DESIGN AND FABRICATION OF COCONUT TREE CLIMBING EQUIPMENT

PROJECT REFERENCE NO: 38S0308

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INTRODUCTION:
In olden days most of the activities were done manually. Nowadays most of the activities which include human efforts are either replaced or automated by the use of machines or other kind of equipments. One such approach is being given in the area of Cultivation and Harvesting of Coconuts. Coconut plantation being one of the major agricultural activities in the southern part of India, a better study and development of equipments for the ease of harvesting are required. In case of these trees, the height and absence of branches makes it very difficult to climb on them. This activity is traditionally carried out by the socio-economically backward communities, where men are trained in the art of climbing trees rapidly and plucking the coconuts or spraying pesticides. Considering this scenario, a device which will help the user to climb coconut tree easily will be useful for the people who are having large coconut cultivation as well as residents with less coconut trees. This kind of devices will encourage more people to come forward to agricultural sector.

The coconut palm is essentially a tropical crop. Appropriately referred as “The Tree of Life” by villagers, every part of the coconut is utilized in one or the other way. The outside husk is used to make strong ropes, while the leaves of the tree are used as roofing material in villages. Tender coconut water is a delicious and healthy drink. More importantly, tender coconuts are used as a medicine for diseases such as thyroid.
Coconuts are exported around the world in huge numbers, bringing revenue to various tropical countries. Total world coconut area in 2012 was estimated at 11 million hectares and around 93 percent is found in the Asian and Pacific region.

Systematic efforts to evaluate agronomical harvesting practice of coconut climbing of labors by manual climbing and machine climbing methods is necessary. Therefore, to make the coconut tree climbing equipment suitable for the workers, due attention needs to be given to their capabilities and limitations while designing.

Therefore, certain attempts have been made by us to do the same by designing the tree climber.

OBJECTIVES OF PROJECT:

- The idea is to make a device which does not use Electrical energy but a device completely depending on mechanical linkages
- Provide an alternative to the existing methods of climbing.
- To tackle the problem of unavailability of coconut tree climbers for coconut farming and plant protection activities

METHODOLOGY:

The Principle of working is based on the fact that if a certain minimum friction between the tree trunk and wire rope is achieved then it will help in adhering to the tree with the help of a wire rope. This adherence is dependent on the weight of the climber and the reaction from tree for that particular weight.
Let, $A$ - Point of contact of gripping aid with trunk,

$\alpha$ - The inclination of frame with respect to horizontal, 45 degrees.

$W$ - The load due to weight of climber on the frame,

$S$ - Horizontal distance between $A$ and point of action of CG ($W$) of climber,

$R$ - Reaction force exerted by tree,

$E$ - Vertical distance between the centres of gripping aids,

$\mu$ - Coefficient of friction of surface of trunk with steel wire

$D$ - Dia. of tree trunk, found to be 300mm mean value.

Taking the moment about $A$,

$$W \times S = R_t \times E$$  

For stability of frame without slipping, the frictional force experienced by the gripping aids ($R_t$) should be more than the vertical component of weight of climber ($W$).

**WORKING:**
In the construction, the user has to stand and operate the device. Initially the steel rope wires of both left and right assemblies has to be looped with the tree and has to be locked to the arrangement provided to the foot rest. Then the user can stand by placing foot on both assemblies. As the user lift the assembly by foot the steel rope will get loosened and when he pushes back with foot it will get tightened, by this process the user can climb to the tree easily.

To go down the user has to loosen the loop by raising his leg and pulling the handle, then he has to move down the device to a particular distance. From there the loop has to be tightened by pushing the leg downwards. For easy climbing, the body posture has to be kept straight. The height of the equipment can be altered according to the convenience of the user. Also the equipment can be disassembled easily by removing the locking screw, which will help the user to transport the equipment easily from one place to another.

**ISOMETRIC VIEW OF 3D ASSEMBLY**
## COMPONENTS OF THE DEVICE:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper frame (Solid)</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Lower frame (Hollow)</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Sliding frame</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Helical tension spring</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>U- Type Bolts with nuts</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Locking screw</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Steel rope wire (6x19)</td>
<td>12m</td>
</tr>
<tr>
<td>8</td>
<td>Safety harness</td>
<td>1</td>
</tr>
</tbody>
</table>
FABRICATION:

1) Upper frame (Solid)

   Material: Mild Steel

   Operations: Drilling, Bending, Tapping and Welding.

