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Development of Wireless Agricultural Cultivator Machine

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ABSTRACT - Integrating wireless electronics technology with agricultural equipment, a new wireless agriculture cultivator is a revolutionary product in agriculture. This unique system autonomously performs necessary functions in the development procedure, including tillage and weeding, using a combination of wireless channels, detectors, and independent management methods. Precision agriculture is another excellent example of LD because a cultivator can work autonomously and efficiently in the field with the aid of GPS and artificial intelligence, completing tasks without human interaction It forms a wireless link to allow real-time data transfer from the machine to the cultivator, giving a centralized view of the entire process. By creating this feedback loop of communication, remote monitoring, control, and modifications are all possible, resulting in resource efficiency and higher yields. This innovation brings a new revolution in farming practices by Eco-Friendly, Energy-Efficient, Soundless Operation Made available in all ranges of agriculture, with the ultimate aim to reduce farm working efforts, increase output levels and reduce environmental issues. With fairly a bit of potential to rework contemporary agriculture, your adaptiveness in addition to that's thought-about an important component within the evolution of contemporary agriculture

***Key Words*:** wireless cultivator, low fuel usage(battery)

1.INTRODUCTION

Farm is key because agriculture is done to feed all these people who are growing up in the world, but working the soil made farmers tired and the process is time-consuming. So, to carry out farming conveniently and more efficiently we designed and implemented a Wireless Agricultural Cultivator Machine. Without human effort, this machine helps farmers till, weed, and prepare t soil. remotely controlled — so farmers can work it from miles away. It saves time, reduces physical strain and ensures ease for the farmers. So overall this project aims to build a machine that is good in field and can also be produced at low cost but still be reliable. This cultivator hopes to enhance productivity and assist farmers in their task with the help of contemporary technology.

Our project is a Wireless Agricultural Cultivator Machine which helps to do the agriculture work like tillage to soil, weeding, etc. through remote automation. A voice controller like a remote or mobile app, is used to give commands to the machine. When received by the machine's control unit, these commands are processed and the motor and mechanical elements are powered. The motor drives the cultivator blades or tools, which till or weed the soil as needed. They are capable of moving in a range of directions, controlled from a distance. It allows for accurate operation and minimizes manual labor. Designed to be compact and durable.

1.1 CULTIVATOR IN AGRICULTURE:

The evolution of Agriculture has become more mechanized and one of the most important machines in modern agriculture is the cultivator (tiller) machine. Cultivator: cultivator is a type of agriculture equipment which is used for tilling the soil, deleting the weeds and fluffing the soil. It also helps loosen hard-packed soil so it can better support crops.

Cultivators are often used for secondary tillage, allowing farmers to improve soil conditions following primary ploughing. Manually operated, tractor- mounted and power tillers are their types designed to help farmers. Farmers can use a cultivator to mix soil with fertilizer, optimize water storage in the soil and ultimately improve their crops.

Innovations such as wireless and automated cultivators are on the rise, creating greater efficiency and less need for hand labour due to an increasing reliance on technology. Sustainable Agriculture Through Innovations Optimizing Energy Usage and Decreasing Soil Degradation.

A cultivator (tiller) machine is a lot more than a tool in modern agriculture, it has revolutionized the productivity and soil health for sustainable farming practices and the constant innovation in technology and wireless and automated cultivators are now also booming in the market, making it more efficient and reducing on-labour.

1.2 CULTIVATOR USES:

This assists with loosening compacted soil, increases water infiltration, and provides a fine seedbed for improved germination. Used liberally between rows of growing crops to eliminate weeds, cultivators lessen the application of chemical herbicides. They also help with combining fertilizers and organic material into the earth for improved nutrient distribution. They power all those beneficial processes that burn away crop residues, improving soil fertility and enabling sustainable farming practices. Due to their basic yet effective functions, cultivators—especially the new wireless and automatic cultivators—have shown a lot of promise for improving agricultural efficiency whilst reducing labor efforts, making them one of the cornerstones of industrial agriculture.

1.3 OBJECTIVES:

1.Remote-Controlled Cultivation System Development creates a wireless cultivator machine to operate remotely
2. Improve Productivity and Save on Manual Work Expenses
3.Keep Resource Usage in low consumption (Battery)

2.EXPERIMENTAL PROCEDURE:

2.1 RESEARCH:

Research current agricultural cultivator methods to understand both their advantages and disadvantages. Research appropriate materials and elements to use in the making of the project, keeping in mind factors like price, longevity and availability.

2.2 IDEA FOR DESIGN:

Shaft driving mechanism based automated cultivator Ideas and concept generation Consider the following factors:

1. Chassis and Frame: Mild steel used for durability
2. Tilling tool: Implement with reinforced metal edges and bent factories employed for aerating dirt.

