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Innovative Design of Earth Auguring Field Mobile Robot for Productive Farming

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Abstract

Farmers are required to work hard to dig plantation holes under traditional method.Agricultural processes are being transformed by technological advancements in mechatronic related fields and robots are becoming part of this process. The goal of this paper is to present design details of a field robot developed with these factors in mind. Theoretical model of field robot mounted with earth auger to drill plantation hole along with making circular farrows over it is debated in this research article. A concise summery about design concept, structural components, actuator elements and dimensional details provided in this article could bolster further implementation of this idea in real time. Earth augers are usually simple machines with spiral blades built around a rotating metal rod which drill holes in the soil. It is most commonly used for planting tree saplings and banana corms auxiliary purpose include digging post holes. They are available in various sizes and diameters subjected to crop varieties.

1. Introduction

Most of the agriculture practice involves implanting seeds into the soil after the land is prepared. Seeding activity is very tedious and hard job to be done manually, to overcome this problem an automated low cost mobile robot capable of injecting seeds into the soil is fabricated and tested[1]. A wide range of automation techniques, such as seeding and fertilizer spraying, are used in modern farming applications for easy and staff-free operations.An autonomous agricultural robot prototype will be developed, including an automated guidance system, and will be suitable for use at different stages of horticulture[2]. Several proposals were made to reduce water consumption in irrigation.AISWP (automated irrigation system with weather prediction) is currently in use at a single farm and has a limited accuracy and reliability in weather prediction.In order to enhance the performance of an irrigation system, a robot-based system is proposed[3]. In agriculture, robots are not widely used because there are still no regulations or standards that will allow the industry to follow them, such as communication protocols for mountable equipment, chassis and body dimensions, and control systems incorporating sensors

and actuators. Formica 01 is a mobile robot designed for various agricultural uses.The article describes a prototype of Formica 01 and various applications in the field[4].A self-contained pesticide sprayer is being designed and developed for chili fertigation.It is intended that the sprayer arm will be flexible, allowing the pesticide to be sprayed under the leaves of the crop, respectively. It is possible to mobilize an autonomous pesticide sprayer developed in this manner[5]. The paper proposes a quadratic traversal algorithm for selecting 2D coordinate points in the pixel coordinate system as well as the related traversal search box.Intelligent weeding robots can be made more efficient by performing more precise weeding operations as a result of this study[6]. Basically, the project is about designing, analyzing and fabricating an autonomous mobile robot with a 30 kg payload.Automated warehouse material handling can be accomplished with the help of this robot[7]. This study describes the creation of a brand-new four-wheel drive agro mobile manipulator for collecting crop/soil information in broad fields[8]. Agri.q, an ingenious UGV (Unmanned Ground Vehicle), is introduced in this research.The rover is especially built for precision agriculture tasks and can function in an unfamiliar setting on uneven terrain, collaborating with drones when required[9]. A robot capable of spraying pesticides beneath grapevine trellis was designed and tested.According to the trial results, the robot system enabled precision spraying operations and exact operation recording[10].

2.Problem description

Since the industrialization of agriculture, traditional or manual farming methods have been used.It is becoming more and more difficult for people to make a living from agriculture.In this regard, the following reasons are particularly noteworthy:

Land:Land area inversely correlates with population size.Land for agriculture is becoming less available as a result.A limited amount of land necessitates increasing yields with lower input.

Urbanization: Among the downsides of globalization in India is that youth are less interested in farming, and people living in cities find it difficult to monitor crops regularly.

Disabilities:Even those living far from the field find it difficult to monitor their crops regularly, especially disabled people and women.

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Ease: Human mind-set and lifestyle are changing, with more people demanding comfort and a reduction in farm labor needs.

Labour: Insufficient labour availability, resulting in a reduction in crop care.

Health Problems:In fields, manual sprinkling of pesticides and weedicides causes health problems.

Seed: A randomized growth of crops is caused by the uneven spread of hybrid seeds. It takes a lot of manpower to spread seeds and it's also a slow process.

On account of the above mentioned complications, robotic application in agriculture gains a huge scope.

