Tree Climbing Coconut Plucker

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Abstract- For coconut harvesting, the tall coconut trees whose height varies from 60-100 feet are climbed upon by humans till the canopy in order to pluck the coconuts that grow on the top of coconut trees. These individuals, who take up this dangerous task, actually risk their own lives by climbing up to such a height without any proper safety measures taken to protect them from falling down. So, it is decided to design a coconut plucker with the concept of tree climbing and extending it as coconut harvester (plucker). This robot can climb 60 to 100 feet tall coconut trees as well as it plucks the coconuts from the tree branches by the use of controller. The signal will be transmitted from the base of the tree to the robot and robot will acts accordingly. By mounting the camera on the robot will help us to watch the scenario of the tree top which is helpful to locate the position of the coconut.
Keywords – Coconut Harvesting, Climbing Robot, Robotics

I. INTRODUCTION

Coconut is cultivated all over India, particularly in 18 states and 3 union territories [1]. Among these, southern India (Kerala, Tamil Nadu, Karnataka and Andhra Pradesh) alone contributes to 90% of the land and 91% of the coconut production. Farmers of very small and marginal income hold 98% of coconut harvesting in India. Coconut trees belong to a unique category where each and every part of the tree is used by people. From coconut we can produce oil, milk, chips, milk powder, toddy, refined sugar, jaggery/palm sugar, flower syrup, jam, vinegar, jelly, tender coconut water etc. Thousands of people can get employment from industries which produces floor mats, geotextiles, coconut wood products, coconut based handicrafts etc [1].

The tall coconut trees whose height varies from 60-100 feet are climbed upon by humans till the canopy in order to pluck the coconuts that grow high up those trees. These individuals, who take up this dangerous task, actually risk their own lives by climbing up to such a height without any proper safety measures taken to protect them from falling down. A clutch of thin ropes made up of coconut fibers is their only aid as they ascend the coconut tree and along with them they are required to carry a sharp edged Axe with which the pluck the coconuts. Apart from the coconut plucker's point of view, this traditional method of harvesting coconuts is also a problem for the owners of the coconut trees as it is not at all economical. The demand for the individuals who pluck coconuts remains high but there is a shortage of such men in majority of the areas. Also the ones that are summoned to pluck the coconuts are retrieved after a long wait and they do charge a lot for doing the job. The tree owners are left with no option than to hire these coconut plucker individuals and pay them the amount that they demand. While sticking to this traditional method, many of the trees are left unclimbed, since climbing a coconut tree with not more than five mature coconuts would prove uneconomical. The monsoon season (June to September) is also dreaded by the business of coconuts as a sufficiently dry trunk is the basic requirement for the tree climber to climb the tree. Thus all of these problems form the origin for the construction of a machine that attempts to solve all of these problems.

The idea of tree climbing is recently come into picture in 2010 when Tin Lun Lam has demonstrated the principle of climbing a tree. His tree climbing robot (treebot) uses two grippers and a continuum body. He also used Linear-time Path and motion planning algorithm. According to that algorithm, every branch has given a sequence number and to reach on particular branch it plans that, via how many branches it should pass. This bot after defining the path using gripper starts climbing on the tree. The drawback of this bot is, it cannot climb too thin branches as well as more higher trees [2][3]. In 2015, M.I. Faizal designed pole-like tree climbing robot to climb a tree having a diameter of 10 cm. As mentioned by him, this robot also climbs the street light pole, traffic signal pole, etc. The mechanism of the bot is two grippers hold the pole/tree, one from front and one from back. To push the assembly in ascending or descending servo motors is used [4].

In 2015, Rajesh Kannan Megalingam has designed DTMF based robotic arm and control for coconut tree climber. It uses DTMF technology for controlling ascending and descending motion as well as arm motion of robot. The arm attached to the climbing circuitry consists of two motors namely base motor and elbow motor. Each motor has assigned different DTMF frequency, so that they can control separately [1].

So, after studying such good researches, it is decided to continue the concept of tree climbing and extending it as coconut harvester (plucker). The 'Tree Climbing Coconut Plucker' is a machine in itself that has several parts working together for a specific task. The apparatus consists of various metallic frames welded together, gears, motors, etc. This machine does not function itself. It needs a manual control over it to perform the tasks. This manual control is given to the end user of the machine. The user and the machine are constantly connected to each

other making use of a wireless medium of contact. Apart from the mechanical parts and the mechanics used about the forces applied, torque, etc. The machine constitutes of various electronic components as well.

1.1 Significance of the study-

The significance of the Tree Climbing Coconut Plucker lies in its ability to help to do the job of harvesting the coconuts, which if carried out in the same old traditional way, proves to be a dangerous job and can risk lives of people doing the same. The proposed Tree climbing coconut plucker machine can accomplish the task of plucking the coconut from the canopy of the coconut tree with no risk to the life of any individual. Also, making use of this machine can further prove to be very much of an economical way for the tree owners as it requires less expenditure, costing only for the maintenance and not on a per tree basis. The end user can control the machine with a better user experience as it uses a wireless medium to connect the user instructions to the machine, and can selectively pluck the mature coconuts from the tree.

