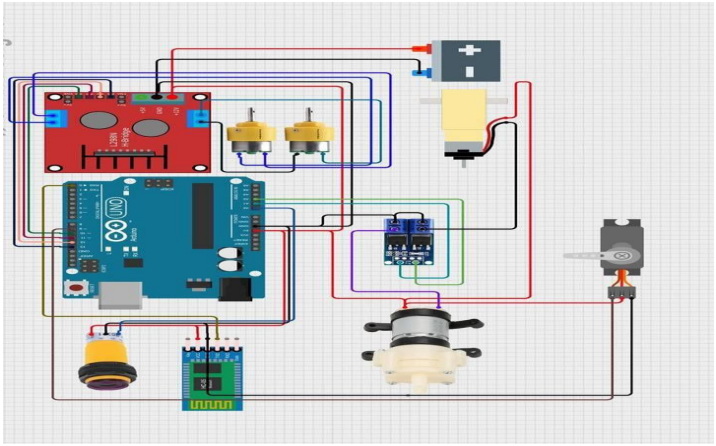

Fig 10: Working mechanism

A. APP Instructions

1) First make sure your HC-05 Bluetooth Module is paired with your mobile. Check the manual of Bluetooth module.
2) Click on "SELECT DEVICE" icon to select paired Bluetooth module.
3) When you touch mobile "FORWARD" it sends the data "F" to Bluetooth Module connected with the circuit. When Microcontroller detects "F" the Robot / Robot Car moves FORWARD.
4) When you touch mobile "BACKWARD" it sends the data "B" to Bluetooth Module connected with the circuit. When Microcontroller detects "B" the Robot / Robot Car moves REVERSE.
5) When you touch mobile "SEEDING/ GRAIN" it sends the data "G" to Bluetooth Module connected with the circuit. When Microcontroller detects "g" the Robot / Robot Carstop .
6) When you touch mobile "PLOUGHING" it sends the data "P" to Bluetooth Module connected with the circuit. When Microcontroller detects "p" the Robot / Robot Car stop
7) When you touch mobile "SPARAY BUTTON" it sends the data "W" to Bluetooth Module connected with the circuit. When Microcontroller detects "W" the Robot / Robot turns ON the sprayer using PUMP.
8) When the mobile phone is not touched in any direction (screen upward position), it sends the data "S" to Bluetooth Module connected with the circuit. When Microcontroller detects "S" the Robot / Robot Car gets STOPPED. You can also stop the robot by pressing STOP button which is in the center of remote.
9) Click on "DISCONNECT" icon to disconnect paired Bluetooth module.

