

Design and Fabrication of Pneumatic Coconut Tree Climber and Harvester

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Abstract – In ancient days population is very less, so that cultivation and harvesting of coconut is low. Gradually increasing population leads to increasing in cultivation and harvesting of coconut is very large number. Coconut picking from coconut tree is a tough, arduous work. It is one of the high risky job. The farmers in all countries are facing unsafe activities due to shortage of skilled workers for harvesting. We have designed and fabricated a pneumatic coconut tree climber and harvester. The pneumatic system for tree climbing and electrically operated cutter for harvesting is used. They can be safely operates from ground.

Key Words: pneumatic double acting cylinder, DC gear motor, clamp attachment, cutter.

1. INTRODUCTION

The coconut palm is essentially a tropical crop. Every part of the coconut is useful. The outer part of coconut husk for manufacturing of strong ropes, and then leaves as roofing material. Inner coconut water is sweet, delicious and healthy drink. Moreover, they used as medicine for diseases like thyroid.

Coconut cultivation is one of the major agriculture activities in the southern part of India, so a better study and development of equipment's for the safer of harvesting required. To avoid the risk harvesting practice of coconut climbing of labors by manual climbing used machine climbing methods is necessary. Therefore, to make the coconut tree climbing equipment suitable for the workers.

Coconut palms are cultivated more than 75 countries of the world, with a total production of 60 million tons per year. Coconuts are origin from "Arecacea" family, called as palm family; it consists of about 250 genera and 2600 species.

Many countries exported coconut all over the world, main revenue was depend on the coconut cultivation. India produces and export about 25% of the world's coconut meat and fiber, are used for eating or made into natural soap, coconut oil, herbal shampoo, rope, and door mats. The integral part nut is also of Indian culture, where used in religious ceremonies, ornamentation and decorative item in Hindu weddings. Nearly half of India's harvest are produce in Kerala. More over state name in a Malayalam-language combination of the words for "coconut" and "land".

Primitive methods of collection of coconut need for a new device. Experienced climber had taken about 3-4 minutes for climbing operation, 4-5 minutes for cutting and 3-4 for grounding therefore averagely it need 10-15 minutes for one tree harvesting. In some developed areas, methods of harvest and coconut picking involving rope-climbing gears and spiked shoes, but they are not safe and in efficient for use in large scale harvesting. Example in the Indian state of Tamil Nadu, a climber makes Rs.40-50 per tree. Therefore, coconut picking in unsafe condition were danger and economically low salary to person it is very risky activity to work at height situation.

Traditional idea of "man's job" in coconut harvesting extremely strenuous. [1] Advanced remote controlled coconut harvesting robot used various arm to climb and harvesting the coconut but cost of the ARCH is more. [2] In coconut tree climbing device they have use two types of technique (I) sitting type climbing device (II) standing type climbing device but both of them were handled manually and fall from height risk is also available. [3] semi-automated areca nut tree climbing and harvesting robot in that hexagonal frame is newly introduced and fixed with motor to climbing the setup and harvesting is done by c-clamp by rotating the clamp by adjust motor to the correct position. [4] Coconut harvesting machine in that same hexagonal shape frame fixed with dc motor and adjustable spring to lock position during climbing and harvesting carried out by dc motor. [5] Coconut harvesting robot: COCOBOT some special design to hold weight and complicated mechanism for climbing and harvesting. [6] Semi-automated coconut tree climber used the gripper mechanism for climbing it is only tree climber. [7] Automated coconut harvester prototype used motor and wheel for the climbing and harvesting.

2. OBJECTIVES

Goal of this study is to design a coconut tree climbing and harvesting coconuts for farmers. It is very difficult to climb on coconut tree manually due to the cylindrical unshaped structure and single stem. Other type of trees there are many branches for holding and help the climber. A professional climber with adequate training only could able to climb a coconut tree.

Currently in the market there is no any 100% safe coconuts harvesting device. We have selected the project to reduce risk for human and harvest safety.

3. MATERIAL USED

1. Pneumatic double acting cylinder (big)
2. Pneumatic double acting cylinder (small)
3. 5\3 direction control valve
4. Air connector
5. Pneumatic pipe
6. 60 RPM dc gear motor
7. 10 RPM dc gear motor
8. Mild steel pipe
9. Cutter
10. On-Off switch push button

Table -1: Specification of pneumatic double acting cylinder (BIG)

Name	Specification
Action	Double acting cylinder
Rod	Single
Bore	63 mm
Stroke	200 mm
Pressure	7 bar
Return stroke	1962 mm
Outward stroke	2182 mm
Cushioning type	Air
Length	595 mm

Table -2: Specification of pneumatic double acting cylinder (SMALL)

