

Design and Fabrication of Java Plum Planting Robot

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ABSTRACT

The primary goal of the study is to design and fabricate a Plant sapling planting robot to facilitate planting on barren land and increase forestation. At present, most of the planting process is done manually by the labours. So, in order to minimize manual effort and to solve the problems related in this field it is essential to have sapling planting robot. We can also adopt innovative methods like these to solve the problem of shortage of labour and efficient reforestation.

The scope of the study is such that the problem is general one but the solution to it is a bit specific which along with the consideration of efficient reforestation, it also considers the ergonomics and aesthetics in the design. The main points that were considered while designing stage was calculating the size of the sapling to be planted and weight of the robot. Also, a separate mechanism was developed for carrying and dropping of the saplings.

This prototype prepared to bolster this research paper in prepared from a mélange of materials ranging from aluminum sections to parts prepared by rapid prototyping (RP).

KEYWORDS: Barren Land, sapling

INTRODUCTION

Today, due to problems like Climate change and Global Warming, there is a serious need to cover the barren land with trees and other plantation. The green cover is declining day by day due to excessive cutting of trees and modern construction. Growing Trees in vast areas of barren land without forest cover is a tedious task. There are multiple number of problems encountered during the plantation process. These lands are usually remote and require Manual Labor and Logistics. There might be a shortage of labor for the plantation process. Investing manual labor in planting trees in areas like army camps (with no trees) might be difficult. Due to all these reasons, the need to automate the process arises. Automation can lead to greater efficiency in the plantation process and the process will be less time consuming.

Our main aim is to reduce manual labor and devise a solution to minimize the effort of planting a sapling using an automated vehicle. The entire planting process will be carried out by the robot. We will use an Auger drill bit as it is ideal and useful for digging the ground. There will be GPS and other sensors for automation. The robot can plant the saplings with greater efficiency than manual labor. It will be less time consuming. Hence, there will be more plantation. It can be used in areas where plantation process is difficult.

Thus, the proposed solution shall plant saplings and suggest improvements to increase the green cover. Also, the plum sapling used is very beneficial for the environment. This

solution will surely help to increase the green cover. It is a cheaper and convenient option compared to manual labor.

The Java Plum Planting Robot is a semi-automatic vehicle which does not weigh a lot and thus more portable than most of the already available alternatives. The highlighting feature about the vehicle is that it is designed for the Java Plum Sapling which gives a hardy fruit and can be grown under adverse soil and climate conditions. Jamun plant is suitable for tropical and subtropical climate. A slow growing species, it can reach heights of up to 30 m and can live more than 100 years. Hence, we can also carry out plantation on barren land and military area with no green cover.

LITERATURE REVIEW

Anna-Karin Bergkvist designed a Tree planting robot. It is a four-legged planting robot which is completely autonomous. This robot is equipped with a planting arm and a planting head. The legs of the robot reduce the pressure applied on the forest floor and allow the machine to be smaller, while still being able to move through tough terrain. This robot prepares the planting spot in an environmentally friendly way by using hot steam to kill competing vegetation. The seedling is planted with a protective barrier made of biodegradable plastic. [1]

Nick Birch and Tyler Rhodes designed the "Tree Rover" which is a four-wheeled, battery-powered semi-automatic vehicle and holds the tree planting mechanism which

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consists of a magazine of 10 tree seedlings. Through the use of compressed air, a hollow spike is dug into the ground which releases the seedlings into the soil. [2]

The Automatic Agricultural Seed Planter is a seed planting robot. It precisely positions the seeds in the soil and then covers them. It can improve the organization of crops and allows massive areas to be seeded. It saves a lot of time as the process is completely automated. It majorly covers agricultural land which greatly reduces the effort for farmers in the seed sowing process. [3]

Richard Parker, Karen Bayne and Peter W. Clinton researched 'Robotics in Forestry'. New technologies are increasingly being integrated into everyday tasks to assist users and could radically change the nature of how industries operate. Forest harvesting operations have been traditionally considered physically demanding and potentially dangerous, with forest workers on foot exposed to heavy and fast-moving trees, logs and machinery. This paper provides a broad background to robotics and then focuses on aspects of robotics relevant to forestry. [4]

Naoshi Kondo & K.C. Ting* researched 'Robotics for Plant Production'. Applying robotics in plant production requires the integration of robot capabilities, plant culture, and the work environment. Commercial plant production requires certain cultural practices to be performed on the plants under certain environmental conditions. In many cases, the required cultural practices dictate the layout and materials flow of the production system. The robots which are to be used for performing plant cultural tasks must recognize and understand the physical properties of each unique object and must be able to work under various environmental conditions in fields or controlled environments. [5]

Du Danfeng, Ma Yan, Guo Xiurong, Lu Huaimin researched "Forestation Hole Digging Robot." In order to save time of digging hole when trees are planted, a robot that has six degrees of freedom is developed. In this paper the structure and function of a forestation hole digging robot is introduced and analyzed. At the same time, by the experiment it can be proved that the efficiency of the robot is very high and the ground surface destroyed by the robot is very small. The maximum diameter of the digging hole is 0.55m, a seedling tree can be planted in the hole. [6]

