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COMPUTER APPROACH TO THE DESIGN OF COCONUT DEHUSKING MACHINE

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ABSTRACT: *This research centres on the Design of Coconut dehusking machine using computer Approach. A total of sixty nine parameters form the database. Computer "If statement" was used. The user's interface was printed. Each variable's value was selected from the previous calculated results and in turn were inputed to the system programme whilst the corresponding result was displayed. The summary of the result is being tabulated. The major components of the design covered the angle bar, the handle rod, the fasteners, the shaft, the spring and the bushing. Valued parameters include the Areas (mm^2), the weight (kg), the thickness (mm), length (mm), the volume (mm^3), the Diameter (mm) etc. the beauty of this design is its flexibility, interchangeability and manufacturability. It is compact, easy and simple. This original design can also be manipulated and modified.*

KEYWORDS: Computer, Design, Coconut Dehusking Machine

INTRODUCTION

Preambles

Coconut (cocos nucifera) is one of the world's most useful and important perennial plants. The coconut fruit is made up of an outer exocarp (Franco, P.J.H. and Gonzalez, A.V; 2004), a thick fibrous fruit coat known as husk; underneath is the hard protective endocarp or shell

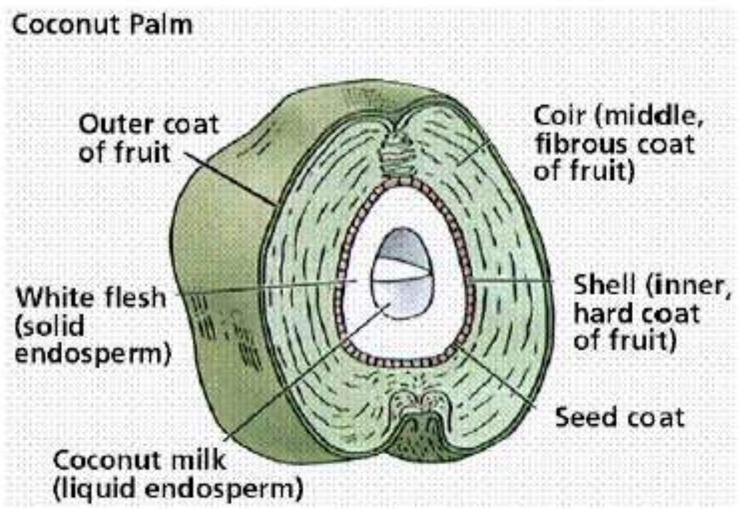


Fig.1 Parts of Coconut

The coconut palm is widely cultivated in the tropics. India is the world's third largest producer of coconuts after the Philippines and Indonesia (Umali B.E; 2002). Other producers are

Thailand, Malaysia, Papua New Guinea and the Pacific Islands. With coconut plantations extending over more than a million hectares, India produces about 5500 million nuts a year. Copra produced in the country is about 0.35 million tons and India accounts for about 50% of the world trade in coir. Coconut plantations are mostly concentrated in the coastal and deltaic regions of south India. In India, the crop is produced mainly by small and marginal farmers who number about 5 million (Genaro Celaya; 1930). The average size of holding is as small as 0.25 hectares. With agricultural labour problems worsening and water resources dwindling, more and more plantation acreage is being converted from arca to coconut since the latter is easier to grow and more remunerative (Feltran, (2007).

Coconut production plays an important role in the national economy of India. According to figures published in December 2009 by the Food and Agriculture Organization of the United Nations, India is the world's third largest producer of coconuts, producing 10,894,000 tons in 2009.

Traditional areas of coconut cultivation are Kerala (45.22%), TamilNadu (26.56%), Karnataka (10.85%), Andhra Pradesh (8.93%) and also Goa, Orissa, West Bengal, Pondicherry, Maharashtra and the island territories of Lakshadweep and Andaman and Nicobar.