2.3 DESIGN SPECIFICATIONS:

Create plans / drawings for cultivator machine. The key components of this stage are as follows:

1. Wheel: Use high treads rubberized wheel
2. Power System: 24V (10-20 A) for lite weight and longtime operation

2.4 METHODOLOGY:

Figure 1 (Architectural diagram)

Problem identification:

The project starts by gathering information about agricultural technologies and identifying challenges faced by farmers, such as labor shortage and time-consuming manual cultivation. Thus, there is an overview on the need of a wireless agricultural cultivator to improve efficiency and decrease manual work.

Identification & Selection of Suitable Materials:

Components are then chosen according to the project needs. This encompasses components related to the cultivator frame, motors, wheels, remote control modules, batteries, sensors and microcontrollers. Specific materials were selected based on durability.

Material Purchase:

Thereafter, from reputable vendors, the approved spare parts are ordered. This is where you take the mechanical parts for the cultivators' body and the electronic components (motor drivers, controllers, remote modules, etc.)

Sketch the Proposed Model:

3D Model design a wireframe/CAD model of the wireless agricultural cultivator. It describes placement of components; it might be wheels, cultivator blades, motor placements, an electronic control unit, etc.

Welding & Fabrication Works:

The cultivator frame is constructed by welding and assembling structural metal parts. The wheels, motors, blades, etc., are assembled according to the design. Field operations require structural integrity and durability, for which proper fabrication is of utmost importance.

Demonstration:

The assembled wireless agricultural cultivator is tested in a greenhouse or small agricultural field. It shows the remote control function, moving ability and culture efficient. That is, if any problem is detected during the test run, corrections are made.

Outcome of the Project:

The project is done with a working Wireless agricultural cultivator. The results, which include better efficiency, less manpower and cost-effectiveness is recorded. It provides a way to assess whether the project is successful, fulfilling agricultural needs, and generates good performance.

3.DESIGN:

The 3D design listed below is made with SOLIDWORKS Software:

3.1. ISOMETRIC VIEW:

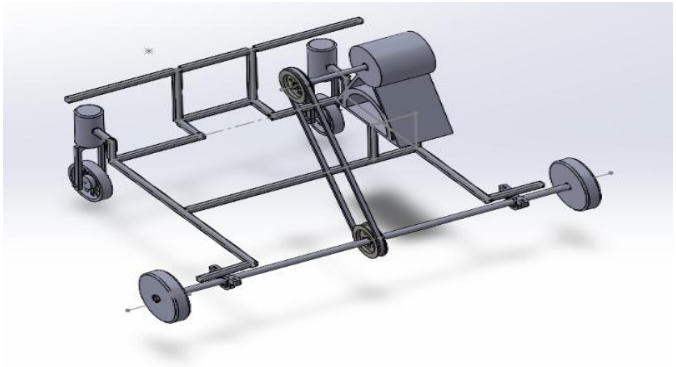

Figure 2 (Isometric View)

3.2. FRONT VIEW:

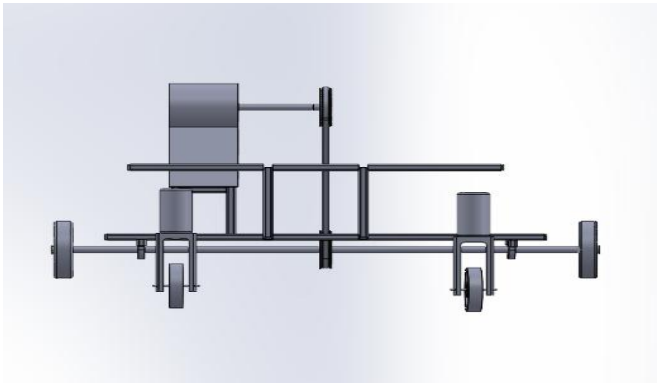

Figure 3 (Front View)

4.ANALYSIS:

The below analyzed image is made with ANSYS analysis software:

4.1. TOTAL DEFORMATION:

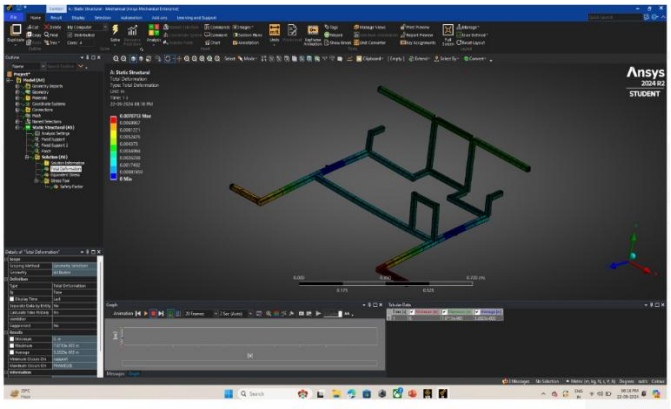

Figure 4 (Analysis on Total Deformation)

