Design and Fabrication of Coconut Tree Harvesting Machine

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Abstract - Coconut tree is one of the most important trees in agriculture. In India, agriculture is the key development in the rise of sedentary human civilization. So we are choosing a project in the field of agriculture. Coconut tree harvesting helps to cut the coconut from the tree by controlling it through the mobile phone or switches. The structure of the coconut tree is cylindrical and single stem manually, so climbing on coconut tree is very difficult. The climbers suffer from musculoskeletal disorders in the long term. The climbers are not available at all the time. Due to this problem the coconut begins to ripen so the white meat begins thickness and eventually hardening with time. The existing techniques are not sufficient to solve the problem of unavailability of works for coconut tree climbing. Our primary goal of this project is to develop the coconut tree harvesting machine which helps in climbing and cutting the coconut from the tree without human efforts and replaced by robotic arms, motors, wheels, control switches and with the help of current. This project is fully compact system by using light weight and good strength materials and it is depend upon mechanical and electrical properties. It is less noise pollution and does not disturb the environment. This machine is not only used for coconut tree harvesting, it is also used for palm tree harvesting where the structure of both the tree is same. This machine has a big scope in agriculture for palm and coconut tree harvesting in order to bring a coconut and increase the productivity. The coconut is very good to human beings who help us in bone health, metabolism of carbohydrates, proteins and cholesterol. In this study paper we have discussed the importance of coconut tree harvesting and the machine which reduces the cost efficient and does not require the skilled labors and waste of time

Key Words: Monile phoneor switches, mechanical cutting arm, coconut tree climber.

1.INTRODUCTION

In India, coconut is one of the lucrative crops.However, coconut farmers and homegrown coconut tree growers confront significant challenges in finding manual coconut tree climbers to collect the coconut. There is a severe lack of human coconut tree climbers not only in India, but around the world. This employment has traditionally been held by India's socially and economically underprivileged people. As the literacy rate rises and India's economy expands, individuals seek higher-paying jobs.

Additionally, it's a dangerous career where accidents can often be fatal. If the climber is the only one who can support and earn a living for the family, this might be devastating for everyone without adequate insurance coverage. It has also been observed that those who work in this field for a number of years get skin-related problems. Better methods must thus be developed because harvesting coconuts is an extremely dangerous task. This study aims to address the several solutions that are now accessible, their drawbacks, and offer potential comprehensive solutions. Harvesting coconuts is traditionally done by climbing and cutting the tree. Due to the challenges associated with climbing and harvesting, various techniques have been devised. There are two ways to climb: one is with a mechanical aid, and the other is with a robot that can climb and cut. While there are various uses for robots, their primary function is to replace humans in labour-intensive and hazardous tasks. The state of technology now allows us to create a wide range of robotic systems that can do many

activities, including picking and putting, cutting, climbing, flying, and swimming. This study focuses on climbing robots, specifically those that climb coconut trees. Since climbing coconut trees is a laborious task, robots can be a valuable tool in identifying a long-term solution. Coconut tree is one of the most important trees in agriculture. In India, agriculture is the key development in the rise of sedentary human civilization. So we are choosing a project in the field of agriculture.

2.LIERATURE REVIEW

Rajesh Kannan Megalingam (KINETIC BASED WIRELESS ROBOTIC COCONUT TREE CLIMBER - 2013), propose the body shape should consist of a hexagonal chasis with 6 wheels and 6 motors for climbing up the tree. This enables to arm to rotate about circumference of the tree trunk to chop off coconuts hanging at orientation. He also tells that the arm was built using aluminum plates in the shape of the rectangle and L angles. The plates are connected at the required position using 3mm diameter screws. The joints of the arm are replicated using servo motors. i.e. three servo motors are used for the three degrees of freedom. two motors are at elbow and one in between elbow and shoulder for twisting.

Sundar Ganesh(DEVELOPMENT OF AUTOMATED COCONUT HARVESTER PROTOTYPE-2015),we get the study of how to select the right motors & wheels. There are different types of motors. Apart there are two motors Stepper motors and Servomotors are used for their highly precise and accurate applications. Servomotors have high holding torque, but the weight of the motor is so huge. DC Geared motors are chosen for their light weight, cost and torque. It is rated to operate at a wide range of voltage of 4V-24V. It also gives the basic force and torque calculation.