Name	Specification
Action	Double acting cylinder
Rod	Single
Bore	20 mm
Stroke	100 mm
Pressure	10 bar
Cushioning type	Air
Length	37 mm
Operating temperature	70°C

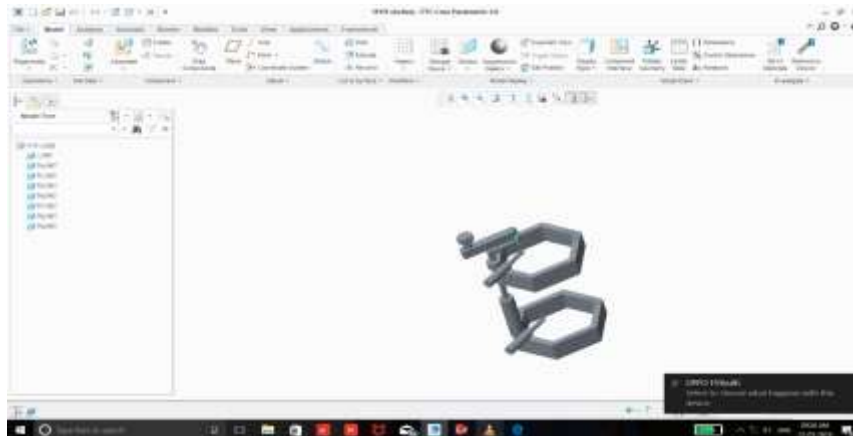
Table -3: Specification of 5/3 direction control valve

Name	Specification
Port	1/8"
Voltage	220 V
Voltage range	187 V-253 V AC
Housing	Aluminum
Function	5/3 way
Operation	Indirect
Minimum pressure	1.5 bar
Maximum pressure	8 bar
Mono/bi-stable	Mono stable
Maximum temperature	50°C
Power	2.8 W

Table -4: Specification of 60RPM DC gear motor

Name	Specification
DC supply	4 V-12 V
RPM	60
Brush type	Precious metal

4. DESIGN



5. CALCULATION

5.1 Pneumatic Cylinder (BIG)

Extension force $E = P * AP$

P – Pressure

AP – Area of piston

AR – Area of piston rod

$E = P * AP$

$E = 7 \times 10^5 \times \frac{\pi}{4} \times 0.0632$

$E = 2182 \text{ N}$

Retraction force $R = P * (AP - AR)^2$

$R = P * (AP - AR)^2$

$R = 7 \times 10^5 \times \frac{\pi}{4} \times (0.063 - 0.020)^2$

$R = 1962 \text{ N}$

5.2 Pneumatic Cylinder (SMALL)

Extension force $E = P * AP$

P – Pressure

AP – Area of piston

AR – Area of piston rod

$E = P * AP$

$E = 5 \times 10^5 \times \frac{\pi}{4} \times (0.020)^2$

$E = 157.07 \text{ N}$

Retraction force $R = P * (AP - AR)^2$

$R = P * (AP - AR)^2$

$R = 5 \times 10^5 \times \frac{\pi}{4} \times (0.020 - 0.005)^2$

$R = 147.26 \text{ N}$

6. FABRICATION

Here we discuss about the fabrication of the pneumatic coconut harvester. The important thing is a clamp because they will be a carry the whole equipment. The clamp has enough strength to withstand the weight. Therefore, we had taken square pipe of dimension 0.0254 x 0.0254 m we cut them and joint them together to form a hexagonal structure we used MIG welding to joint together. The upward and downward motion is achieved by the double acting cylinder (Big) is attached with the clamp. We fixed two DC gear motors on the clamp for angle achievement and connected two DC gear motors with the mild steel tube. At top portion, we fixed another DC motor for cutting operation. The figure shows the cutter attachment.



Fig -1: Cutter attachment

7. WORKING OF PNEUMATIC HARVESTER

7.1 Pneumatic Harvester

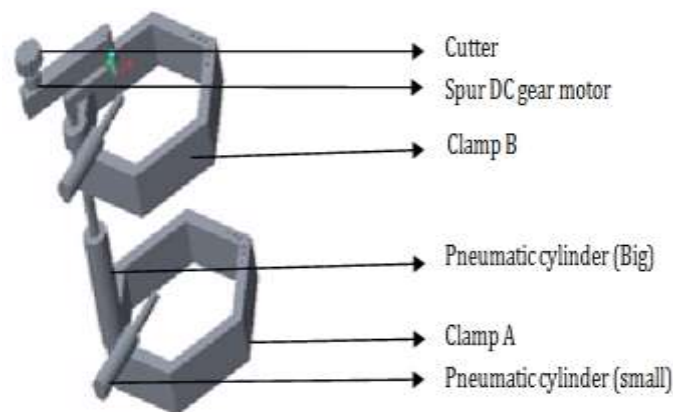


Fig -2: Pneumatic harvester

7.2 Tree climbing

Attached the coconut harvester on the tree by closing the both clamp. The pneumatic cylinder of 63mm bore diameter carry the whole weight of the harvester another two pneumatic cylinder of 20mm bore diameter help for the climbing motion by alternating. Attachment 2 DC spur gear motor help for the angular achievement DC motor is attach with the cutter for cutting.



