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Design and Development of Multipurpose Agriculture Equipment

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Abstract: *The design and development of a multipurpose automated agriculture equipment utilizing a Bluetooth module with a hopper for fertilizer, spraying, and grass cutting is presented in this paper. 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 and weeds. 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: Hooper, Spraying, Grass Cutting, Microcontroller and Bluetooth Module

I. INTRODUCTION

Our project aims to develop an innovative agricultural machinery system that utilizes electronic and mechanical components to automate various agricultural processes. This machinery will be equipped with advanced capabilities such as spreading fertilizer, cultivating the soil, mowing the lawn, and spraying pesticides. By incorporating a DC motor to drive the wheels, the machine will have the necessary mobility to navigate through fields and perform these tasks efficiently.

The scarcity of trained labor, particularly in the agricultural sector, poses a significant challenge to the development of many nations, including India, where approximately 70% of the population depends on agriculture. To address this issue, the industry needs to embrace automation and technological advancements in order to improve productivity and reduce dependency on manual labor.Our project specifically focuses on automating procedures such as spraying, cultivating, and cutting grass around plants like soybeans and gram. By automating these tasks, we aim to streamline agricultural operations, increase efficiency, and alleviate the burden on labor-intensive processes.It is important to mention that the final product of our project will be an original creation, and we are committed to ensuring that the content produced is free from plagiarism. We will conduct thorough research, adhere to proper citation guidelines, and ensure that any referenced

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material is appropriately credited to its original source. This approach ensures that our project maintains academic integrity and respects the intellectual property rights of others.

To address the challenges of minimizing human labor and increasing productivity in crop production, our project proposes the development of an automated agricultural system. This system will encompass various tasks such as fertilizing, cultivating, spraying, and grass mowing, with the aim of reducing reliance on manual labor and improving overall efficiency.One key feature of our system is the utilization of remote control technology. This enables operators to modify the course of the equipment once it reaches the edge of the field, providing flexibility and ease of operation. By implementing remote control capabilities, we aim to streamline the workflow and ensure precise execution of tasks.While tractors are commonly used on farms for spraying and cultivation, they often require significant time and manpower. With the introduction of automation, we can reduce the number of workers required, thereby addressing the labor shortage issue prevalent in many regions. Automation also brings the advantage of speeding up production processes, eliminating the need for laborious manual labor, and increasing overall operational efficiency.In addition to addressing labor shortages, our project also aims to bridge the gap between traditional farming practices and new technologies. We recognize that some farmers may have limited exposure to or familiarity with modern agricultural techniques. Therefore, we will focus on providing education and training to farmers, helping them embrace and understand the benefits of automation and new farming technologies. Multipurpose equipment in agriculture refers to machinery that can perform various tasks efficiently. These machines are designed to serve multiple purposes and include equipment such as sprayers, grass cutters, and fertilizer applicators. Fertilizer applicators are specifically used for applying fertilizers to crops. Their primary function is to distribute fertilizers evenly across a field, ensuring maximum effectiveness and improved crop yields. Fertilizer applicators come in a wide range of sizes and designs, ranging from handheld versions to large tractor-mounted units. Grass cutters, on the other hand, are utilized for mowing grass in fields. They are commonly employed to maintain pasture lands in optimal condition or to manage weeds in crops. Grass cutters are available in various shapes and sizes, ranging from small handheld devices to larger machinery.Use the enter key to start a new paragraph. The appropriate spacing and indent are automatically applied.

A. Bluetooth Module

In recent years, the agricultural industry has witnessed a significant shift towards automation and digitalization. Multipurpose automated agriculture equipment has emerged as a solution to increase efficiency, optimize resource utilization, and improve crop yields. One critical component that facilitates seamless connectivity and control within these systems is the Bluetooth module. This module enables wireless communication between various agricultural devices, offering real-time data monitoring, remote control capabilities, and streamlined automation processes. In this article, we will explore the role of Bluetooth modules in multipurpose automated agriculture equipment and discuss their benefits and applications. Bluetooth Technology in Agriculture:Bluetooth technology has revolutionized the way devices communicate with each other. It provides a wireless connection between electronic devices over short distances, making it an ideal solution for agricultural applications. Bluetooth modules enable data exchange and control between sensors, actuators, and other agricultural equipment, forming a robust network within the automated system.

