Design and Fabrication of Coconut Tree Climbing and Harvesting Robot; Review

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Abstract

With over five billion coconuts harvested every year, coconuts play a huge role in the economy of several regions and countries. In India prominent places of harvested are the states of Tamil Nadu, Kerala and Karnataka. The majority of coconuts are harvested by climbing the tree and cutting the nuts by hand. This process may seem simple; however, it is actually quite dangerous. In response, there is a genuine need to develop a device for coconut tree climbing and harvesting. We hereby studied various research papers related to the work in this area. There is large scope of development in this topic because of the cost and complexity of various devices available in the market. So the major objective of this study is to design a prototype of the device for coconut tree climbing and harvesting containing less complexities and which is comparatively less costly.

Keywords: Coconut Harvesting, Problems Faced, Injuries During Harvesting, Coconut Tree Climbing Robot

I. INTRODUCTION

Coconut palms are grown in more than 80 countries of the world, with a total production of 61 million tonnes per year. Coconuts are known to belong to the "Arecacea" family, also known as palm family, which is comprised of about 200 genera and 2500 species. Coconuts are exported by the tonnes around the world, bringing in revenue to various tropical countries. However, they also have other important uses. Appropriately referred to as "The tree of life" by villagers, every part of the coconut is utilized is some way. India produces about 25% of the world's coconut meat and fibre, which is eaten or made into soap, oil, shampoo, rope, and door mats. The nut is also an integral part of Indian culture, used in religious ceremonies, ornamentation and Hindu weddings. Kerala produces nearly half of India's harvest. In fact, state's name is a Malyalam-language combination of the words for "coconut" and "land".

Primitive methods of collection provide a need for a new device. An experienced climber takes about 7-10 minutes alone just to climb the trees (this doesn't include cutting the coconuts and the return trip). In more developed areas, methods of harvest and coconut removal involving rope-climbing gears and spiked shoes are used, but are impractical and in efficient for use in large scale plantation harvesting. In the Indian state of Tamil Nadu, a climber makes Rs.40-50 per tree. Hardly anyone aspires to become a coconut harvester because of the unsafe conditions, low income and social stigma, resulting in a virtual vacuum in the job market. Furthermore, most coconut harvesters are currently men. This is because of the traditional idea of it being a "man's job" as coconut harvesting extremely strenuous.

With over five billion coconuts harvested every year, coconuts play a huge role in the economy of several regions and countries. We considered India for survey. Prominent places of harvested are the states of Tamil Nadu, Kerala and Karnataka. The majority of coconuts are harvested by climbing the tree and cutting the nuts by hand. This process may seem simple; however, it is actually quite dangerous. In response, there is a genuine need to develop a device.

Primary goal of the study is to design a coconut tree climbing and harvesting coconuts for farmers and residents. It is very difficult to climb on coconut tree manually due to the constant cylindrical structure and single stem. In other type of trees there are branches for holding and to support the climber. A professional climber with proper training only could able to climb a coconut tree. There are no 100% safe coconuts harvesting device currently in the market.

Considering this scenario, a device which will help the user to harvest coconuts easily will be designed. This device will be useful for the people who are having large coconut cultivation as well as residents who are having less coconut trees. This kind of device will encourage more people to come forward to agriculture sector.

In an attempt to assist the climbers, our group will device a coconut tree climbing and harvesting robot that meets the following goals:

- It will be controlled from the ground.
- Not only men but also women, children's will be able to operate the robot.
- The harvesting method becomes as fast as or faster than present methods.
- The robot that can successfully climb a coconut tree of variable diameters and height is made.

II. LITERATURE REVIEW

Akshay Dubey, Santosh Patnaik, Arunava Banerjee[1] presented "Autonomous control and implementation of coconut tree climbing and harvesting robot", this paper focuses on designing a low cost coconut tree climbing and harvesting robot. The kinematics and the motion of the robot are designed by referring to the motion of coconut harvester. The robot consists of two segments joined by a pair of threaded rods coupled to motors. The mechanical frame is designed in draft sight software and is implemented using aluminum segments and threaded rods. It has two arms driven by motors for holding. Locomotion of the robot is achieved using six motors out of which four motors are used in two hands and other two are used for upward and downward motion. The other part is a robotic arm for cutting down the coconuts. The robotic arm is attached on top of the climbing part. The operation of the cutting arm is done manually from the ground using a remote. But the disadvantage of this prototype is that the climbing process is slow. Also the climbing process fails if there is misalignment in threaded rod and nut.