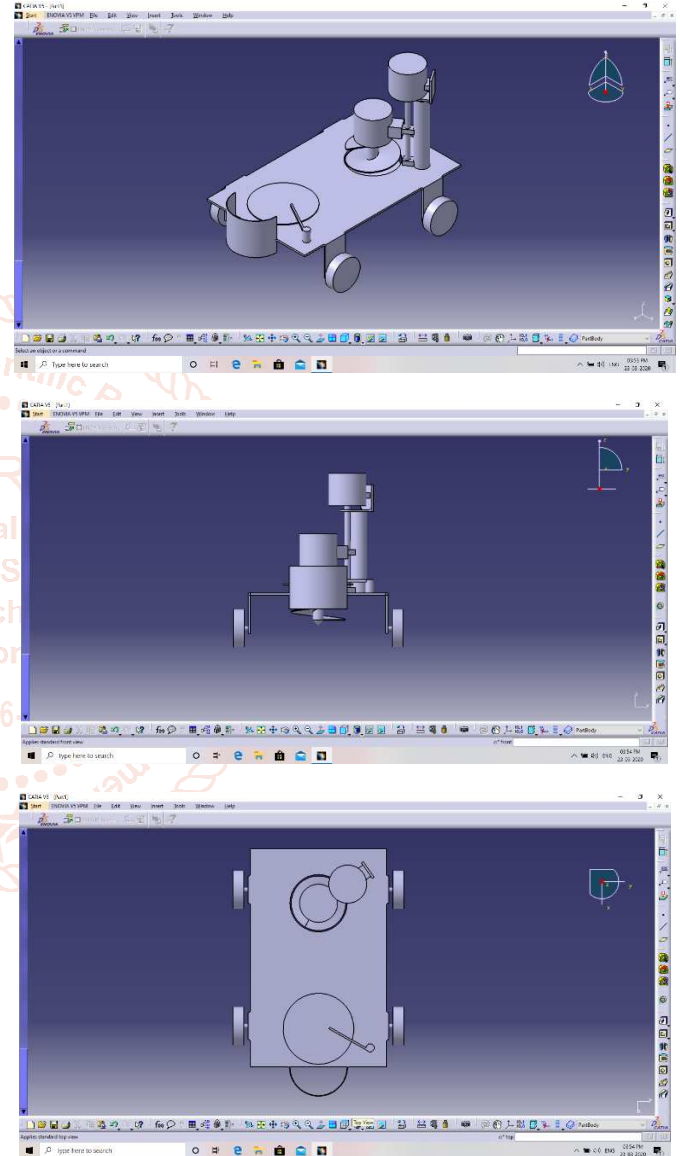
CONSTRUCTIONAL DETAILS

The first research we did was regarding the soil quality and weather conditions in the desired region of plantation. It was found that the major land is covered by Red Clayey Soils and the weather conditions may be adverse. Jamun is a hardy fruit and can be grown under adverse soil and climate conditions. It thrives well under both tropical and subtropical climate. It requires dry weather at the time of flowering and fruit setting. Early rains are beneficial for better growth, development and ripening of this fruit. It is a slow growing plant species which can reach heights of up to 30 m and can live more than 100 years. It also attracts honey bees in large numbers during flowering. As it is equipped with dense foliage, it attracts birds too. This tree is therefore very much eco-friendly. Hence, we selected the Java Plum as our sapling that is to be planted.

The basic concept includes digging of a hole, dropping a sapling in that hole and covering the sapling with the soil

around it thus completing the plantation process. The planting vehicle has a Drill in the front part of it which digs a hole in the soil. The hole is dug by using an Auger drill bit. The drill performs a vertical up and down motion during the process. Now, the vehicle has sensors at the bottom and it is programmed such that the Funnel from where the sapling is released reaches the hole dug by the drill by covering the distance between the hole and the Funnel. Then, the Plum sapling drops through the Funnel in the hole and the robot moves forward. There are Extensions present at the back side of the vehicle which press the soil around the sapling inside the hole in order to complete the plantation.

Here is the 3D Model of the Robot:



The Java Plum Planting Robot will be constructed using the following components:

BLDC motor

Here BLDC motor is used to drive the machine from one place to another.

Stepper motor

The use of stepper motor is to drive the arm which pushes the sapling from the loaded conveyor (circular disc) towards the funnel.

Auger Drill Bit

It is a special drill bit use to create a hole in soil. Pit can be made in less than one minute. Removed soil will be placed

around the pit which becomes easy to fill the pit back after plantation.

Jamun Sapling

It is a plant sapling which our robot is going to plant. Jamun is a hardy fruit and can be grown under adverse soil and climate conditions.

PLC Module

A programmable logic controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of robotic devices, or any activity that requires high reliability control.

Metal Pipe

Metal pipes are used to build the basic structure of robot. The material used is SAE4130

WORKING

The working of the mechanism can be broken down into certain steps that helps us to understand each and every action in very detailed manner. Thus, following are the steps in sequence that describes the working of the Java Plum Planting Robot:

- The Drill in the front part of the Robot digs a hole in the soil upto a sufficient depth.
- The Robot is programmed such that the Funnel reaches the hole by covering the distance between the hole and the Funnel.
- Then, the Plum sapling drops through the Funnel in the hole and the robot moves forward.
- The Extensions present at the back side of the vehicle press the soil around the sapling to complete the plantation.

CONCLUSION

The purpose of designing this Java Plum Planting Robot is to minimize the labour required for plantation and increase the Reforestation. We to a greater extent have assured it by designing the mechanism and estimating the potential flaws that can lead to failure. It is an ergonomically designed

mechanism that has the potential to plant the saplings efficiently optimise the plantation process.

In a country like India, where deforestation is practiced on a large scale, introduction of such Robots will help to increase reforestation. Also, cost is one of the most important factors which is taken care while designing of the mechanism. Thus, purchasing cost will be on a lower side and its our guarantee that the maintenance cost will be also low. The mechanism has a potential to revolutionize the reforestation methods in India.

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