

MOTORIZED ARECANUT CLIMBER AND PESTICIDE SPRAYER

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ABSTRACT: Motorized Arecanut Climber and Pesticide Sprayer is a machine is used to help our arecanut farmers for cutting arecanut from tree and also spraying pesticide on tree. Agriculture is one of the major sectors of Indian economy. Of many cash crops produced in India, areca nut is the most important one. Especially in the rainy season, the areca nut attacked by the fungus at the tree top. Tree climbing is risky job during monsoon. Hence an attempt is made to design and fabricate unit that serves this purpose. It contains 2 rollers. It mounted on the slot of supporting beam. The upper roller is freely rotated and the down roller is drive by motor. And we use a wiper sprayer used in four wheelers. First we fixed the machine according to the picture. Then we connect the motor to battery and rotate the motor and the machine climbed up. The movement of up and down of machine controlled by the controller. And then the arecanut is cut by the needling the picture by the upward movement of machine. Using that force we cut the arecanut . UP and DOWN motion and the rotation of machine is controlled by the remote control or mobile app .And for spraying we control our sprayer by mobile app.

INTRODUCTION

GENERAL

Areca nut known by its biological name Areca catechu, is a species of palm tree which mainly grows in tropical Pacific region, south East Asia, Indian subcontinent and parts of eastern Africa. Areca nut known by its biological name Areca catechu, is a species of palm tree which mainly grows in tropical Pacific region, south East Asia, Indian subcontinent and parts of eastern Africa. It is a medium-sized tree, growing straight up to 20-meter-tall, with a trunk diameter varying from 10–15 cm. The leaves are 1.5–2 m long usually present in the top region of the tree. The tree bark is usually narrow and grows vertically, with a medium soft trunk and isn't rough like other tree out barks. The trunk diameter varies constantly from the bottom narrowing towards the top. In recent years, non- availability of labors has emerged as one of the biggest challenges in farming. One crop that has been most affected by this is the areca nut. Arecanut trees attain a height of about 60-70 feet. It is mandatory to climb the trees a minimum of five times a year for a successful harvest - twice for the preventive spray against fungal disease, and thrice to harvest

the areca nut. Koleroga is another such disease prevalent in high rainfall regions. This disease assumes intensity during south- west monsoon causing heavy damage to the crop. Bud-rot, food rot, stem breaking, inflorescence die- back, stem bleeding are other diseases which affect areca yield and cause damage in varying degrees. Yellow leaf disease has been causing much damage to areca nut. This disease is categorized by the yellowing of leaves of leaves. As a result, there is reduction in the size of leaves and nuts, tapering of the stem and mature nut fall occurs. It is estimated that about 35- 40 % of areca plantation in Kerala has been affected by this disease. In addition to the diseases mentioned above areca nut are also affected by many pests and insects. Therefore, in order to prevent the above-mentioned problems pesticides are sprayed frequently to the Arecanut. This also solves labor problem. Also, it reduces the wastage of pesticides. The farmers are exposed to the toxicity of pesticides and suffer from pesticide poisoning which range from skin irritation to coma or even death.

TRADITIONAL METHODS AND COMPARISON

In olden days' farmers used to manually climb the trees till the

top and spray pesticide to the areca nut bush. After spraying pesticides to the Arecanut they would jump to the adjacent tree. This is a very risky job as the tree climbers could slip and fall down and meet with serious injuries. Moreover, the tree climbers also do not have any kind of medical insurance, this only worsens the problem. In modern days' farmers use mechanical pump or electric pump to spray pesticide to the Arecanut. First the farmer has to climb the tree halfway and then use a nozzle to spray pesticide to the Arecanut. This method is less risky than the previous one. But this method consumes a lot of time and lot of pesticide is wasted as all the pesticide does not reach the Arecanut. Therefore, a prototype electric robot is developed which climbs the tree for the required height, cut the Arecanut and spray pesticides more quickly and efficiently without wasting pesticide.