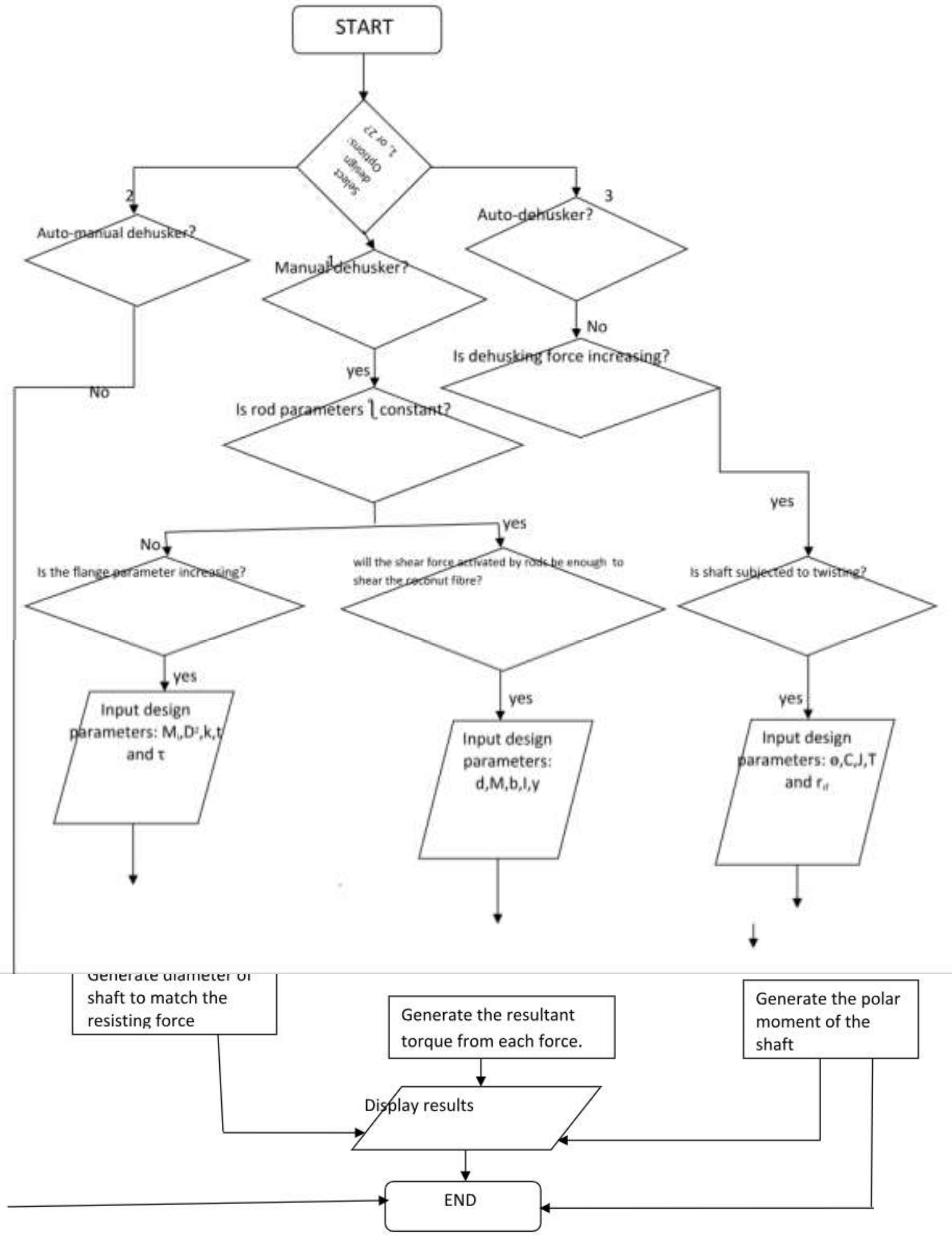
Almost all the parts of coconut are useful. The meat of immature coconut fruit can be made into ice cream while that of a mature coconut fruit can be eaten fresh or used for making shredded coconut and livestock feed. Coconut milk is a refreshing and nutritious drink while its oil is use for cooking and making margarine. Coconut oil is also very important in soap production (Ohler, J.G;1984). The shell is used for fuel purpose, shell gasifier as an alternate source of heat energy. The husk yields fibres used in the manufacture of coir products such as coir carpets, coir geo-textile, coir composite, coir safety belts, coir boards, coir asbestos and coir pith. Coir is a versatile natural fiber extracted from mesocarp tissue, or husk of the coconut fruit. Generally fiber is of golden color when cleaned after removing from coconut husk. Coir is the fibrous husk of the coconut shell. Being tough and naturally resistant to seawater, the coir protects the fruit enough to survive months floating on ocean currents to be washed up on a sandy shore where it may sprout and grow into a tree, if it has enough fresh water, because all the other nutrients it needs have been carried along with the seed (Balzer, P.S; 2007).

