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Design and Fabrication of Areca Nut Climber and Harvesting

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***Abstract*: Kerala is the second largest producer of areca-nut in India which depends on conventional climbing technique and skilled labour for harvesting areca-nut however in recent time's skilled climbers has become scarce and farmers find difficult to harvest the nuts. Manual climbing involves high risk jumping from one tree to another. This project deals with a manual machine which uses a spring and pulley mechanism to climb and harvest the nut. The main objective of this project is that it is economical and doesn't require any skilled labour it is safe and can be easily implemented. The use of this machine reduces the extensive labour cost and increases safety considerably.**

***Keywords*: Areca-nut, Climbing and harvesting, Labour.**

1. Introduction

Usually areca-nut trees are unbranched which grows up to a range of 10-30m these trees grow in the region of high rainfall. And these trees are harvested by means of manual climbing and cutting down the nuts. Of which Kerala accounts for nearly 70 percent of India's areca-nut production. Usually farmers all over the India practice this traditional try climbing technique which involves high risk, due to the stunning heights and lack of branches it is difficult to climb these trees and requires highly skilled labour. Only there are few skilled climbers which tend to increase the demand and results in high wages. The scarcity of skilled climbers leads to the disruption in the harvesting cycle which results in loss for farmers. Considering this scenario we developed a manual spring mechanism based machine which helps the farmers to harvest the trees without any delay and search for skilled labour. Which reduces the harvesting cost and risks involved in harvesting.

2. Objectives

- Provide an alternative to the existing traditional methods of climbing.
- This idea is to make a device which does not use electricity but a device completely depending upon mechanical linkages and spring actions.
- To tackle the problem of unavailability of traditional tree climbers and increased wages during the period of harvesting.

3. Literature Review

[1] Eldhouse Pine fully automated. In this survey they used DC motor and the speed of the motor is around 30rpm and this motor provides a self-locking so that the device cannot come downwards due to gravity. They used hexagonal frame because it requires less material for support compare to rectangular frame. By using this frame the weight of the machine is also low. Helical spring is used to store energy due to resilience and to absorb shock and also to maintain the force between contacting surfaces.

[2] A. Vasanthi et al., carried out a study about the robotized areca-nut climber with pesticide sprayer. In this, they used 12V battery which gives supply to relay control unit and motors. And also they uses 433MHz transmitter which sends signals through the antenna to receiver. It receives the signal from the transmitter circuit. Control unit consists of electromagnetic relays which used to control the motor for climbing the tree. They used 12v and 10rpm motor with gears is attached to the wheels and used to climb the tree.

[3] Mohit Rane et al., carried out a study about design of semi-automatic areca-nut tree climber plucker. In this survey they design the machine with multidisciplinary purposes like climbing, spraying pesticides and the inspection of fruit condition, and harvesting the ripened fruit. They used two batteries to run the entire device. The guide way for the arm is also connected to the frame so that it is able to rotate 360 degrees. The climbing mechanism consists of links, springs and a geared DC motor and rubber wheels. They designed the rubber wheels to provide necessary coefficient of friction to maintain contact over the tree surface.

[4] R. Gokulraju et al., carried out a study of areca-nut tree climber which uses a rope, pulley mechanism to operate and it is safer compared to other climbing techniques. It is very simple for villagers to operate also this reduces the time required to harvest the nuts. There was a knife to cut the nut and bring them down by using rope. In this project vynaprene gripper made of rubber is used which has more strength compared to other spring and has excellent anti slip properties. It climbs the tree when the rope is pulled the upper clamp is pulled down and the spring starts to compress when the rope is released the spring expands and the clamp moves up and grabs a position above that and the process repeats to reach the top.

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[5] S. M. Arun Kumar et al., carried out a study about removing a bunch of areca-nut from the plant and spraying pesticide by using remote operated device. In this they used an L shaped base frame which supports all the components build up on. It has a petrol engine which provides power to all operations. Self-locking is achieved by means of taper wheel which is attached to gas spring and this also acts as support which helps in balancing while climbing. Nylon tyres with rubber grips are used which are mounted parallel to each other for effective climbing to accommodate the change in diameter of the tree enough clearance is provided. Here wireless remote control systems are used RF transmitter is fitted in the remote and a receiver is connected to the servomotor which controls the acceleration of the petrol engine. This can also be used for spraying pesticide by using special attachments.

[6] Fasil T. K. et al., carried out a fabrication of remote controlled arecanut plucking machine. Which uses the basic principle of rope pulley system. The motor is welded to the frame which consists of a drum which winds the steel rope which runs between two pulleys a spring is attached to the frame between the pulleys during the winding phase of the drum the spring gets contracted and the spring force acts against it. This opposite force generates the necessary upward motion during the unwinding phase of the motor. There are two rings which grabs the tree while climbing these rings are provided with holes at different length so it can easily adjusted by the pin according to the diameter of the tree. Here a collector attachment is also provided to prevent the falling of areca nut after cutting operation.