LITERATURE REVIEW

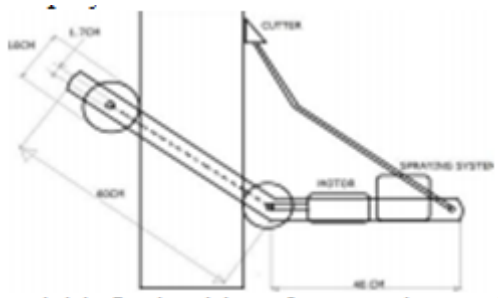
Mani A, Jothilingam A [1] discussed about the development and fabrication of a tree climber and harvester. It consists of two mechanisms. One for climbing and another for harvesting. They designed an octagon shaped chassis where wheels at specific intervals were provided. The proposed design by Mani and Jothilingam had the location of center of mass of the device outside the tree and it fused both spiral and straight climbs. An arm was provided in order to fulfill the harvesting requirement. The bunch of nuts is located by a camera which is fixated to the arm. The cutting is done by a saw after a clear view of the nuts is obtained. The entire mechanism was controlled by remote control. They discussed about the hardware setup and controlling units were designed. Rajesh Kannan, Megalingam, R Venumadhav, Ashis Pavan K, Anandkumar Mahadevan, Tom Charly Kattakayam, and Harikrishna Menon T, [2] analyzed various models of climbing and harvesting devices. Safety, reliability, ease of use, cleaning the tree tops, spraying pesticides were given prior importance. They designed a system that can be controlled by anyone. The designed prototype responds to human gestures with negligible gap in the response time. A prototype of the arm was designed and tested against human gestures and found successful. Their machine was designed to consume less power, so longer working hours doesn't affect the power consumption.

P. Mohankumar, D. Anantha Krishnan and K. Kathirvel, [3] discussed about the ergonomical parameters and ergo refinements of their design model. They designed two models and selected one through trial and error testing on basis of lower physiological cost, safety and discomfort. The inclination of the upper frame of climbing device is increased with respect to the horizontal, while moving towards the top. This resulted in unstableness and insecurity of the labor. A design of tree climbing robot was presented by Rahul V, Sebin Babu, Sameer Moideen CP, Vineeth VP, and Nikhil Ninan [4]. They used three linear electrical actuators - two for gripping and one for vertical up and down motion in their climbing device. They analyzed the model and found the design to be safe. Their climbing mechanism is very similar to a man climbing a tree. They tested their prototype under real life conditions and suitable changes were incorporated. In their paper, "Semi Automated Tree Climber", they discussed about the possibilities of modifying this device Justin Gostanian, Erick Read [5]", discussed about the design, construction, and testing of a robot to climb trees to detect Asian Longhorn Beetle infestation. The primary goal was to design and build a robot that could successfully climb a tree. After researching existing climbing robot designs, a robot prototype was built using concepts from the existing designs. The prototype was then tested to determine the effectiveness of the design. The prototype proved to be partially successful, being capable of gripping a tree and staying on, but could not move. Though not entirely successful, the project identified many important aspects in a tree climbing robot's design. Salice Peter, Jayanth M, Arun Babu M.K, Ashida P.V, Akhil K.T [6] focused on designing a tree climbing robot. Their prime consideration in designing tree climbing robot is of the motion planning and method of gripping. The design has 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 result shows that it can successfully climb the trees. Tree climbing robot has the potential to be applied to various pursuits, such as harvesting,

tree maintenance, and observation of tree dwelling animals.

METHODOLOGY

Parts of machines are Supporting Rod, 2 rollers, 12 v dc wiper motor, remote control system, 12v dc battery, sprayer system and a cutting system It contain 2 rollers. It mounted on the slot of supporting beam. The upper roller is freely rotated and the down roller is drive by motor. And we use a wiper sprayer used in four wheelers. Fist we fixed the machine according to the picture. Then we connect the motor to battery and rotate the motor and the machine climbed up. The movement of up and down of machine controlled by controller or mobile app. And then the arecanut is cut by the needilein the picture by the upward movement of machine. Using that force we cut the arecanut and it go to ground. And for spraying we control our sprayer by remote controller. And a supporting wheel is used under the device It use simple method to climb the Arecanut Tree and cut the Arecanut and spray the