B.C. Widanagamage, T.N. Gallege, S. Salgado, J. Wijayakulasooriya[2] presented "Treebot: An Autonomous Tree Climbing Robot Utilizing Four Bar Linkage System", the work presented in this paper, focuses on designing Tree Robot: a tree climbing robot. Our prime consideration in designing tree robot is of the mechanical structure and method of gripping. With arms involving a four bar linkage system and screw mechanism. The mechanical structure is designed to move the structure upwards against the gravitational forces in successive upper body and lower body movements similar to a tree climber. The gripping is designed in a way to hold the upper or lower part of the structure to the tree facilitating the upward movement. The scope of this project is limited to climb coconut trees having diameters only between 15 cm and 25 cm.

Salice Peter, Jayanth M, ArunBabu M.K, Ashida P.V, Akhil K.T[3] presented "Design and Construction of a Tree Climbing Robot", the project presented here, focuses on designing a tree climbing robot. Our prime consideration in designing tree climbing robot is of the motion planning and method of gripping. With arms involving four legs and sharp end as feet. The mechanical structure is designed to move the structure upwards against the gravitational forces in successive upper body and lower body movements similar to a tree climber. The gripping is designed in a way to dig the upper or lower part of the structure in to the tree facilitating the upward movement. The results show that it can successfully climb the trees. Treeclimbing robot has the potential to be applied to various pursuits, such as harvesting, tree maintenance, and observation of tree dwelling animals. The scope of this project is limited to climb coconut trees having diameters only between 10 cm and 20 cm and this robot has a load carrying capacity only 0.75 kg.

Senthilkumar S K, Aashika Srinivas, Maria Kuriachan, Sibi S M, Veerabhadhran, Vinod B, Sundar Ganesh C S[4] presented "Development of Automated Coconut Harvester Prototype", this paper focuses on designing an automated tree climbing robot, Tree robot which does not require human labour to accompany the device but only to control it from the ground using a remote control. Conventionally, harvesting of coconuts has always been done manually and any device developed also requires a human labour to accompany it. Safety of the worker and the increased labour charges are the primary concerns of the coconut farm owners now. The device is a triangle with a movable third side and consists of three wheels, one attached to each side of the triangle. Two springs, each attached to the other two sides of the triangle help in adjusting to the varying diameter of the tree. Each wheel is driven by a high torque geared DC motor. Two L293D drivers are used to drive the three motors in a bidirectional way. These drivers are fixed on the frame of the device. A RF transmitter /receiver unit is used to provide control signals to the driver. A 12 V3000 mah rechargeable battery pack is used to provide on-board power supply for the receiver, two drivers and the three motors. An arm with a rotary blade at its end is fixed to one side of the Tree robot to harvest the coconuts. This robot has a triangular structure hence it cannot be adjust with the variable diameters of tree.

Eldho Jacob, V.P Haridasan[5] presented "Development of An Autonomous Tree Climbing Robot", the project works consist of developing an "autonomous tree climbing and pesticide spraying robot". Here the robot is made to analyse and climb on the tree autonomously. Tree Robot, is inspired from human pole climbers and relies on wheel mechanism to ensure smooth and fast climbing motion. The robot has been modelled and designed using 3-D design software. L293D Motor driver is used along with PIC 16F877A and 7805 – 5v voltage regulator for micro controller. Electronic compartment was developed to accommodate the electronic parts on board. Calculation of power required, upward force, and torque are done. This robot has only single layer hexagonal structure hence it is not dynamically stable.

Rajesh Kannan, Megalingam, RVenumadhav, AshisPavanK, Anandkumar Mahadevan[6] presented "Kinect based wireless robotic coconut tree climber", in this paper we discuss various models for tree climbing and plucking. We have taken into account the safety, reliability, the ease of use which is capable of climbing trees, cutting down coconuts, cleaning the trees tops

and spraying pesticides. This system is so designed that it can be controlled by anyone. A prototype of the arm has been designed and tested successfully using Microsoft Kinect. The designed prototype responds to human gestures with negligible gap in the respond time and hence can be implemented in a real time. This model is not reliable for inclined trees and tall trees. It has heavy structure and mounting is difficult [6].

III. CONCLUSION

We have referred various research papers related to our topic. There is lot of work already done in this area but there is no device which is 100% accurate. There are various designs which are giving positive results but contain lot of complexities. Various designs have limitations of tree sizes as they are limited for particular diameters. By referring various research papers we have designed one model of coconut tree climber and harvester. This robot will have a simple configuration which will be result in simple design and reduce complexity of control compared to the existing tree climbing robots. We selected the hexagonal shape of robot so that it can easily adjust with the diameter of tree with the help of a spring action implemented in the robot. The system also aims to make easy and simple model which can be used even by laymen. This system paves way for technology in reducing economic and social hurdles.

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