METHODOLOGY

Thirty-Seven (37) basic and fundamental theories were set out and studied, mathematical equations were derived for each component of the machine, the method used for the design and fabrication of the research work, is based on the fabrication of parts which include arc welding and bending of various part together.

Java was also used for the programming and the algorithm was also analyzed with the use of system design. ‘If statement’ was used. Sixty Nine variables were inputed to produce the eighty major outputs as shown on table 1.

FLOW CHART OF THE DESIGN OF COCONUT DEHUSKING MACHINE



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Written Commands

Where:

A_a= Area of one angle bar (mm^2)

L = Length of bar (mm)

T = Thickness of the bar (mm)

W = Width of the bar (mm)

w_a= Weight of four(4) bar, (N)

ʅ = Density of the bar (Kg/m^3)

V = Volume of the rod (m^3)

ʅ = Density of the rod(Kg/m^3)

L = Length of rod (mm)

W = weight of rod (N)

T = Torque

Le_2 = Length of engagement of thread (mm)

J = Tensile strength of external thread

Le = Tensile strength of internal thread

A_t = Nominal stress developed on the screw (N/mm^2)

A_{ts} = Area of the screw (mm^2)

$E_n max$ = maximum pitch diameter of internal thread(mm)

$D_s min$ = minimum major diameter of external thread(mm)

$K_n max$ = maximum minor diameter of internal thread(mm)

$E_s min$ = minimum pitch diameter(mm)

N = total number of coils = (n + 2)

d = diameter of spring wire coil(mm)

X_2 = maximum deflection(mm)

C_a = clash allowance(mm)

T = torque (Nmm)

F = force acting at the centerline of the spring(N)

L= length of the spring (mm)

D = mean coil diameter(mm)

P = Specific bushing

Wr= Load on bushing(N)

d= Inside diameter (mm)

D= Outside diameter(mm)

Wt= Load on thrust(N)

N= Speed of rotation (rpm)

δ= Angle of oscillation (rad)

N= Frequency of oscillation (Hz)

V= Sliding speed (m/s)

F=applied force or load (N)

l=length of the pin(mm)

δ_{y}= deflection at the guerdon pin(mm)

m_{ir},= moment

'D' and D_{k} or D_{b} = the inner and outer diameter of the hub are respectively(mm)

J= polar moment of inertia

t = gudgeon pin constant

E=Modulus of elasticity

I=Moment of inertia (mm^4)

y = radius of the circular section (mm)

z = section modulus

σ= stresses in the (4) angle bars respectively

T= torque on spring

K= Wahl factor

C= spring index

f = spring stress

G = modulus of rigidity of the spring wire. For spring steel wire G is usually taken as 78.6 GPa.

e = strains in the (4) angle bars respectively

p = force

a = cross sectional area

l = length (mm)

v = volume

u = strain energy

$\boldsymbol{\mu}$ = coefficient of rod friction

d = dept of the Shaft

b = breadth of the shaft.

M = bending moment

δb = bending stress

P =applied force

dl or sl = change in length

A = area

If the thickness of the angle bar = known, **Then**

Compute the area of the four angle bars using $(A_a \times 4) = 4[(L \times T) + (W \times T)]$

Compute the weight of the four angle bars using $w_a = (A_a \times 4) \times L \times$ʅ

If the computed weight > the computed area, **Then**

Design is satisfactory

Else select a better thickness and redesign until:

the computed weight ($w_a = (A_a \times 4) \times L \times$ʅ) > the computed area $(A_a \times 4) = 4[(L \times T) + (W \times T)]$

End If

Having **known** the density of the handle rod, **Then**

Compute its mass using (M = V × ʅ)

Compute the volume, using ($V = \pi r^2 L$)

Compute the weight using (W = A × ʅ × L)

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If the computed mass (M = V × ʅ) > the computed volume (V= $\pi r^2 L$), **Then**

Design is satisfactory

Else select a better density and redesign until:

the computed mass > the computed volume

End If

If the diameter of the screw thread = known **Then**

Compute the area of the screw using ($A_t = \frac{\pi}{4}(D - 0.938184 \times P)^2$)

Else If the = unknown **Then**

Compute the diameter of the screw thread area of the screw using $A_{ts} = \pi\, \mathrm{Le} D_s \min\{\frac{1}{2n} + 0.57735\,(D_s\, min - E_n \max)\}$