3. Materials and methods

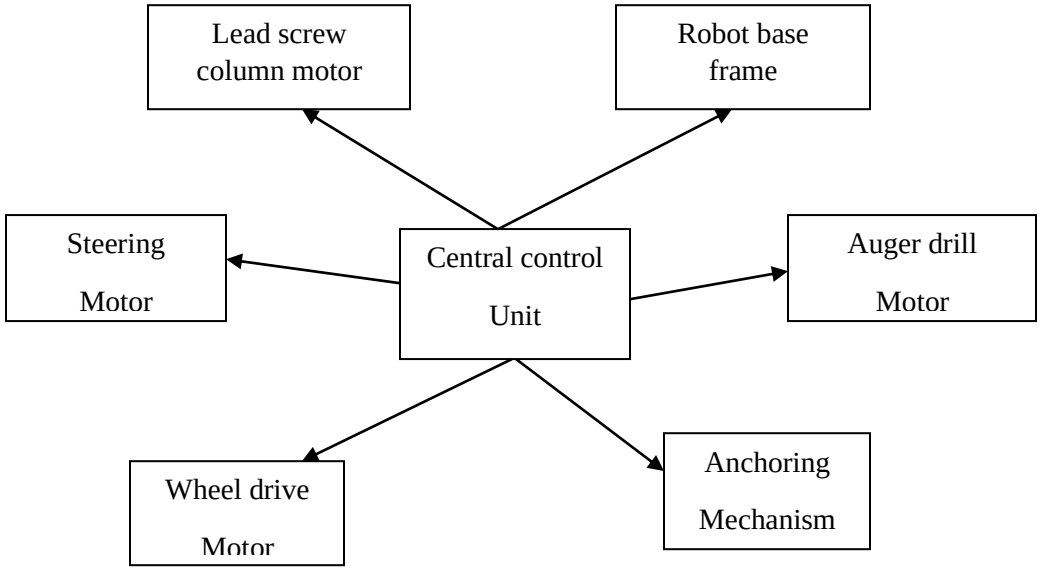

Fig.1. Block diagram of the robotic vehicle

In order to implement locomotion, sensing, actuation, hole making, data processing, communication, and other functions the robotic vehicle designed in the present study is divided into six separate modules as given in the Fig.2.The entire system is designed to be tele-operated, so for controlling any of the above mentioned blocks as a physical unit a separate key is assigned in a remote controller.

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Robot base frame

Robots base frame is designed with aluminium profile of 40x40 cross section. Aluminium has an exceptional strength-to-weight ratio, which is one of its primary advantages.Brittle fractures are less likely to occur in it. T-slot in the profile facilitates fixing of additional electronic accessories into the structure.

Auger drill Motor

As the name suggests, auger motors are used for powering augers, which are drill-like tools used to make holes by removing the soil. Auger motors can be able to rotate CW and CCW as required. Drilling through thicker and harder surfaces is much easier with motorized augers

Lead screw column motor

It takes little effort on the part of the operator to effectively use a motorized auger; one simply needs to keep the auger steady and straight. Once the bite is spinning, the auger can drill into most surfaces without requiring much effort on the part of the operator. To eliminate the human involvement dual lead screw mechanism is used to hold, raise and lower the earth auger.

Steering Motor

Four wheel steering mechanism is adopted for this rover, which enable the robot to move all four wheel as an individual unit as well as synchronously along the axis perpendicular to wheel axis. This helps the robot to move around all coordinate points in the 2D plane. Servos of large torque are employed as steering motors because they are capable of continuously controlling their rotation angle through a program.

Wheel drive Motor

High torque DC motors are used as wheel drive motors. Each wheel is fixed with separate drive motors, weight of the robot is divided coequally between the 4 four drive motors connected to four wheels. If the total weight of the robot is 50kg than each motor must possess torque to move 12.5kg.

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Anchoring Mechanism

The stability of the robot might be lost during earth auguring due to axial upward reaction forces, in turn robot would start to shake out of balance. To overcome these two linear actuators are fixed sideways at the middle portion of the frame, it is also fixed with flat base plate to stay in level with ground. This setup constitutes an anchoring mechanism. During auguring process this anchoring mechanism controls the shake and vibration caused by auguring. Once the hole is created this would move up to its reference position to aid the robot movement.

