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Numerical analysis & fabrication of coconut peeling machine

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Abstract : The study has been undertaken to design and fabricate economical coconut peeling machine to remove husk from green young coconut. As the coconut is the necessary part of the daily life of many peoples across the world. Different parts of coconut used as flesh used for food, milk, and flour. Coconut water used as a healthy and refreshing drink and oil for cooking, skin and hair. But for the convenient use of coconut after harvesting from farm de-husking operation is important for the reduce transportation cost. The existing methods are manual, hydraulic operated and pneumatic operated machines. Which has high cost to overcome these limitations proposed system consist lever operated coconut peeling machine. This model consists ac motor as a power source upper and side peeler to trim coconut and lever to feed the husk.

IndexTerms **- AC Motor, Peeling, Upper Peeler, side Peeler, Lever.**

I. INTRODUCTION

Coconut is produced in across the 93 countries of the world, with the production of 54.9 billion tons per year across the world. The common problem in many countries like India was to de-husk the fruit for the convenient utilization. The existing methods for peeling of green coconut are using knife manually to peel the fruit. These methods cause injury to the operator and it is time consuming. To overcome these problems and make the operation economical proposed system consists lever operated coconut peeling machine. This machine consists lever operated upper peeler and lead screwed side peeler which trim the fruit from upper and side portion resp. The AC motor used as a main power source. This machine works on the principle of lathe machine which makes it efficient and economical for small scale industries and street vendors.

II. Methodology: - This project aims to study and analyzed the coconut peeling machine. Base will design to fix the frame; frame was rigid in which upper and side peeler are fixed.
The main power source used here is the motor. Which is fixed on the frame with the help of fastener nut and bolts.
1.The machine consists of two main parts: I. Frame II. Tools to perform the peeling operation.
I. Fixture: Use to hold the coconut which is operated manually by the lever mechanism. It is divided into two parts upper part having vertical linear motion and second bottom part being Rotating. These two parts hold the coconut operated by lever.
II. Tool: - The tool used for peeling: - There are two tools used to peel off the young coconut fruit. One is upper peeler and side peeler which used to trim the young coconut. These peelers having sharp cutting knife fixed with the help of fastening by nut and bolts.

III. Components: -
1.AC Motor 2. Main Frame 3. Upper Peeler
4. Shaft 5. Side Peeler
III. 1. AC Motor:- A single phase motor is used to drive the mechanism. This motor is generally used in various kinds of industrial drives. The motor acts as the driver wheel connected through shaft directly to the rotating fixture that acts as the driven wheel. The rotation speed of the output shaft of the motor is 800 RPM. The motor's output shaft is connected directly to the rotating fixture reduced the transmission losses. The motor bed is rigidly fixed onto the frame of the machine.

Fig: - 1. AC Motor

III. 2 Main Frame: - It consists of a mild steel frame that supports a manmade object in its construction and use, consisting of the frame (on which the components are mounted). This is used to provide support to the rotating part of the machine and absorbing reaction force of the fruit. It guide the motion of the tools and avoid the bending of the tool. For the construction of frame L shaped bars are used which is made up of mild steel.

Fig:- 2. L- Shaped Bars.

III. 3 Upper Peeler: - Upper peeler is a cutting tool of conical shape having sharp knife fastened with the help of nut and bolts. This

III. 4 Shaft: - A shaft is a rotating machine which is, usually circular in cross-section, which is used to transmit power from one part to another, or from a machine that produces power to a machine which absorbs power.

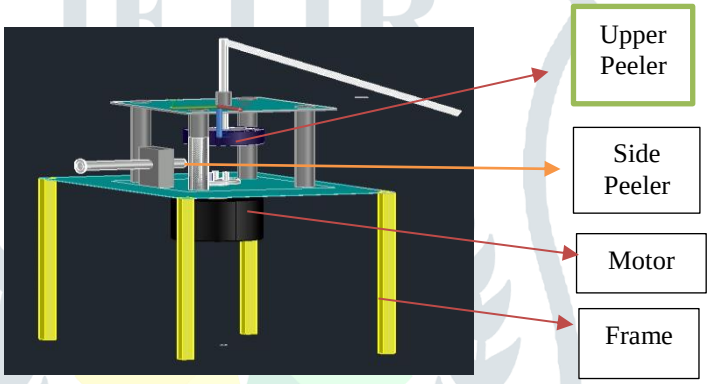

Fig. 3. 3D CAD Model of coconut peeling machine.

III. 5 Side peeler: - It consists of vertical sharp knife with sliding motion which is mounted on frame. This peeler aims to trim the fruit from circumferential part of the coconut.