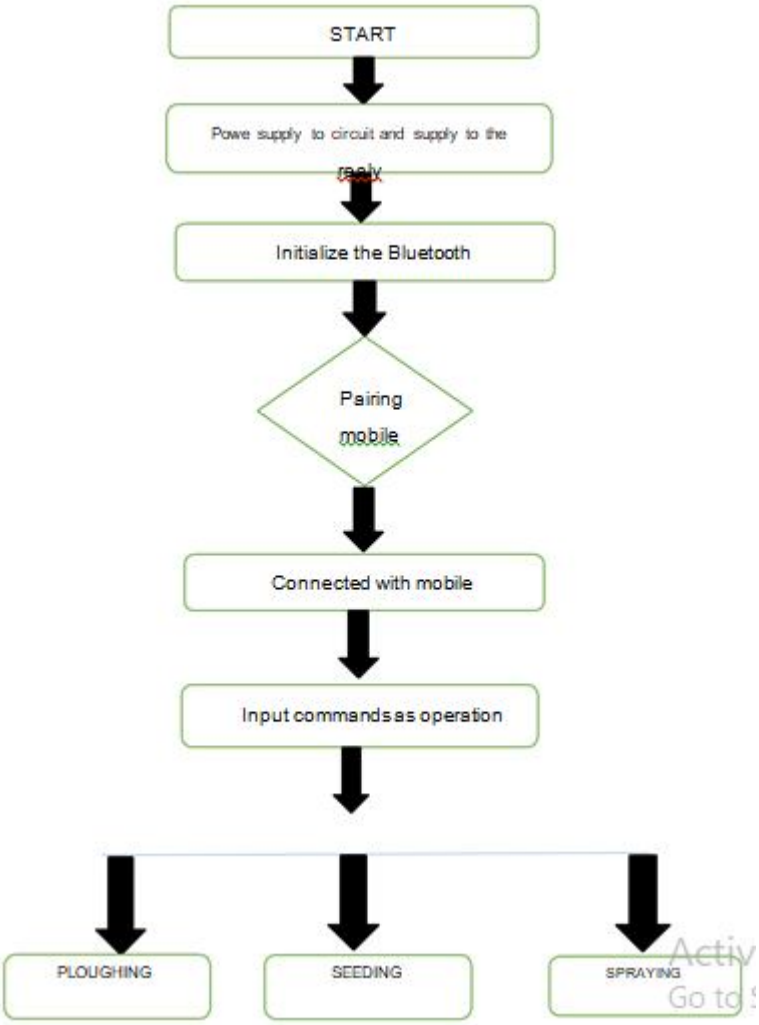

Fig 11: Modeling and analyzing

VI. RESULT AND DISCUSSION

1) Field Capacity

Working width = 1.2 meter
Operating speed = 3km/h
Time taken = 1.5 hours
Area covered = 0.4 hectares

Total Field Capacity

$$TFC = \frac{1.2 \times 3}{10} = 0.36h \ /h$$

Efective Field Capacity

$$EFC = \frac{0.4\ h}{1.5\ h} = 0.267h \ /h$$

Field Capacity

$$FC = \frac{0.36}{0.267} \times 100 = 0.741 \times 100 = 74.1\%$$

2) Seed Rate

SR=
Total seed used = 500g = 0.5 kg Total area used = 0.4 hectares

$$SR = \frac{0.5}{0.4} = 1.25 \ /h$$

3) Spraying Efficiency Rate

SER =
Total water used = 1liter
Area covered = 0.4 hectares

$$SR = \frac{1}{0.4} = 2.5 \ /h$$

If 0.74 hectares was effectively sprayed = SER $= \frac{0.74 \times 100}{0.4} = 29.6\%$

A. Cost-Economic Development of the Machine

The primary objective of this project is to design and develop a low-cost, solar-powered multipurpose agricultural machine that can perform essential farm operations such as ploughing, seeding, and spraying. By utilizing renewable solar energy and integrating multiple functionalities into a single unit, the machine aims to reduce the dependence on fossil fuels and costly traditional equipment. Special emphasis is placed on minimizing the overall production and operational cost without compromising efficiency, thereby making it economically viable for small and marginal farmers. The machine is intended to promote sustainable agriculture by lowering input costs, increasing labor productivity, and reducing environmental impact.

Sl. No.	Components	Cost (Rs)
1	Solar Panel	3,200
2	Solar Charge Controller	300
3	Speed Regulator	400
4	Battery	1,200
5	Tank and Spray Wand	1,000
6	Connecting Pipes	150
7	Controller Box	400
8	Fabrication	2,300
9	Transportation	300
10	Miscellaneous	250
	Total	**10,000**

VII. ADVANTAGES

A. Saves Time and Labor

This machine combines multiple functions—ploughing, seeding, and spraying—into a single unit, which significantly reduces the time required for farm operations.

Farmers do not need to switch between different machines or manual tools, which also reduces physical effort and the need for additional labor.

It simplifies workflow, allowing small farmers to manage their fields more efficiently.

B. Eco-Friendly Operation

Powered by solar energy, the machine operates without fossil fuels like diesel or petrol.

This reduces air and noise pollution and contributes to a cleaner, more sustainable farming environment.

It also reduces the farmer's carbon footprint, aligning with global goals for sustainable agriculture and climate change mitigation.

C. Cost-Effective Compared to Multiple Machines

Purchasing separate machines for ploughing, seeding, and spraying can be expensive and impractical for small or marginal farmers.

A multipurpose unit provides all three functionalities at a fraction of the combined cost, making it an economically viable option over time.

Maintenance is also cheaper since farmers deal with a single unit rather than multiple machines.

D. User-Friendly for Small Farmers

The machine is designed keeping small and marginal farmers in mind. It is lightweight, compact, and easy to operate.

With minimal training, even farmers with limited technical knowledge can use it effectively.

It reduces dependency on external labor or services, empowering farmers to carry out tasks independently.

VIII. FUTURE SCOPE OF THE PROJECT

The future scope of the project " DESIGN AND DEVELOPMENT OF PLOW -SEED-SPRAY '' is to design the very same model in a bigger scale with some upgrades so that the agriculture machine we fabricate covers a lot more ground which is turn save times. The current idea of this project is to operate this agriculture vehicle wirelessly using Bluetooth and sensor connectivity. Here , the operation is still manually carried out by a user using a mobile phone for the agriculture operation (ploughing , seeding and spraying) . This can be further upgraded by applying an even complex code for IoT usingGPS, hybrid and humidity detector. This will eliminate manual wireless operation of a user and the operation will be carried out automatically as per applied code. This will completely eliminate the human interference in operating the machine.