Pesticide. It should perform on the tree by the control of a man in ground itself. It should be affordable. It should be light in weight. It should be easily detachable from the tree. It should be portable. It should be fast cutting device it contain a supporting bar. It is hollow bar and it hold shaft of roller and hold motor .It is made up of steel .it hold the motor, battery, spraying system, wheel and whole system. And also the cutter is fixed on it. The roller assembly consists of two rubber wheels mounted on the shaft wheels of 100mm outer diameter is used .The wheels are fixed to the aluminum shaft of 17mm diameter These roller assembly is mounted on the slots provided in the supporting beam. The upper roller are freely rotated and the down roller is drive by motor .The motor we are using is a low speed DC motor .it is a 12 VOLT, 4AMP motor having a speed of 40RPM. .Weight of the motor is 1kg .The motor is connected to tyre by a shaft. When the motor

rotated then the wheels also rotated and the machine climb upward. The motor is connected to mobile app and it connected to battery, here we use wifi for wireless connection

PARTS

MOTOR

Two motor are used in this machine, in which 1 motor are used to drive the wheels, other 1 motors are used to controlling the nozzle attachment for spraying pesticides. The DC motor used to drive wheel is square geared DC motor. It is the heart of the setup. It is the main source through which torque is generated. It provides the very essential torque for the setup to climb up and come down along the length of the tree. Specifications are given below;



- Operating voltage: 12V
- Speed: .55rpm
- Running current: 2A
- Power: 120W
- Torque: 42.5 kg-cm

NOZZLE MOTOR AND PUMP

Nozzle motor is used to control The nozzle attachment for spraying purpose. Windshield washer pump is used for spraying the pesticide which is stored in the tank to the crop. The pesticide is being transported from the tank to the nozzle with the help of plastic tubes. The specification of nozzle motor is listed below.

- Weight = 125 grams
- Diameter (shaft) = 6mm
- No-load current = 60 mA (Max)
- Speed = 10rpm
- Torque = 12 kg-cm
- Load current = 300 mA (Max)



WHEELS

This is the part of the machine which will be in direct contact with the tree. The wooden rollers are connected to the shaft of the DC motors and are rotated by supplying powers these motors. The machine ascends to the required height to perform the required job. By rotating the rollers in opposite direction, the robot is made to descend. The diameter of the rollers is 9 cm and length is 20 cm. To create friction between the rollers and the tree, the rollers are covered with rubber. Generally, for gripping purpose natural rubber is used. For special purpose and working in very hot temperatures Nitrile rubber is used. The rubber used for rollers are made from natural rubber. The Natural Rubber is having high carbon contents which will give the rollers tight bonding nature and having the ability of high resistance to wear and tear. In this machine three driving wheels are used. Driving wheels are machined from nylon rods having diameter of 100 mm which is used to provide firm grip and also to operate the machine so that it climbs the tree easily. And inner diameter of 17 mm



With their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors. Large format lead–acid designs are widely used for storage in backup power supplies in cell phone towers, high-availability settings like hospitals, and stand-alone power systems. For these roles, modified versions of the standard cell may be used to improve storage times and reduce maintenance requirements. Gel-cells and absorbed glass-mat batteries are common in these roles, collectively known as VRLA (valve-regulated lead–acid) batteries



SUPPORTING BAR

It contains a supporting bar. It is hollow bar and it hold shaft of roller and hold motor .It is made up of steel .it hold the motor, battery, spraying system, wheel and whole system. And also the cuttrr is fixed on it.



CALCULATIONS

FORCE CALCULATION

Weight of the machine, $W = 8 \text{ kgs}$

$$W = 8 \times 9.81$$

BATTERY

The storage battery or secondary battery stores electrical energy as chemical energy and this chemical energy is then converted to electrical energy as and when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of the secondary battery. During charging of battery, current is passed through it causing chemical changes inside the battery which absorb energy during their formation. When the battery is connected to the external load, these changes take place in reverse direction, during which the absorbed energy is released as electrical energy and supplied to the load. The **lead–acid battery** is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to volume ratio, its ability to supply high surge

currents means that the cells have a relatively large power-to-weight ratio. These features, along