Benefits of Bluetooth Modules:

- Wireless Connectivity: Bluetooth modules eliminate the need for physical wired connections, reducing clutter and simplifying installation in agricultural setups. They enable seamless connectivity between devices, allowing real-time data transfer and control.
- Low Power Consumption: Bluetooth modules are designed to consume minimal power, making them suitable for battery- powered agricultural devices. This energy efficiency ensures extended operation without frequent battery replacements.
- Compatibility and Interoperability: Bluetooth technology is widely adopted and supported by a vast range of devices, making it easy to integrate Bluetooth modules into multipurpose automated agriculture equipment. The compatibility with various platforms and operating systems enhances the flexibility and interoperability of the system.

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- Scalability: Bluetooth modules allow for scalable agricultural systems. Multiple devices can be connected within the Bluetooth network, enabling the expansion of the automated equipment without compromising efficiency or performance.

II. LITERATURE REVIEW

In Paper [1] title Development of Multipurpose Agriculture Machine " Using a multipurpose agriculture machine, as opposed to doing it by hand, allows us to finish the same task in the same space (1 acre) with just one worker. the same throughout the day because a machine cannot be stressed like a guy can.Therefore, employing the multi crop cutter can also save time. The device is found to be the most cost-effective."

In Paper [2] title Agribot: Arduino Controlled Autonomous Multi-Purpose Farm Machinery Robot for Small to Medium Scale Cultivation " It is a robot that carries out farming operations. It is a prototype autonomous robot that will support farmers in their agricultural operations. This robot, which is controlled by an Arduino, will be able to plough, plant, and irrigate the farmland. It can take the place of conventional farming equipment in developing nations. It can complete all farming tasks at the flick of a switch. In order to go from one farming strip to another within 1s +/- 0.05s, the robot will perform farming utilising the analogy of ultrasonic sensing. The robot can function on 0.25 acres of farmland under its current specifications. The specifications could be improved to function on expansive countryside. The machine Consequently, will substantially aid in the development of farming techniques."

In Paper [3] title " The project's goal is to create a robot with the ability to dig up soil, plant seeds, level terrain, and spray water. The robot's entire system will run on solar and battery power. More than 40% of the world's population selects agriculture as their major profession, and in recent years, interest in the creation of autonomous agricultural vehicles has surged. Through the input of an IR sensor, a relay switch controls the vehicle. The language input enables a user to communicate with the robot, which is well-known to the majority of people."

In Paper [4] title " Our project's main goal is to design and create a multi-use agricultural wheel hoe that can be used for weeding, ploughing, and cultivating tasks all at once. Our goal is to decrease the amount of labour needed to operate the wheel hoe. The only option is to automate it, but we are unable to fully automate it owing to a few limitations, such as the need for electricity, which is not always available in rural areas, and for microprocessors and sensors, both of which add to the cost and may require technical expertise to operate."

III. METHODOLOGY

The design and development of automated multipurpose agriculture equipment was carried out by a team members of the project who carefully analyzed the different components and factors involved in the project. First select the material of chasis on which the all the components are mounted such hopper, sprayer, grass cutting , battery and microcontroller bluetooth module. To make the chasis we use the mild steel material it has greater strength which has dimension is 3.6 feet in length and 1.6 feet breadth. For making the prototype we select mild steel square pipe of 1mm thickness and cut in proper dimension . This prototype is fully automated means all operation are automatic such as forward, backward, left and right. The prototype perform three operations such as fertilizer, spraying and grass cutting operation which are fully automatic using bluetooth module and having microcontroller for reducing the speed of motor. In this prototype we 4 PMDC motor for forward, backward motion and remaining are use in hopper. For turning the left and right motion we use the rack and pinon. All operations required power for this we use the 12v 9AH lead acid battery because it is rechargable. For grass cutting we use pmdc motor of about 3000 rpm. At this stage we complete the structure of the prototype

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HOPPER :-

In the system we use wedge shaped hopper of capacity 5 kg and it is made up of wooden material. For proportional spray the fertilizer we use the four bar chain mechanism. We calculate the calculation for for 5 kg capacity of hopper.

Step 1 :- Determine the dimension Base width: 30 cm

Base length: 40 cm Height: 60 cm

Feel free to adjust these dimensions based on your specific requirements.