4.2. EQUIVALENT STRESS:

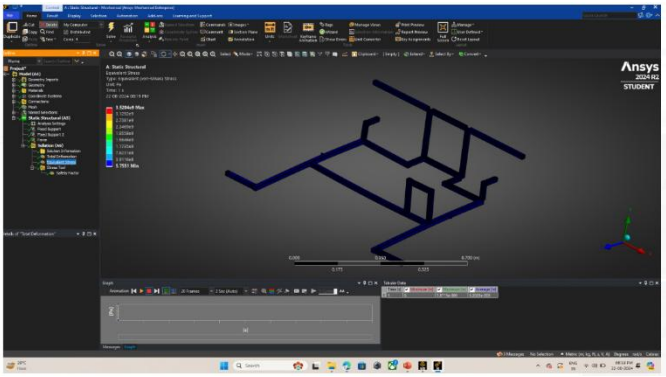

Figure 5 (Analysis on Equivalent Stress)

5.CALCULATION:

W - Weight of Vehicle

Fr = rolling resistance coefficient

Rolling resistance:

$$Fr = w.g.fr.\cos\alpha$$

$$= 80 \times 9.81 \times 0.100 \times \cos(20 \times \pi/180)$$

$$= 74N$$

Grade resistance:

$$Gr = w \times \sin 20°$$

$$= 80 \times \sin(20)$$

= 27.36

Acceleration force: α

F = ma
a = F/m
=220/80

6.LITERATURE REVIEW:

Yuting Liu [1], with University of Sanya, Sanya, Hainan, proposes a Smart agriculture system, combining WSNs and LoRa technology, are developed to improve grain crop yield on large outdoor plantations. Western nations are promoting smart agriculture solutions, employing sensor technology, big data and cloud computing to maximize crop yield.

Rushikesh Mohale [2], Sinhgad Institute of Technology, Lonavala, Maharashtra, India, The Smart Phone Operated Multipurpose Agricultural Robot is a multi-purpose machine capable of working in farms. It can be controlled through Android smart phones using Bluetooth, enabling it to be managed remotely. This is used for soil moisture measurement to be helpful in efficient agriculture with the help of the Arduino Mega 2560, which is a type of microcontroller board. These technologies are two prime examples of how robotics and technology in agriculture work together, as remote-control and soil moistness monitoring make farming both easier and more efficient.

Spyros Fountas [3] discusses the "Agricultural Robotics for Field Operations". They emphasize that Agricultural robotics has become a hot topic because very labor-intensive field operations Harvesting and weeding are well explored, and less so with disease detection and seeding robots. Improving agricultural robotics needs better algorithms, communications, and sensing

Ru Jiang [4], affiliated with Institute of Automation, Qilu University of Technology, Jinan, China, emphasizing the use of The Intelligent Agricultural Machinery Control Device based on the ATmega 328p chip connects all the sensors and actuators to a computer and makes it possible to control agricultural operations at a low cost, written by Ru Jiang [4] Institute of Automation, Qilu University of Technology, Jinan, China. It provides features of high accuracy and quick response, which are applicable to intelligent agricultural machinery.

Kaushik Deo [5] becomes affiliated from PVG College of Engineering and Technology, Pune, India, with the help of cutting programming and technology robotics can easily be implemented by farmers to solve problems like high-cost inputs or labor shortages. Multi-tasking agricultural robots are made to carry out multiple tasks, minimizing physical effort, dependency on manual labor, and health risks from pesticide exposure.

Kavya A P [6] Vidyavaridhi College of Engineering, Mysuru, India, Advances in agriculture robots are discussed to enhance efficiency while reducing labor These robots can plough, sow the seed and cut the crop and are controlled via Bluetooth using an Android application. Bluetooth technology allows cheap and easy control, and you can use motor drivers such as the L298N Motor Driver Module to control multiple DC motors for speed and direction.

Dipali Muntode [7], associated with P.R.E.C College of Engineering, Loni, India, made clear that autonomous vehicle development is more than mechanical, but related to how autonomous vehicles should be deployed in farming. Using a combination of battery and solar power, the multipurpose agriculture robot performs tasks such as soil digging, seed sowing, mud leveling, and water spraying.