1.2 Objectives-

- To make an efficient machine that holds the trunk firmly, while it climbs up the tall coconut trees and reaches the canopy
- To make a movable arm attached to the tree-climbing assembly, that can help in the harvesting process of the coconuts by simple and selective plucking of coconuts from their respective branches
- Let the end user have a better control over the selection of the coconuts to be plucked and also over every movement of the machine
- Provide the end user with the LIVE footage, through a wireless medium, of the happenings going on at high up the coconut tree
- Reduce the risk of human lives by making the coconut harvesting process more safer
- Creating an economic and cost-effective option for the coconut tree owners, in order to pluck the coconuts

This Tree Climbing Coconut Plucker system is explained in section II. Experimental results are presented in section III. Concluding remarks are given in section IV.

II. METHODOLOGY

Tree climbing coconut plucker is to be designed in order to reduce human efforts and to cease risking their lives in climbing up the tree of average height 60 to 100 feet. Major efforts that this robot has to take are to climb up the tree and pluck the coconuts on its own. Thus tree climbing coconut plucker is a robot that will climb up the coconut tree and will pluck the coconuts with the help of its arm assembly. The Tree Climbing Coconut Plucker is constructed using three major parts and they are as follows,

- Tree climbing assembly
- Arm sliding mechanism and
- Coconut Plucking element

2.1 Tree climbing assembly–

Tree climbing assembly shown in figure 1 below is a part of the robot that will take it to the top of the tree i.e. near to the canopy form where coconuts are to be plucked. This assembly consists of two hexagonal aluminum frames joined by the aluminum pipes at each vertex with respective vertex of other hexagon. Each frame has three wheels placed with planes containing them at 120 degrees with respect to each other. Each wheel is attached to a bearing which is mounted on an aluminum plate as shown in structure below. The aluminum plate is mounted on alternate edge of the hexagon so as to get a proper alignment of wheels at 120 degrees. The mounting of aluminum late is done by means of a rigid support and springs. The rigid support will restrict the wheel motion in vertical direction while spring will give adjustments to the wheel in direction perpendicular to the trunk. Wheel shaft is then joined with a high torque motor shaft by means of a coupler which will give rotations to the wheel so as to climb up the tree.

Figure 1. Three Dimension model of Climbing Assembly

2.2 Arm sliding mechanism-

It is that part of robot which will give a motion to the robotic arm so that arm can adjust itself according to the position of the coconut on the tree. This mechanism consist of two parallel rods in a circular shape and a wheel between them as major components. As structure in the figure shows that the wheel shaft is connected to a bearing mounted on a plate which gives support to the motor mounting. The wheel shaft is then further extended up to the motor shaft and they are placed near each other with the help of bevel gears. As the motor shaft rotates the wheel is forced to rotate due to bevel gear.To restrict the reverse motion of the motor two "L" shaped rods are attached to the mounting of the motor as shown in figure, and that two small wheels are placed at the end of the L shaped rod which are guided by an aluminum track specifically made for those wheels. As the motor shaft is rotated the larger wheel moves in circular path along two parallel rods.