   A 15mm diameter solid MS rod was purchased. It was cut into 4 pieces of 600mm each. On each rod 4 holes of 5mm diameter each were drilled at a distance of 50mm from the bottom. After drilling, tapping of 6mm diameter was done in the holes. With a solid plate of 5mm thickness, 2 plates of L shape were cut and holes were drilled in them. In this plate the top most hole in the centre is for attaching the spring and other holes are for locking purpose. Taking another 4 plates from the sheet of 120mm length, 2 holes of 8mm diameter were drilled in each plate. These plates are for fitting the U-type bolts. These plates were welded to the rods by arc welding. Thin rods were bent and welded near the handle for two different purposes, one is for guiding the steel wire rope and other is to hook the safety belt.

2) Lower frame (Hollow)

   Material: Mild Steel

   Operations: Slotting, Drilling, Bending and Welding.

   A hollow MS rod of outer diameter 20mm and inner diameter 16mm was purchased. It was cut into 2 pieces of 400mm each. A slot of thickness 6mm was done on the rods up to a length of 270mm from the top end. The slotting is provided for the sliding of L shape plate. On each rod, 2 holes of 6mm diameter were drilled at a distance of 50mm from the top end. Further, welding a thin flat plate was at the bottom end, maintaining a distance of 118mm between the 2 rods for maintaining constant separation. Another rod was bent as a semicircle as a support for the equipment in the lower frame and was welded to it.
3) **Sliding frame (Solid)**

   **Material:** Mild steel

   **Operations:** Drilling, Bending, Welding, Riveting.

   A solid MS rod of 10mm diameter was purchased. It was cut into 4 pieces of 470mm each. 120mm length of the rod was bent at 90 degrees at the bottom for the purpose of foot rest. 4 rods of length 340mm were cut and bent them as per required shape for sliding on main frame. Next, welding of the 2 rods was done horizontally at a distance of 220mm from each other on the other vertically placed rods of 470mm. The locking system for the steel wire rope is welded in the sliding frame at a distance of 25mm from the upper horizontal rod. A small metal part with a hole of 6mm diameter is welded at the upper horizontal rod to hook the spring.

4) **Helical Spring**

   **Material:** Spring Steel

   **Operations:** Drawing, Cold forging, Hardening, Tempering.

   A spring of 3.2mm diameter was purchased.

5) **Steel Rope Wire**

   **Material:** Steel

   **Operations:** Drawing, Strandng, Closing, Clamping.

   A steel wire rope of specification 6*19 of length 12m was purchased.

6) **U-Type Bolt**

   **Material:** Mild Steel

   **Operations:** Turning, Welding, Bending, Cooling, Threading.

   A solid MS rod of 10mm diameter was cut into 4 pieces of 265mm length each. Turning operation was carried out to obtain rod of 8mm diameter. Threading of 6mm was done at the ends of the rod for a length of 50mm. These rods were bent into U shape with the help of gas flame.
CONCLUSION:

The project “DESIGN AND FABRICATION OF COCONUT TREE CLIMBING EQUIPMENT” is designed and erected.

The machine is built by following the natural phenomena present before us. Machine works on timely gripping and release of the tree by the two metal wire ropes locked to the moving frame. By this design, the structure is able to carry a load of 100kg and anyone can use it easily. At the beginning it is time consuming but with continuous use and practice it will reduced the time required for the Climbing. It is flexible to change the height of the equipment up to 100mm according to the requirement of the user. It has easy maintenance. This structure will be beneficial for middle class family with its affordable cost.

The design and erection of this equipment involved a great deal of effort to make the project successful and useful.

We conclude the project on “DESIGN AND FABRICATION OF COCONUT TREE CLIMBING EQUIPMENT” will be very useful in the field of agriculture.

FUTURE SCOPE:

Our project has been to bring together both simplicity & safety, along with comfort to the user of the machine which is the duty of every engineer. The end result of our effort has resulted in the development of “Coconut tree climbing equipment”.

We feel the project that we have done has a good future scope. Benefits resulting from the use of this device will make it pay for itself within a short period of time & it can be a great companion for any agriculturalist. The device affords scope for modifications and further improvements. The weight of the equipment can be reduced by the use of alloys or composite material. It can be automated. Also better safety accessories can be thought of and included along with the equipment.