IV. Design Calculations: -

Motor Specification: - Single phase AC motor, Power = ¾ HP = 551 watts, Speed = 800 RPM

Force Required: -

Maximum Total Force required: - $F=m\times g$ N

$F= 6.70\times 9.81$

$F = 65.727$ N

Total Torque Required = $T = F\times r$

$T = 65.727\times 0.05$

$T = 3.28635$ N-m

Actual Torque Required= $T=3.28635\times 2$

(Considering F.S. = 2)

$T= 6.5727$ N-m

Power Obtained= $\frac{2\times\pi\times N\times T}{60}$

$= \frac{2\times\pi\times 800\times 6.5727}{60}$

$P = 550.7$ Watt

From Design Data Book for Mild Steel,

- Density = $7850\ kg/m^3$
- Yield strength, σ_y = 378 MPa ,
- Ultimate strength, σ_u = 585 MPa,
- Young's modulus E = 210 GPa,
- Shear modulus, G = 81 GPa ,
- Poisson's ratio = μ = 0.3.

Design of Shaft:-

Assume, Factor of safety, F.S.= 2 to 4,

Working or Allowable normal stress, $\sigma = \frac{\sigma_y}{F.S.}$

$$\sigma = \frac{378}{2} = 189 \text{ N/mm}^2$$

Allowable stress in shear,

$$\tau = 0.5 \times \sigma = 94.5 \text{ N/mm}^2$$

Torque, $T = M_t =$ 6572.7 N-mm

General expression for torsion is, $\frac{M}{J} = \frac{G\theta}{I} = \frac{\tau}{r}$

For Strength, $\frac{M}{J} = \frac{\tau}{r}$

$$J = \pi/32 \times d^4$$

Therefore Diameter of the shaft, d= 13.03 mm

From Design Data Book: -

∴ Standard Diameter of Shaft = d = 14 mm

V. Fabrication of the System: -

Frame was constructed by welding the L angles. The frame has a base to hold the motor and Tool. The positions of the motor and Tools are fixed and fastened using bolts and nuts to the frame. The positions of the motor are fixed on the top of the frame and fastened using bolts and nuts. The cutting knifes are welded on the frame in such a way to peel the husk. The sharpened knife is spaced at a substantial equal distance. The patterned positions of the knife are positioned to peel the coconut and trim the fruit. High torque is attained by rotating the shafts at lower rpm. The knife provides a peeling action on the green husk, once trim into the outer layer of the coconut. The small pulley is mounted on the motor shaft upon which vertical spikes are welded to fix the coconut for peeling.

Now the drive is connected, and the coconut is placed on the shaft for peeling. While the traditional spike iron method can give a productivity of 50 nuts per hour, the fabricated machine can peel off around 70 nuts per hour. It can be operated by unskilled labors and the risk of injury to the labors is eliminated.

VI. Working: -

The project was initiated to design and develop a prototype of young coconut peeling machine. The main purpose of the design was to trim most of the outer husk of the young coconut (green husk) to create an attractive and hygienic looking trimmed green coconut (hexagonal shape) which could easily be cut open. The working of machine was based on lathe trimming mechanism which consisted of a pair of blades and bottom-up holder to clamp the young coconut. During operation, the young coconut was placed vertically at the lower fixture and clamped before the body and shoulder trimming. Power is on and supplies to motor for rotating coconut. When the fruit rotated, the operator adjusted the trimming blades to trim the body and upper part of the fruit. The rotational speed used for trimming the fruits can be adjusted accordingly the requirements. The prototype machine could trim 95 newly harvested fruits per hour when the rotational speed was set at 800 rpm. The percentage of defect was 5% and the knife had to be changed after every 30 nuts**.**

VII. ADVANTAGES

- Fast operation, less manpower requirement
- Nuts per hour high compared to pneumatic and hydraulic systems.
- Cost less compared to pneumatic and hydraulic systems.

1. Skilled labor is not required for the operation. 2. Easy operation of peeling.

3. Maintenance is less of machine. 4. Investment is less compared to another machine.

5. It can be transported easily from one place to another place for use since dismantling and assembling is easy.

VIII. CONCLUSION: - A lever operated motorized coconut peeling machine was designed and developed. Coconut peeling machine which peels green young coconuts without any breakage and machine is easy to operate and perform with an average peeling efficiency and capacity of 94% and 72 coconuts per hour. Attempts were made to develop different coconut peeling equipment as human powered to reduce labor cost and maintain the quality. The equipment developed was simple, easy to operate

and techno economically feasible for farm level processing. Performance of the equipment was found quite satisfactory and, therefore, can be used for carrying out operations easily with the help of ac motor.

Through this project we will be able to offer

- Low-cost peeling solution.
- Maximum scrap utilization.
- 72 to 80 nuts per hour.

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