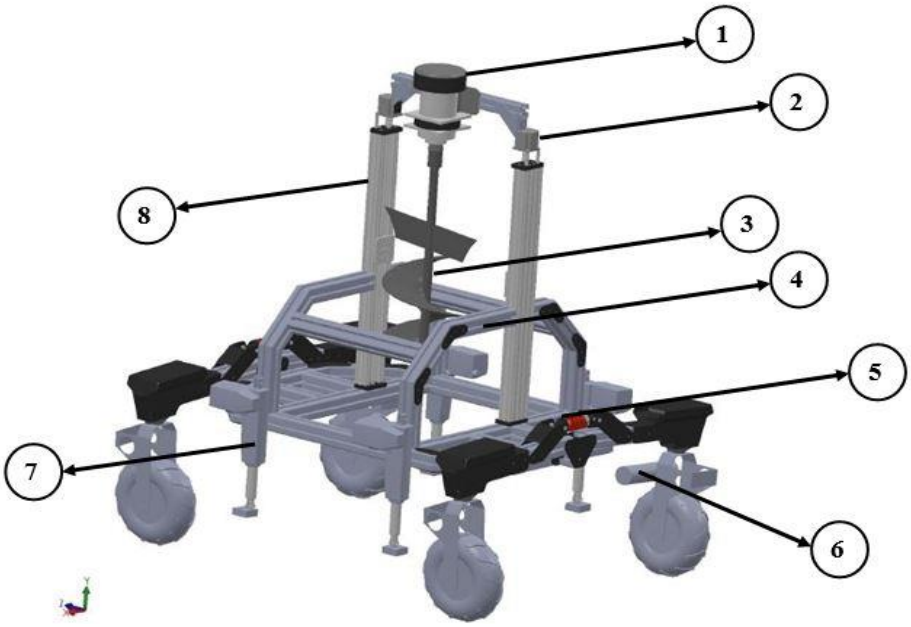

Fig.2. Three dimensional modal Auger bot

1. Auger drill motor, 2. Lead screw actuator, 3. Auger drill with farrow maker, 4. Aluminium channel frame, 5. Rocker bogie suspension mechanism, 6. Wheel drive motor, 7. Linear actuator for anchoring mechanism, 8. Lead screw channel

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Dimensions of the robot

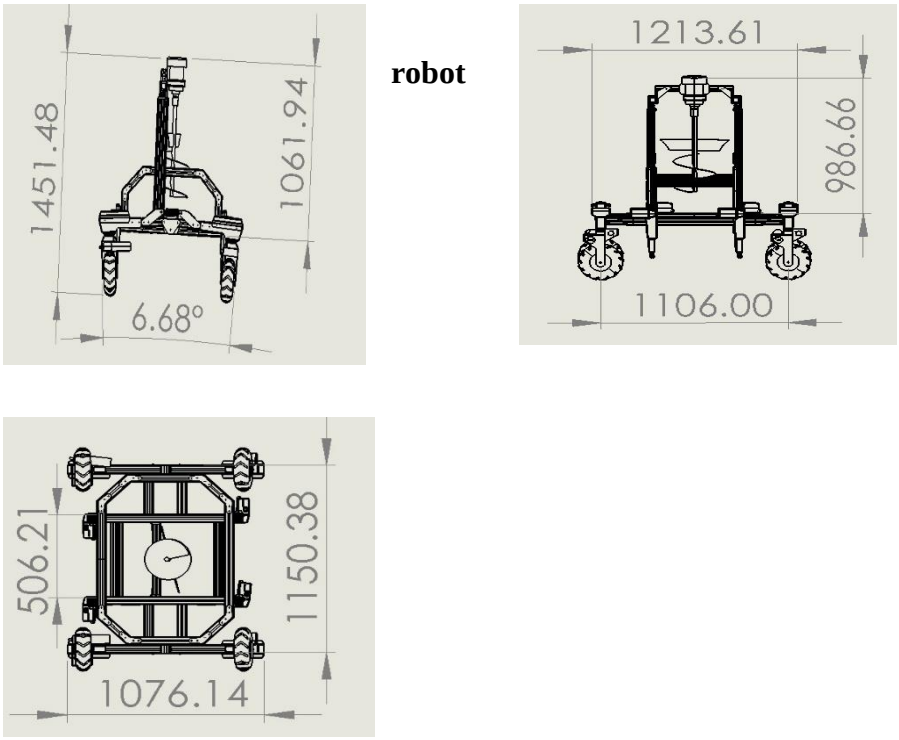
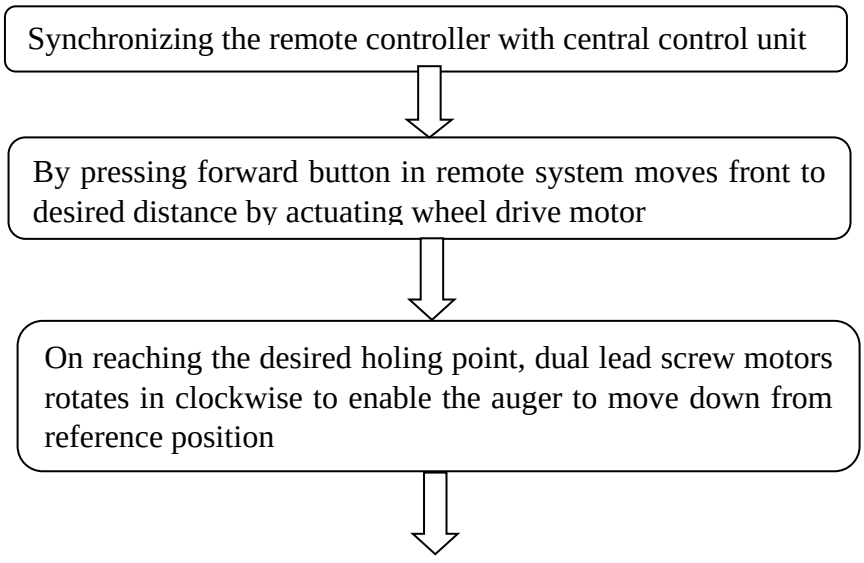