[7] J Sharana Basavaraja et al., Tree climber is mainly focused on two unit's RH, and LH. The RH unit create the downward movement of the pedal, through which the steel wire rope is stretched and locks the areca tree. Now the LH unit is lifted up by pulling the handle attached to it to limb and the same process is repeated to reach the required height. To descend the tree, the pedal of RH unit is pushed down and the handle of the LH unit is also pulled down alternatively till the bottom of the tree.

[8] Arjun Prasad et al, carried out the fabrication of wireless palm tree climber which uses friction to hold on to the palm tree by means of springs. This machine is made so adaptive so that it can adjust itself according to the variable diameter of the tree. Adeptness is possible because of the compressive springs along the periphery of the machine. In this a video camera was also used to locate the fruit and guide the device with the help of zig bee microcontroller and xbee RF module it can be controlled wirelessly.

4. Components and Functions

A. Main Frame

It is made up of mild steel. This acts as a rigid support for the entire structure. It has a Y shaped fork like structure mounted to it grasps the nuts

B. Spring

A spring of length 30 cm is attached between the upper and lower clamp this spring compresses and expands every time when the rope is pulled.it helps in raising or lowering the whole structure.

C. U Clamp

Two u clamps are used one at the top and another at the bottom made of mild steel these clamps grab the tree and preventing the structure from slipping.

D. Pulley

Pulley is a mechanical derive used to transfer power. It consists of two v-pulley of same diameter one at the top and other at the bottom.

E. Knife

It is made up of mild steel. It is fitted at the top of the frame it operated by a separate spring action by using rope.

F. Rope

A rope of thickness 5mm is used and the length may vary depending on the average sizes of the tree.

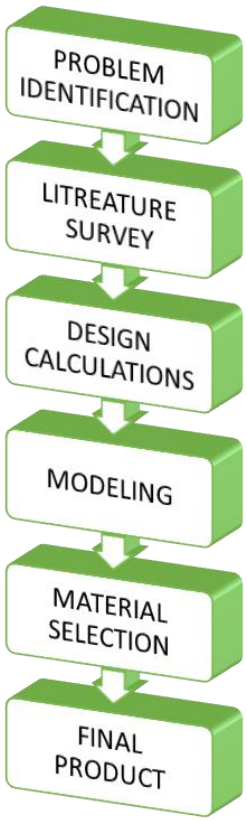

Fig. 1. Methodology

5. Design Calculation

A. Calculation of spring dimension

Parameters known:
Spring Outer diameter,
Do= 20 mm
Wire diameter,
d= 2 mm

Number of coils in the spring,
n= 10
Free length of the spring,
L= 110mm
Tensile strength
σ = 238-350N/mm
Young's Modulus of stainless steel
E= 210 G Pa
Poisson's ratio
μ= 0.3
Density of stain less steel
ρ= 7850 kg/m^3

Calculation:

Mean diameter of the spring
D= DO – d = 20 – 2
D= 18 mm
Spring index
C= D / d = 18 / 2
C= 9
Shear Modulus of Material
G= E/2(1+v) = (210x109) / (2(1+0.3))
G= 8.08 x104 M Pa
Modulus of Rigidity
G= 8.08 x 104 N/mm^2
Spring constant
K= Gd^4 / ($8nD^3$)
K= 8.08 x 104 x 2^4/ (8 x 18^3 x 10)
K= 2.77N/mm
F_{max}= 408.82N
x= 34 mm
Spring Force
F= x*k =34*(2.77)
F =94.18 N
Energy of spring
E=U=k*x^2/2 =2.77*34^2/2
E=U =1601.06 N

6. Working

It consists of two pulleys, springs, rollers, knife, rope and clamps with rubber padding for operations. It uses a rope, pulley and spring mechanism to climb the tree. Initially the device is fitted on the lower stem of the tree using clamps and bolts. When the rope is pulled through the pulleys the spring is compressed and the lower part of the device is pulled up that is the lower clamp moves up this is done by the pulleys fitted on the back side. When the rope is released the spring expands as a result the upper part of the device moves upwards. This is continued till the device reaches the top. Then the separate rope used for the cutting operation is pulled the knife also has a spring attached to its body when the rope is released the knife cuts the areca-nut and the clamps on the body holds the nuts and prevent them from falling. Then pull the other rope to bring back the machine down.

7. Conclusion

Thus, we have come up with machine which reduces the high risk for labours during harvesting. We have been able to design and fabricate areca-nut climbing and harvesting machine. In this paper the attempt made for designing and fabrication of arecanut climbing and harvesting is successful.

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References

[1] Eldhouse paul et al, "Semi-Automatic areca-nut tree climbing and harvesting robot," July 2017.
[2] A. Vasanthi et al, "Robotized areca-nut tree climber and pesticides sprayer," 2017.
[3] Mohit Rane et al, "Design of semi-automated areca-nut tree climbing plucker", May 2019
[4] R. Gokulraju et al, "Areca-nut tree climber," 2017.
[5] S. M. Arun Kumar et al, "Removing the bunch of areca-nut from the plant and spraying of pesticides by using remote operated device," August, 2020.
[6] T. K. Fasil et al. "Remote controlled arecanut plucking machine," April 2018.
[7] J S. Basavaraja et al., "Design and development of areca tree climber," November 2010.
[8] A. Prasad et al., "wireless palm tree harvester," March 2016.