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Design of Robot for Scrambling on Tree and Clutching Fruit Using Foundary Design

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ABSTRACT

The advancement in nature has prompted the presentation of very effective organic systems. Emulating these instruments offers gigantic possibilities for the change of our life and the apparatuses we utilize. Nowadays, the robot is biggest mechanism that is used for each and every process as it has the gripper assembly designed uses a flexible casing which grasps the tree trunk of almost all diameter within the predefined range, basically it uses passive compliance. This mechanism can be used for climbing trees which are almost height like coconut trees and poles. The main drawback is being slow and there is a possibility of damaging the tree trunk. Hence this system propose a new tree climbing mechanism for multi tree climbing robot that can be used to climb trees that are almost straight and height.

Keywords : Robot, Grippers, Climbing trees, Clutching

I. INTRODUCTION

Most commonly used design for tree climbing is inch worm design. These models are very slow. The main body of this type of robot is divided into two parts and each part has a gripper. These models using inch worm mechanism are continuous in their motion and can make over in complex tree environments involving multiple branches. Next common type of design is wheeled robot where in instead of grippers wheels are used for climbing up. The robot engulfs the tree and locks against it and as the motor rotates, it moves up. The sizes of these robots are comparable to the diameter of tree. These models are suitable for trees with straight and plain trunks. The main drawback is it being slow and there is a possibility of them damaging the tree trunk. Hence most of the models are slow, less agile, have less load carrying capacity. As a result, we propose a tree climbing mechanism that can be used to climb trees that are almost straight, like coconut trees and poles with greater agility.

The main locomotion of the robot is caused due to the two motors which facilitates simultaneous motion of two consecutive links. This robot grasps the tree with the help of grippers which is acted by a spring. When the motor is ON it unclamps and clamps while the motor is OFF by spring action while harnessing the spring energy for gripping. When one gripper grasps the tree, the whole body makes a revolution such that the next gripper comes up and grips while the other un grasps and the whole process continues. Attachments like pesticide sprayer, weed remover or some harvesting mechanism can be mounted on the Robot. With these attachments this robot can act as harvesting or maintenance equipment by the farmers.

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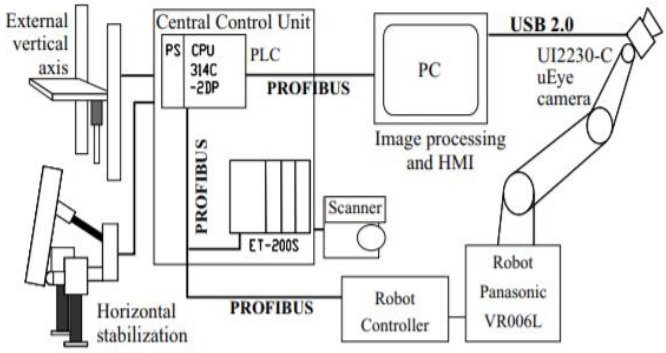

Fig.1. System Model

II. LITERATURE SURVEY

This robot grasps the tree with the help of grippers which is acted by a spring. When the motor is ON it un-clamps and clamps while the motor is OFF by spring action while harnessing the spring energy for gripping. When one gripper grasps the tree, the whole body makes a revolution such that the next gripper comes up and grips while the other ungrasps and the whole process continues. Attachments like pesticide sprayer, weed remover or some harvesting mechanism can be mounted on the Robot. With these attachments this robot can act as harvesting or maintenance equipment by the farmers.

Coconut picking is a tough, arduous work. The farmers in popular coconut cultivating countries are facing severe shortage of skilled workers for harvesting. In recent years, the number of coconut tree climbers has declined sharply, as those men who do this rigorous job of climbing 30 to 80 feet high above the ground, bare handed or with the aid of a rope, have broken away from their traditional role to take-up better paid jobs. Since the Green Revolution of the late 1960s, the harvesting of coconuts today has little changed from how it used to be done for generations. The job of coconut picking, which is perceived as risky and unglamorous, does not attract youngsters either, even though the remuneration is fairly good in local standards. Though there exist few tree climbing machines today, by any measure, climbing for coconuts is hard work. Not only does a climber have to scale the tree and reach out among the fronds and cut the coconut, but they also have to instinctively learn which nuts are ripe enough to be harvested. Besides, those few climbers who still remain in the business of coconut picking, claims higher wages.

III. PROBLEM STATEMENT

In traditional harvesting method on reaching the top of a coconut tree, the climber taps the nut in the lowermost bunch with its harvesting knife to test its maturity. If he is satisfied, he cuts the bunch at the base of the stalk when it drops down to the ground. The climber also cleans the crown and removes the dry leaves, sheaths and spathes. In some places where the trees are not tall, cutting the coconut bunches with a knife, attached to a long bamboo pole, does the harvesting. It seems quite simple to climb the coconut palm in order to stay beneath the leaf crown

to harvest fruits and cut old leaves. But it proves much more challenging to climb up the coconut leaf crown in order to reach the young inflorescences for making controlled pollinations with bagging for research purposes, and for harvesting the toddy (the sweet sap from coconut inflorescences), which serves to produce sugar, vinegar, wine and spirits. This paved the way to the proposed robotic harvesting method, where it can peep and reach out to any remote nook and corner at the top of the tree, of the operator's choice.

IV. METHODOLOGY

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- **Ease of use** - They wanted use of the robot to be something that could be easily learned, so it would not slow down ALB inspection rate.
- **Work safe** - They wanted the system to have fail safes implemented to ensure no potential harm to USDA operators in the field.
- **Minimal damage to tree** - They did not want the robot to inflict any serious harm on the tree it was climbing.
- **Navigation around branches** - They needed to robot to be able to find its way around branches, so inspections could be complete.