Step 2: Cut the wood

Using a circular saw or hand saw, cut the wooden boards according to the dimensions determined in step 1. You will need six pieces: four for the sides and two for the base. The side panels should be cut in the shape of right-angled triangles. The longer side of each triangle should be the desired height (60 cm in this example), and the other two sides should be the base width (30 cm) and the base length (40 cm).

Step 3: Assemble the hopper

Begin by attaching the side panels to the base panels. Place the longer side of each triangular side panel against the corresponding side of the rectangular base panel. And apply the glue for fixing the wooden planes.

Step 4: Sand and finish

Once the hopper is assembled, use sandpaper to smoothen any rough edges or surfaces. This will help prevent splinters and ensure a more finished appearance.

DC MOTORS

In this system we use 4 pmdc motor and calculate the torque for 50 kg weight of prototype.

Mass of vehicle: - 50 Kg Weight: - 50*10= 500 N Weight on each wheel= 250 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

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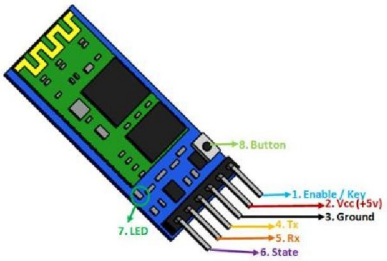
For Factor of Safety Torque = 20N-m = 101 kg cm
Power = 300W

IV. SYSTEM REQUIREMENT

1. BLUETOOTH MODULE
2. DC MOTOR
3. MOTOR DRIVE
4. BATTERY
5. SPRAYING PUMP

BLUETOOTH MODULE

- Serial Bluetooth module for arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible



DC MOTORS

Serial Bluetooth module compatible with the Arduino and other microcontrollers

Operating Voltage:

four dc motors used which is 100 rpm which is used for 4 to 6 volts (usually +5 volts).
100-meter range; • Serial communication (USART) and TTL compatibility.
In our system there is forward and backward motion and also used in hopper

The Grass Cutter require pmdc motor of 1900 rpm.

MOTOR DRIVE

Motor Type: Different types of motors, such as brushless DC (BLDC) motors, stepper motors, and DC motors, require different motor drivers. Make sure the motor driver you select is appropriate for the sort of motor you intend to utilise.
Motor Driver is used to control the speed of pmdc .

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BATTERY

12-volt electricity
9 AH in amps
Chemicals: SLA and AGM
Batteries: F2 Terminal 5.94 inches by 2.56 inches by 3.94 inches are the dimensions.
Package Size: 5 lbs.

PRABHA WASHER MACHINE

Brand:- Prabha Centrifugal Pump Type
pressure :- 2.4 bar minimum pressure, 1700 ml/min
voltage :- 12/24 volts

V. RESULT

To carry out some of the tasks, such as fertilisation and spraying, this is a simple, adaptable system that the average person can use. With a few adjustments, it can be successfully implemented as a Real Time system. Further, the majority of the units can be produced on a single piece of equipment coupled with a microcontroller, making the system compact and increasing the efficiency of the current system. The proposed prototype is design to perform the operation automatic with

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the help of smart mobile and range is about 15 - 20 m. In this prototype we perform all operation automatic using bluetooth module and perform at any two operation at a time. So it easy to operate and one time investment for farmer . This prototype is generally made for soyabean crops. So it prevent the farmer from the toxic nature of fertilizer and also reduces the labour cost.

VI. CONCLUSION

Farmers can gain a lot from multipurpose automated agriculture equipment that combines characteristics like fertiliser application, grass cutting, and spraying. With this equipment, farmers may work more productively and efficiently while saving time and money on labour. Farmers can save money on storage and maintenance by avoiding the need for several pieces of equipment.These versatile tools can not only help farmers save money and time but also lessen their negative environmental effects. Using precision spraying technology, for instance, can lower the amount of pesticides and herbicides required, reducing pollution and safeguarding the health of farm workers.Overall, the adoption of multipurpose automated agriculture equipment is a trend that has the potential to increase the efficiency and sustainability of agriculture.

VII. FUTURE SCOPE

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 fertiliser, pesticide, or herbicide, sensors and software can be used to analyse soil quality and moisture levels as well as identify pests and diseases.

- 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 labour and raise agricultural safety.
- 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 fertilisers, insecticides, and herbicides.
- 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

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