Fig -3: Pneumatic harvester during tree climbing

7.3 Upward motion

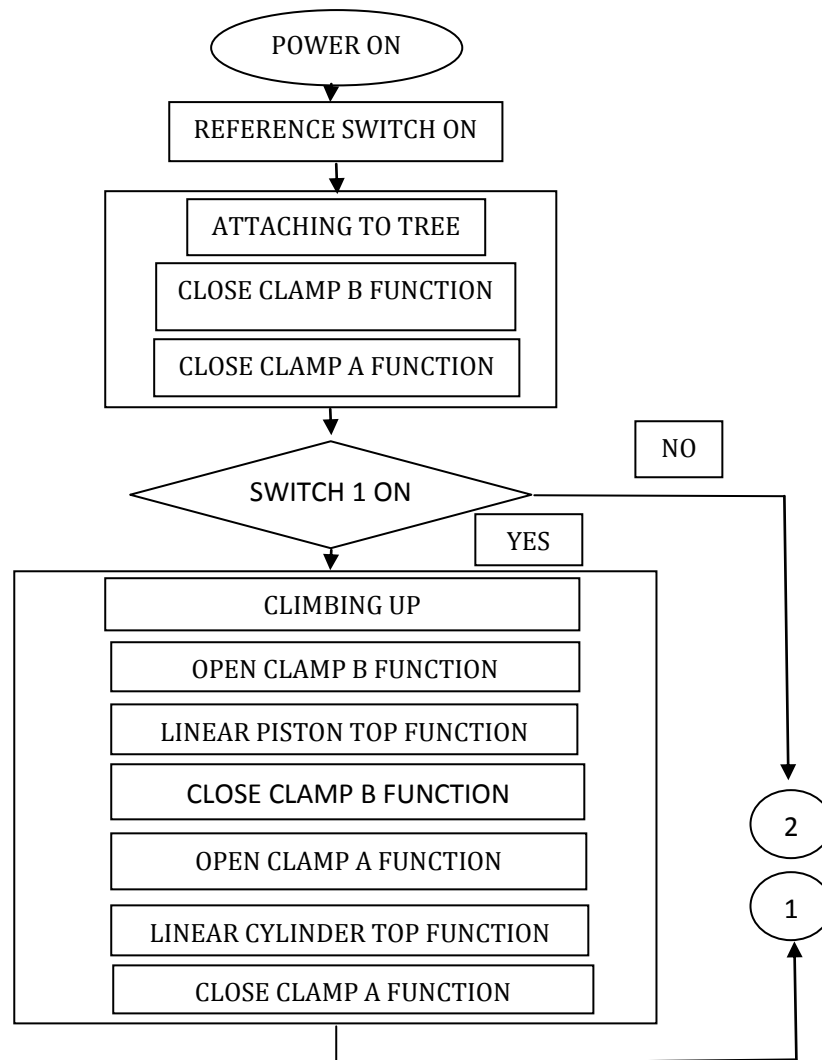


Fig -5: Upward motion flow chart

7.4 Cutting operation

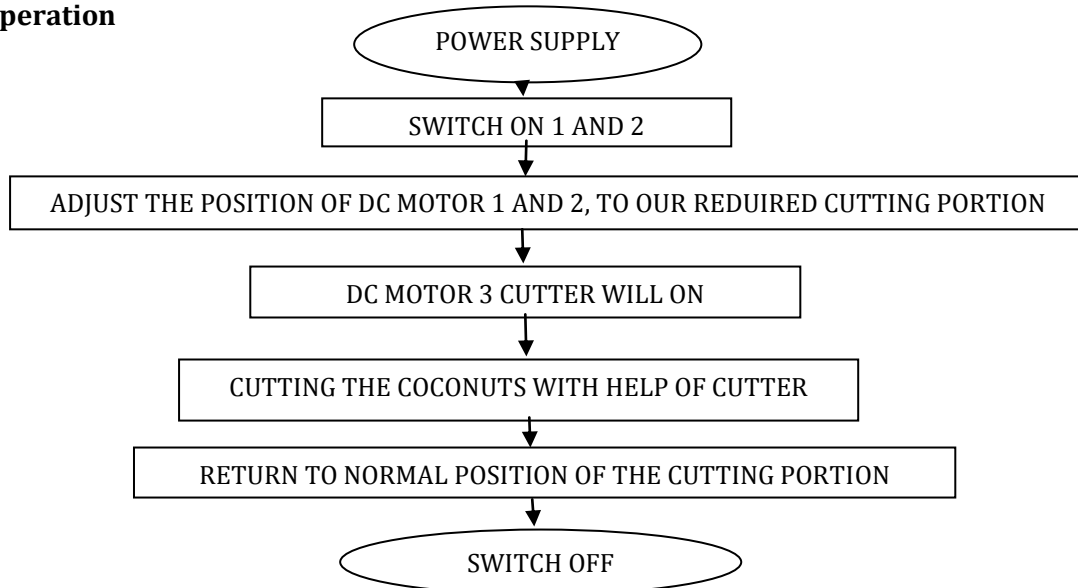


Fig -6: Cutting operation flow chart

7.5 Downward motion

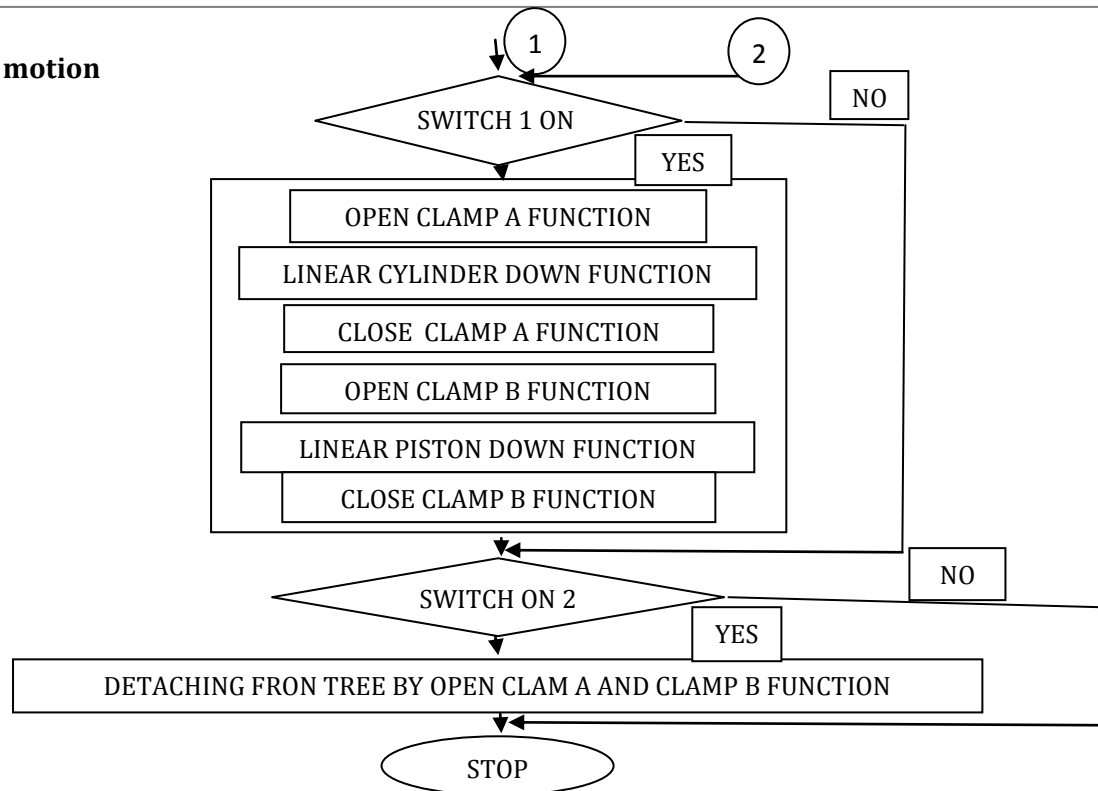


Fig -6: Downward motion flow chart

8. RESULT AND DISCUSSION

The diameter of the clamps can be adjusted according to the dimension of the tree the compressed air is supplied to a direction control valve by adjusting the direction control valve air enter into pneumatic cylinder and reciprocate piston to move. Another two cylinders are used to holding the tree and used for climbing motion DC gear motors are fixed to angle adjustment cutter is more sharp and fixed with DC motor with continues high RPM cut coconut from tree easily.

9. CONCLUSIONS

The project “**DESIGN AND FABRICATION OF PNEUMATIC COCONUT TREE CLIMBER AND HARVESTER**” was designed and fabricated. The project is more useful for farmers as it provides safe harvesting of coconut from the ground without climbing, which would result in mass protection of coconuts. The structure will be beneficial for middle class families with its affordable cost. Using this pneumatic harvester will improve efficiency of harvesting. It is economical as low cost materials are used; majorly that consider about work at height situation it will also reduce worker’s risk. This type of project may help the youngsters to do more projects relevant to agriculture, which would make the agriculture safer, easier and quicker.

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