SaravanaKumar(AUTONOMOUS CONTROL AND IMPLEMENTING OF COCONUT TREE CLIMBING AND HARVESTING MACHINE-2016)gives the front view and top view of the model and explains the holding mechanism. Here there are two holding mechanism provided at the top and bottom and are connected throw a pair of pistons and threaded rod-nut arrangement.it shows the linear motion for the robot to climb. Because of using piston it reduced the vibration. He tells the DC Geared motors rotate in clockwise direction to provide the vertical motion. he explains the free body diagram of Body of weight and help us to know the calculation of

coefficient of friction between the nut and screw. He tells the why we are using a 12V DC geared motor because it has an Rpm of 200 at a rated torque of 1.8Nm and efficiency of 0.95. The power that can be delivered by motor = 35.8141 watts. For cutting operation He used 12V DC,1000Rpm DC geared motor for cutting operation and the blade used which is made up of steel due to cut the coconut mud.

Ramprasath(TREE CLIMBING ROBOT-2016), gives the basic calculation which was required to have the robot holding its position. He analyse the minimum and maximum diameter of the tree and friction coefficient. He also gives the spring calculation which was acting on the element balance the robot on the tree. The material of the spring is steel which was checked and anlaysed . According to the spring calculation he calculate the weight which was balanced so how much force required to pull to a vertical motion. The wheel and motor calculation was assumed according to diameter of the wheel. The torque elemental analysis was done and it is negligible. At last in this paper he clearly reviewed the stainless steel, steel and aluminium alloys benefits and its advantages & disadvantages.

Harikumar(DESIGN AND FABRICATION OF COCONUT TREE CLIMBING AND HARVESTING MACHINE-2019), gives the U-shaped wheel frame design and its material is aluminium. In the U-shaped clemp is used to hold the tyre with the provision for attaching DC motor. Rods were used to fix the clamp to the frame and springs were used in the rods so far that the frame can adjust the diameter variation according the trunk of the tree. In this He used the robotic cutter arm which is driven by DC geared motor having 1500 Rpm. He also explained the spring and slider mechanism. The electronic components and other parts were selected and that dimension was given. The complete CAD model was shown.

Karthikeyan(AUTOMATIC COCONUT TREE CLIMBER WITH EXPROPRIATOR-2020) gives the CAD design of the hexagonal frame and explains the advantage of using the hexagonal mechanical frame. He tells that the maximum diameter of the tree is 60 cm and minimum diameter of tree is 45cm.The side of the hexagonal frame is 37.5 cm. He clearly the movement of the wheel and he used six wheels for the frame. Wheel along with gear motor arrangement is to make grip fitting to the frame. He tells the spring mechanism and

the spring diameter is 7.5 cm and half screwed rod length is 12 cm which used to connect the wheel and the frame. He gives the DC gear motor parameters and its specifications (example: voltage, torque range, Rpm, current etc.) In this he used the 12V DC Battery for 10 hour is used effectively for the motor and movement operation. The battery used is Ampere Sealed Lead - Acid Battery. He also explains the circuit that he is used and its robotic arm.

3.METHODOLOGY

In the design and fabrication of coconut harvesting machine, the research methodology consists of the selection of the coconut harvesting machine frame from the various materials, that is to be fabricated based on the functions it should perform. To achieve the requirements of proper cutting and climbing of coconut so that the robotic arm are planned to fabricate with the stainless-steel material and also the movement of the machine is planned to achieve with Arduino uno and a Bluetooth controller. The three types of motion are continues, discreet and serpentine. Here continues types of motion is used because energy consumption is reduction and speed is increased,the model developed. In discret type the speed of climbing is less compare to continue type. First, the system is attached to tree trunk with the help of gripers and locked using spring. The gripper on the tree trunk and provides adequate friction such that it does not slip. The motors used for climbing overcome the movement caused by its weight.
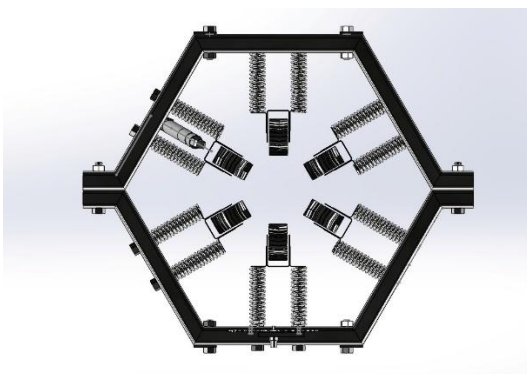