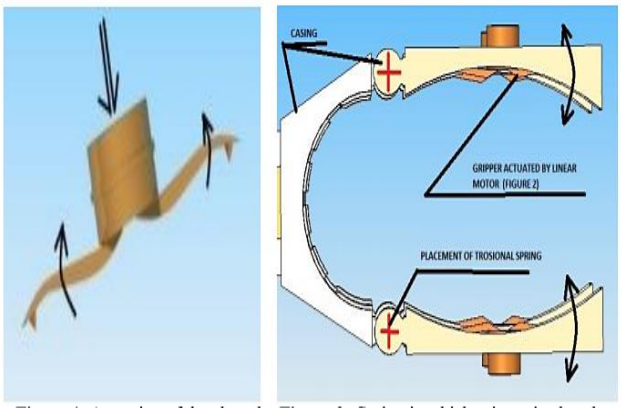


Fig.2. Robot Climbing Model

V. LOCOMOTION OF ROBOT

There are three types of motion. These are classified as continuous, discrete and serpentine. As we get closer to continuum type, energy consumption is reduced and speed is increased. But it is difficult to achieve continuous motion, so discrete form is followed in the construction.

First, the bot is attached to the tree trunk with the help of grippers which grips on to the tree trunk and provides adequate friction such that it does not slip. The motors used for climbing overcome the moments caused by its weight.

The movement takes place as follows:

1. First the arm with first motor will hold the tree.
2. Then the link with second motor will release the grip and the whole setup will rotate about motor one as shown in figure.
3. After half a rotation, the arm with second motor will grip the tree and the process continues. Once the robot reaches the topmost point of the tree trunk, the whole body is gripped on to the trunk without any further movement, i.e., the body is grounded, thereafter miscellaneous action like harvesting or maintenance work can be performed.

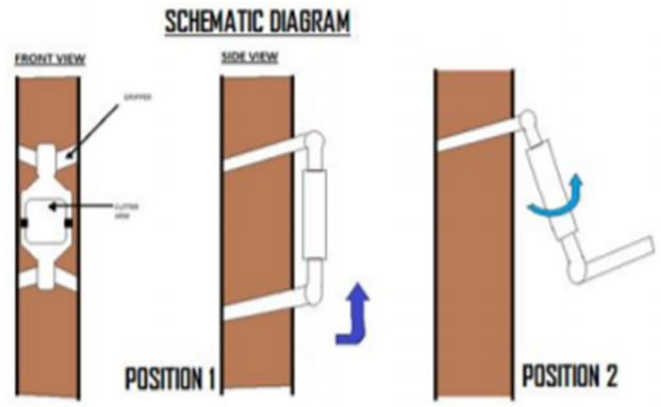


Fig.3. Robot Climbing Model

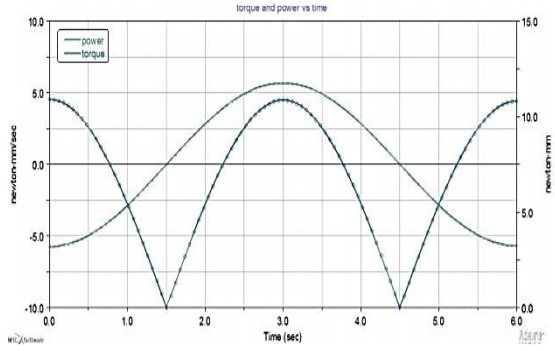
This mechanism can be achieved by using a push plate in the gripper which will be connected to the shaft of linear motor, when the linear motor actuates the push plate pushes the claws and unclamps from the tree.

VI. RESULT AND DISCUSSIONS

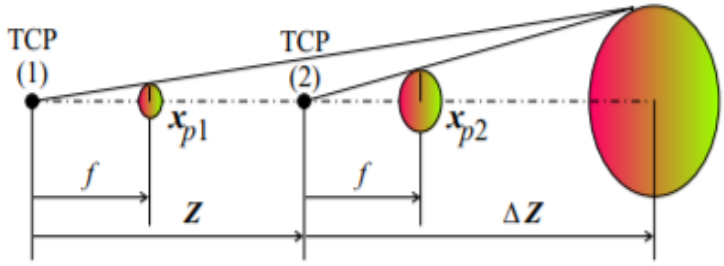
The evolution in nature has led to the introduction of highly efficient biological mechanisms. Imitating these mechanisms offers enormous potentials for the improvement of our life and the tools we use.

We have devised this mechanism inspired from the locomotion of a worm called Stomata pod which uses its whole body as distributed foot facilitating it to move on any terrain and have high agility on a regular tree environment. The gripper assembly designed uses a flexible casing which grasps the tree trunk of almost all diameter within the predefined range, basically it uses passive compliance.

This mechanism can be used for climbing trees which are almost straight like coconut trees and poles. Hence this paper presents a new climbing mechanism for coconut tree climbing robot. It also requires greater agility and high maneuverability to be used as a product. Also the bark of some trees may not be strong enough to bear the weight of the climbing device, hence conventional climbing robots cannot be used for tree climbing applications.



Graph.1. Efficiency Analysis



Graph.2. Robot View

VII. CONCLUSION

In this work a tree climbing mechanism for coconut trees has been proposed this mechanism can also be used to climb structures and other trees which are almost straight like palm trees, poles etc. The mechanism used in this robot is a bio inspired mechanism which is derived from an organism called Stomata pod. This mechanism appears to be more agile compared to other available mechanisms but the main limitation is that it can be used only for a smaller category of trees.

A prototype of robot was made and the efficiency of the slinky type gripper was tested on few trees. Also, software simulation was done for this mechanism. Our future works includes the addition of agricultural equipment's like harvester sprayer etc. also to develop upon the gripping materials as discussed.

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