Compute the minimum length of thread using ($\mathrm{Le} = \frac{2 \times \mathrm{At}}{K_n max\, \pi(\frac{1}{2} + 0.57735\,(Es\, min - K_n max)}$)

End If

Check for the torsional shear stress($T = \frac{\pi}{16} iD^3$) in the spring due to compression using eqn(3.13)

Compute the Wahl factor using ($K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$)

If ($K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$) < $T = \frac{\pi}{16} iD^3$, **Then**

the spring is save under compression

design is satisfactory

Else select a better spring index (C) and redesign until:

the torsional shear stress($T = \frac{\pi}{16} iD^3$) > its Wahl factor ($K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$)

End If

If the outer diameter of the bushing = known, **Then**

Compute the specific bushing load using (**P**= $\boldsymbol{\frac{4Wt}{\pi(D-d)}}$)

Else, **If** the outer diameter of the bushing = unknown, **Then**

Compute the specific bushing load using (**P**= $\boldsymbol{\frac{Wr}{d\, x\, b}}$)

Compute the sliding speed of bushing by oscillation using ($V = \frac{\pi d N Ƃ}{60x\ 10x360}$)

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Compute the sliding speed of bushing by rotation using (V = $\frac{\pi dN}{60x\ 10}$)

If the sliding speed of bushing by rotation and the sliding speed of bushing by oscillation is same,**Then**

Design is satisfactory

Else,find a better outer diameter and redesign until:

the sliding speed of bushing by rotation (V = $\frac{\pi dN}{60x\ 10}$) and the sliding speed of bushing by oscillation

(V =$\frac{\pi dN\text{Б}}{60x\ 10x360}$) is same,

End If

Having **known** the moment of inertia (I) of the shaft, **Then**

Compute its bending stress using ($\frac{M}{I} = \frac{\delta b}{y}$)

Compute the diameter of the shaft using (d = $\sqrt{\frac{6}{Mb}}$)

If the computed magnitude of the bending stress (δb=$\frac{My}{I}$) < the computed diameter (d = $\sqrt{\frac{6}{Mb}}$) , Then,

Design is satisfactory

Else, select a better moment of inertia and redesign until:

the computed magnitude of the bending stress < the computed diameter

End

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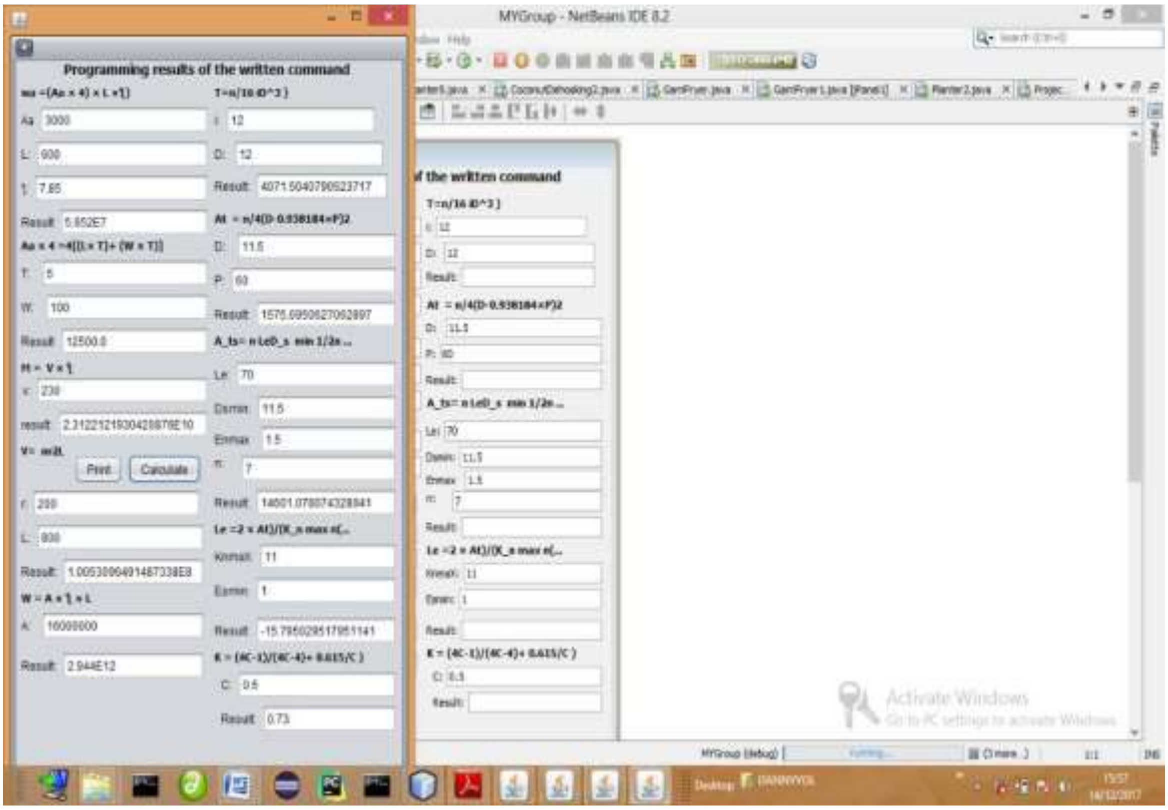