IX. CONCLUSION

This project entitled " DESIGN AND DEVELOPMENT OF PLOW-SEED-SPRAY '' has been designed using the design tool . This agricultural machine is designed and built such a way that it can perform ploughing, sowing and applying water in agricultural field .This module is designed and coded successfully using Arduino coding tool. This machine is useful for agriculture. This implementation of agricultural robot has significant saving in term of time. efficiency and saving reduced utilization of man power should pay cost once this system is activated. The team has successfully studied and combines the ideas from various field of agricultural knowledge in completing this project. Based on all this it can be concluded that this project is a new concept which is patentable and it can be applied for real time situation. By taking a proper system approach, in which we consider a system in term of its actions and implication, we can develop a new mechanization system.

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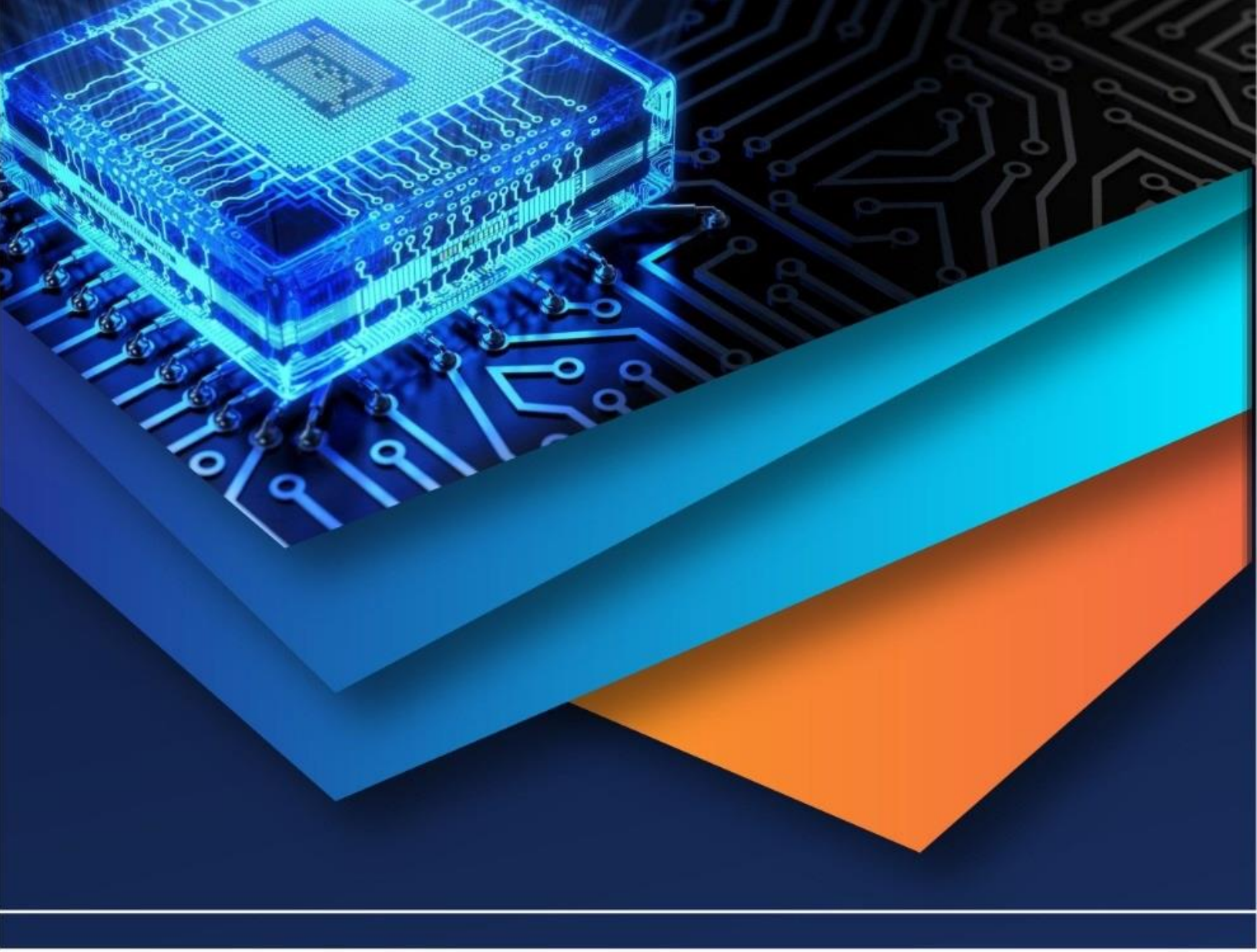

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