$$W = 78.48 \text{ N}$$

Assuming Co-efficient of friction between tree and rubber

$$\text{grip, } \mu = 0.3$$

Actual Force to be lifted, $F=W/\mu$

$$F= 78.48/0.3$$

$$F = 261.6 \text{ N}$$

B. TORQUE CALCULATION

Calculating motor torque,

$$\text{Torque [Nm] = Mass [Kg] } \times \text{ g } \times \text{ Radius [m] Torque} = 8 \times$$

$$9.81 \times 0.045$$

$$= 3.5316 \text{ Nm.}$$

$$= (3.5316 \times 100) / 9.81$$

$$= 36 \text{ kg cm.}$$

C. POWER CALCULATION

$$\text{Power} = (F \times v)$$

$$\text{where, } v = (\pi \times D \times N) / 60$$

$$= (\pi \times 0.09 \times 75) / 60$$

$$= 0.353 \text{ m/s.}$$

$$= 261.6 \times 0.353$$

$$= 92.345 \text{ W}$$

COST ANALYSIS

a remote control. The project concludes that the arecanut tree climber and pesticide sprayer is a

ADVANTAGES

This project aims at replacing conventional methods of spraying, which are dependent on labourers, with a more cost effective and environment friendly system, dependent on electricity. The robot is compact... The robot is user friendly and a person with little technical knowledge can assemble it in an ordinary workshop. It reduces time and dependence on labor. This is the most suitable machine without man climbing on the tree. This robot is attached and removed easily to the tree. This robot is operated from a safe distance without exposing the farmer to the harmful effects of pesticide.

PART	NO.OF UNITS	COST IN RS.
Steel Bar		300
Tyres	6	500
D.C Motor	1	700
Spraying Unit	1	300
Remote Control System	1	1500
Battery	1	500
Kappi		200
Machining And Other Costs		500
Total		Rs 4500/-

CONCLUSION

After testing the machine on the arecanut tree, it has been found that, the design is efficient in climbing the tree very smoothly without damaging the tree. The climbing mechanism and spraying unit was working according to the requirement. The design is simple and appealing to the majority. An unskilled labor can also operate the machine safely and efficiently. Arecanut tree climber and pesticide sprayer is a unique model which serves as a great help and boon to arecanut farmers. The arecanut tree climber and pesticide sprayer has been tested on an arecanut tree with satisfactory results. The innovative component of the developed robot is the 'X' frame with two conical rollers at the bottom and the ability of the sprayer to spray pesticide with a good level of accuracy without wasting pesticide solution. Arduino Uno is used for programming which is a cost-effective device. A farmer with little or no technical knowledge can easily operate the robot from the ground with safe, reliable, efficient robot and reduces the risk involved in manual climbing and spraying to a great extent.

FUTURE SCOPE

The future improvements for this project are as follows: -

Lowering the weight. Computer vision can be added to identify the healthy arecanut. The process of spraying pesticide can also be made fully automatic using image processing sensor. Wheels with better frictional co-efficient can be designed.

REFERENCES

- [1] Mani A, Jothilingam A, "Design and Fabrication of Coconut Harvesting Robot: COCOBOT", International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 3, March 2014
- [2] Rajesh Kannan, Megalingam, R Venumadhav, Ashis Pavan K, Anandkumar Mahadevan, Tom Charly Kattakayam, and Harikrishna Menon T, "*Kinect Based Wireless Robotic Coconut Tree Climber*", 3rd International Conference on Advancements in Electronics and Power Engineering, January 2013
- [3] P. Mohankumar, D. Anantha Krishnan and K. Kathirvel, "*Development of ergo refined coconut tree climbing device*", African Journal of Agricultural Research, Volume 8, November 2013
- [4] Rahul V, Sebin Babu, Sameer Moideen CP, Vineeth VP, Nikhil Ninan, "*Semi automated coconut tree climber*", International Journal of Research in Engineering and Technology, November 2014
- [5] Justin Gostanian, Erick Read, "*Design and Construction of a Tree Climbing Robot*"
- [6] Salice Peter, Jayanth M, Arun Babu M.K, Ashida P.V, Akhil K.T, "*Design and Construction of a Tree Climbing Robot*", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 4, April 2015