FIGURE 3.(A) *3D MODEL OF COCONUT TREE HARVESTING*

MACHINE

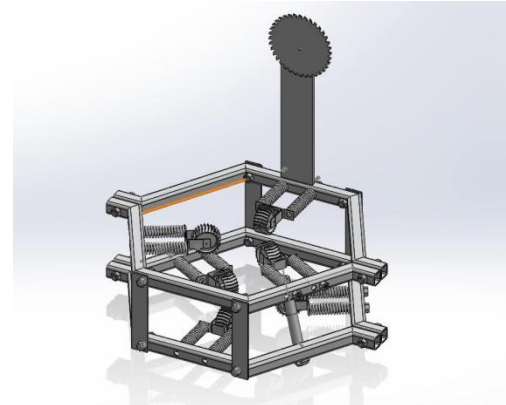We designed the 3d model of metal frame in solidworks software and analyzed.

FIGURE 3.(B) *3D MODEL OF COCONUT HARVESTING   MACHINE*

4. CALCULATION

Hexagon frame Calculation:
The requirement was to have the machine holding its position, hence the calculations were made to reflect the same.

Preselected Data:
Hexagonal shape (Θ = 120degree)
Length of the element, L = 350 mm
Minimum diameter of a tree = 300 mm
Maximum diameter of the tree = 550 mm
Friction coefficient, μ rubber = 0.6

Spring Calculation:
To decide the weight of the robot, the forces by the springs are required. Material: Spring Steel 5

Wire diameter, d = 3 mm Outer diameter, OD = 30 mm
Body length, L = 171 mm
Number of coils, n = (171/3)-6 = 51 Effective diameter, D = 27 mm
Spring constant, k = (G x d4) / (8 x D3 x n) k = [(7.93 x 104) x (34)] / [8 x (273) x (51)]
k = 0.2517N/mm
We know that, F = k x (x)
F = 0.2517 x 175.4 F = 44.148 N

$N = 2 \times F \times \cos 30$ degree $N = 76.46$ N

Now, $\mu \times NT = mg$

$0.6 \times (6 \times 76.46) = m \times 9.81$

$m = 28.05$ kg

So, the maximum supported weight is 28 kg. μNT is the minimum force required to pull or lock the robot at its position. As the weight of the machine is 10 kg, it will be easily supported.

features an eccentric cam , which ensures that the linear motion from the footstep is effectively converted into otational motion. When the footstep platform is pressed, the spring system pushes the crankshaft into motion, creating a rotation. The Chromium rod ensures the smooth vertical flow of the base plate without any type of inclination in it. The crankshaft includes bearings and supports to reduce friction and ensure smooth rotation. It connects to the coil spring mechanism, which stores the energy during compression and releases it to drive the generator rotor.

Wheel and Motor Calculation:

The mass of the wheels was assumed negligible. The diameter was set according to design specifications.

Wheel diameter, $d = 70$ mm

We know that, $\mu \times Nr = \text{T}Motor$

$\text{T} = 0.6 \times 76.46 \times (35/1000)$

$\text{T} = 1.6056$ Nm $\text{T} = 2$ Nm

$\text{T} = 20$ kg-cm

5.WORKING MODEL:

FIGURE 7.(A) *SIDE VIEW OF THE MODEL*

The Project works based on the Climbing Mechanism which the climbing process is done. The system consists of wheel to climb the tree by transmitting the power. When the motor gives power to be wheel. Then using minimum level components to build the machine.

6. FUTURE WORKS

Our project can be further implemented by giving 360deg movement to the arm and arm may be replaced by telescopic type and providing the camera at tip of arm to identify the coconuts and the shape and size can be modified to reduce the weight which results in faster climbing.

This coconut tree climber can be made to pick off the coconut using the robotic arm. Here this idea is being implemented to climb the coconut tree without human labor along with this setup.

Further development of the robotic arm is in progress along with the camera. The camera is used to identify the ripened coconut and to eliminate the tender coconut.

7.CONCLUSION

The design and development of the coconut harvesting machine present a solution for agriculture to overcome the problem. This project major aim should be providing

low cost, no physical work, time and cost compared to current methods.

The frame of the machine is hexagonal which is must able to climb the tree which is difficult in shape as a cylindrical.

The motors used to provide necessary torque which is needed to run the wheel,

FIGURE 7.(B) *FRONT VIEW OF THE MODEL*

To ensure the safety of the operator the current is even off also the machine is able withstand in tree.

The operator the control the machine using the switch box within a particular distance which is accordance to safety.

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