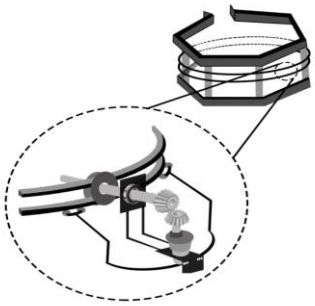


Figure 2. Arm Climbing Assembly

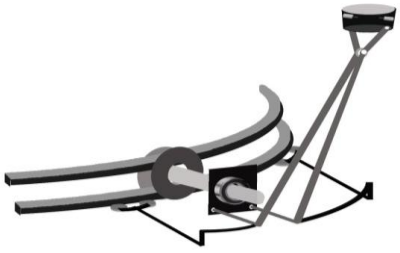


Figure 3. Coconut Plucking Assembly

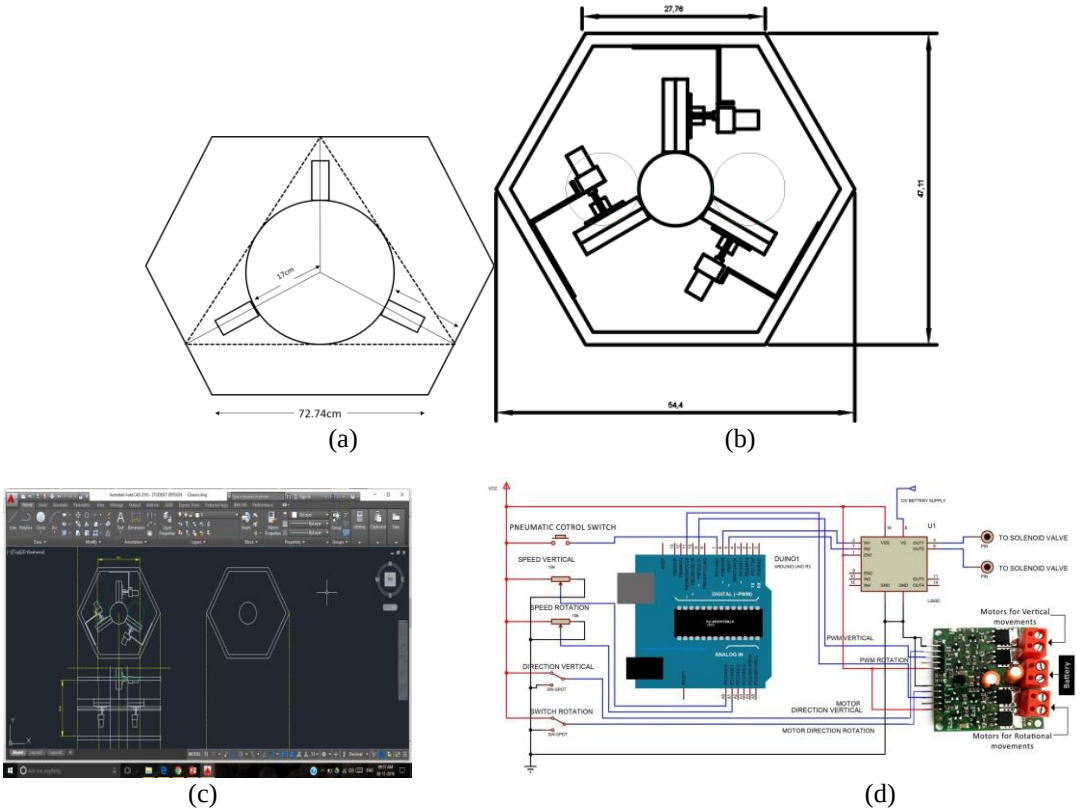
2.3 Coconut plucking Element-

This is the smallest but the most important element of the robot. This is the actual element which separates the coconut from the tree.It consists of two pneumatic whose shafts are opposite to each other. A pointed arrow is attached to the shaft of each pneumatic. The coconut is brought in between this two pneumatics with the help of sliding mechanism and arm movement. As soon as coconut enters the pneumatic shaft it is extended and pointed

arrow grabs the coconut. Then to separate the coconut from the tree the whole assembly will rotate clockwise and anticlockwise several times and the coconut will be separated from the tree.

III. EXPERIMENT AND RESULT

For the mechanical design first the physical structure of the coconut tree i.e. the approximate range of dimensions of its trunk, it's leaves, it's surface as well as the fruit viz. coconut, were studied well. The average diameter of the trunk of the coconut trees came out to be 30-36 cm. Also an actual coconut tree has variation in its thickness throughout its length. At the base the thickness is more as compared to the thickness at the canopy. But since this model is supposed to work on an ideal coconut tree, a fixed dimension for the diameter of the tree trunk was chosen viz. 34cm. As it can be seen in the figure 4a which is the top view of the machine. It was a basic design, with an idea of having three wheels that would climb the tree. These three wheels are projected at 120° with respect to each other and mounted at the center of 3 sides of the hexagonal frame would be walking on the surface of the coconut tree trunk in a vertical direction i.e. along the length of the tree trunk. The triangle that can be seen in the figure is just for the sake of reference to get the proper center of the frame where the wheel needs to be mounted. The approximate dimensions of the sides of the hexagonal frame were also calculated with respect to the dimension of the tree trunk. Also prior to starting our work on AutoCAD we first measured the sizes of the components that we were going to make use of in the machine. This included measuring the diameter of the omni-directional wheels as well as their thickness and shaft, length, breadth of the motor and the hollow cuboidal aluminium pipes that we made use of in the machine. Using these dimensions we made a proper diagram in AutoCAD that has a top view and side view of the machine assembly. These designs made it easier to imagine how the machine would look like and helped a lot in calculating the dimensions of the machine thus acting as the blueprint for the Electronic Coconut Plucker.



(a) (b)

(c) (d)

Figure 4. (a) Basic Model (b) AutoCAD Design (c) Watermarked image (d) Controlling of Coconut Plucker

Figure 4d shows the circuit diagram of Coconut Plucker. It consists of electronic components such as potentiometer and switches and electronic module such as Arduino module, motor driver module and L293D module. Remote control block comprises of two potentiometers, two single pole double throw (SPDT) switches and one normal push button switch. Potentiometer is used to control the speed of the motors and it is used to start and stops the motors. The two fixed terminal of potentiometer 1 and potentiometer 2 are connected to the Vcc and

Ground terminal and variable terminal is connected to pin number A0 and A1 respectively. When variable terminal is connected to ground, it forces motor to stop rotating. As the variable terminal of potentiometer moves towards VCC terminal, the voltage across variable terminal starts increasing depending on the resistance offered. These signals (speed control 1 & speed control 2) are then given to Arduino. Potentiometer 1 is used to control the speed of motors which are meant for climbing and descending on the tree trunk and potentiometer 2 is used to control the speed of motors which are rotating movement around the trunk.

IV. CONCLUSION

This project can bring together several components and ideas of robotic technology to use it for the society to handle the risky task of the coconut farmers to pluck the coconuts instead of personally climbing the tree by the farmers. This project can be utilized for the similar kinds of task for other similar kind of trees and risky climbing applications.

V. REFERENCES

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