Fig.3. Front ,Side and Top view dimensions of the robot

4. Flow of operations



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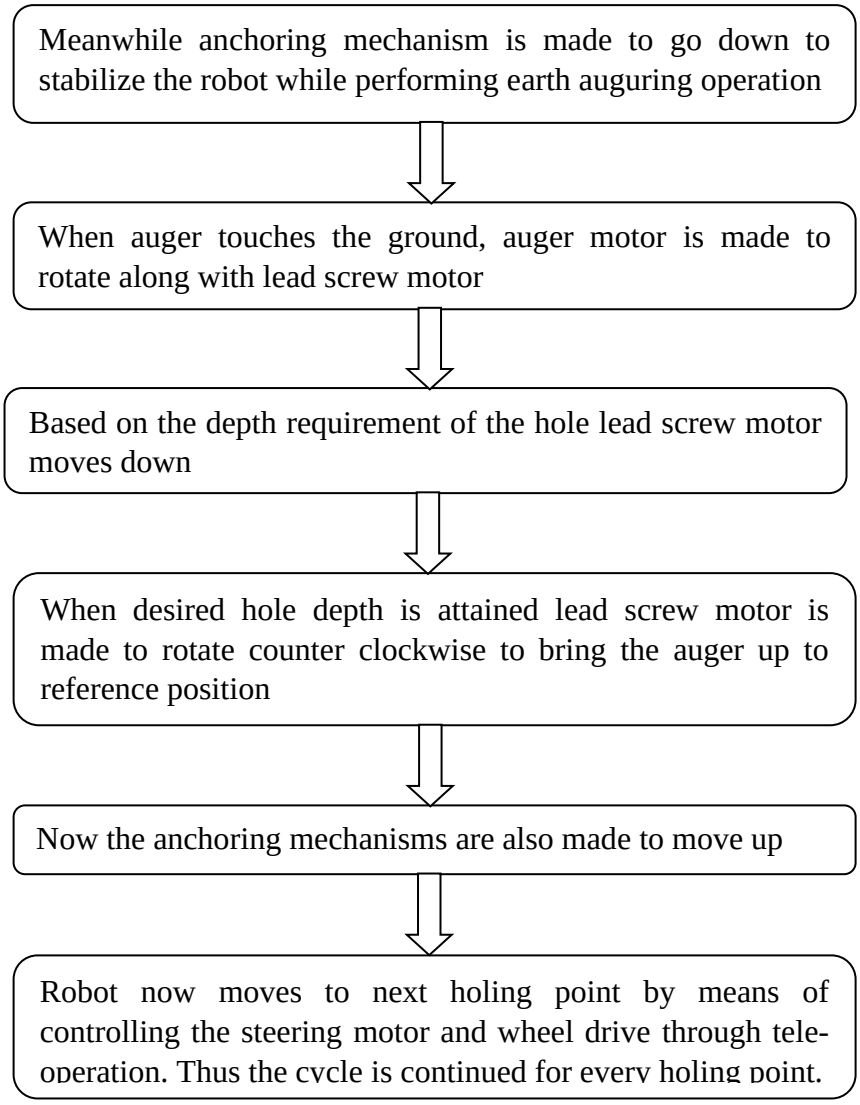

5. Conclusion

In the long run, the implementation of Agricultural robot will lead to significant saving in terms of time, efficiency, reduced resources waste, and reduced utilization of manpower. In comparison to other traditional methods of making plantation holes, the mobile robot-based earth auger system is extremely effective when sensors are integrated. Battery-powered DC components are used in this robot's design.At places where there is no electricity and where people face electricity problems, solar panels might be used to charge the batteries. Although this paper explored design possibilities of the earth auger based mobile robot, in the meantime, it has significant practical potential for successful usage of robot with in the field.

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