Sarfaraz Riyaz [8], speaks "Multipurpose agriculture cultivator". A multipurpose agriculture cultivator, this machine is helpful for small scale farmers to perform tasks like planting seeds, fertilizers, cultivation, and digging. It has been designed to reduce human fatigue and strain on back which occurs due to single cropping for a long time and involves multi functionalities at optimal costs as compared to other machines used in agriculture.

Dhiraj R [9] statement profess the agriculture solar power cultivator is designed for improving weed removal efficacy in Indian agriculture that has its headquarters in Wainganga College of Engineering, Dongargaon, Nagpur, Maharashtra, India. The wheels used for tilling can be modified to allow adjustable spacing between the blades and tilling, promoting a healthy ecosystem for crops. Type of DC motors: DC series motors are used for small electric appliances. However, they cannot be employed in devices where a more or less continuous speed is needed throughout different loading conditions.

Anilkumar PR [10], Sapthagiri College of Engineering Bengaluru, Karnataka, India, Portable electric tiller machines are presented and the advantages of portable electric tiller machines are confirmed- what keeps the human effort in agriculture cost lower. Moreover, studies indicate that using mechanical methods such as electric power tillers for controlling weeds improves soil properties for better water intake and aeration, in addition to removing weeds.

7.COMPONENTS:

7.1. BLDC MOTOR:

A brushless direct-current electric motor can be known as an electronically commutated motor or synchronous DC motor, powered using a direct current (DC) power source. It uses an electronic controller to control the speed and torque of the motor by varying the DC currents in the motor windings and therefore generating magnetic fields which drive the permanent magnet rotor.

The controller changes the phase and magnitude of the DC current pulses to control the speed and torque of a motor, serving as a substitute for the traditional mechanical commutator in many electric motors.

A brushless motor system is commonly developed similar to a permanent magnet synchronous motor; however, it can also be established as a switched reluctance motor or induction motor

They may consist of neodymium magnets and fall under the categories of out-runners, in-runners, or axial types.

The brushless motors are advantageous because of high power-to weight ratio, fast speed and torque control, high efficiency, and require low maintenance. They are used for things like computer accessories such as computer mice and handheld power tools, and as well as in vehicles, from model aircraft to cars. With brushless DC motors, modern washing machines can do away with rubber belts and gearboxes in favour of a direct-drive design.

Figure 6 (BLDC Motor)

7.2. LEAD ACID BATTERY:

Despite having relatively low energy density in comparison to modern batteries, lead-acid batteries can provide very high direct current, and consequently have a very high power-to-weight ratio. Combined with their low cost, these attributes make them attractive for automotive applications, specifically for the high current required by starter motors.

Figure 7 (Lead Acid Battery)

7.3. CULTIVATOR CURVED BLADES:

Rotary tillers and garden cultivators generally have curved or L-shaped cultivator blades. This curvature allows the blades to cut through soil and loosen it easier than straight blade. This design assists in loosening hard or compacted earth, making it more aerated and ready for growing. Their shape also assists in preventing soil clumping, ensuring smoother operation in harsher conditions.

Figure 8 (Cultivator blades)

7.4. REMOTE CONTROL RADIO FREQUENCY:

In cultivator, an RF remote control provides a wider range, greater flexibility and safety. RF signals, unlike infrared remotes, don't need a line of sight and can penetrate obstacles, such as soil or walls, so that the operator can control the cultivator from a distance. This facilitates drive definition and allows purchase of a portable unit for operator safety away from moving parts.

RF remotes are tough and weatherproof qualities that make them perfect for outdoor use in harsh environments where reliable performance is needed.

Additionally, with RF remotes, you gain the ability to control multiple cultivators via a single remote device, proving even more useful for large farming or landscaping

operations. This minimizes the requirement for various control uses and enhances operations, eliminating the potential for confusion or mistake.

8.FRAME WORK:

We have started frame work and was completed by the welding process. The material used for frame is Mild Steel. Mild steel contains 0.03 carbon content. Mild steel is ductile and easy to weld

We fabricated frame of Mild Steel material by Arc Welding

Figure 9 (Isometric View of frame)

Figure 10 (Front view of frame)

9.CONCLUSION:

Imagine Wireless Agricultural Cultivator Machine is a smartphone garden, bringing the ancient art of farming into the technology age. The machine is designed and implemented in such a way that it is time efficient, cost-effective, user-friendly and can be utilized by small and medium scale farmers, thus decreasing their reliance on manual labour he Wireless Agricultural Cultivator Machine is an innovative solution for modern farmers, revolutionizing the future of farming and promoting smart agriculture for a sustainable agricultural ecosystem.

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