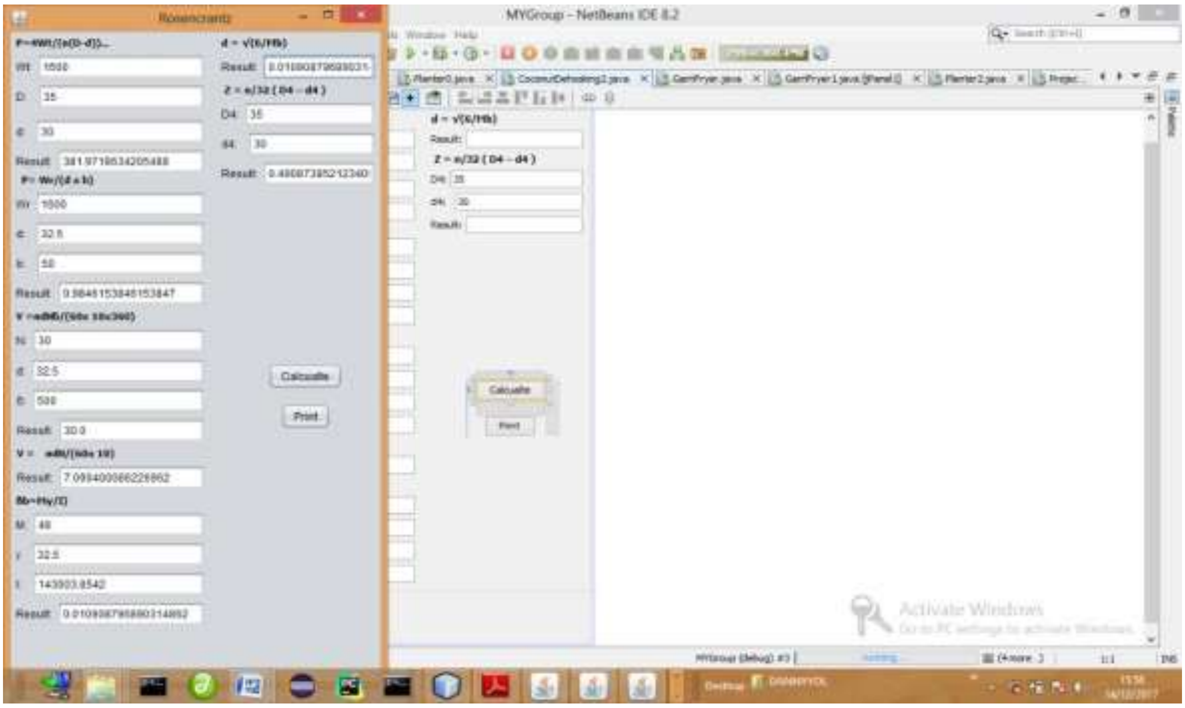

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Table 1: Result Table

S/N	COMPONENT	PARAMETER	RESULT
1	ANGLE BAR	Area Weight thickness	3000mm^2 5.853kg 0.5mm
2	HANDLE ROD	Length Weight volume	800mm 2.944kg 1005309mm^3
3	SCREW	Diameter Length of thread	15mm 70mm
4	BUSHING	Diameter Thickness Length Material	14mm 5mm 100mm Low carbon steel
5	SHAFT	Diameter Length	12mm 240mm
6	SPRING	Stiffness Pitch of the spring coil No of coil Spring coil angle Spring thickness	0.73 5mm 20 60 4mm

CONCLUSION

This is a breakthrough paper as the problem of dehusking of coconut as been major and persist for a long period. The product of this design is not only cheap but compact and flexible. The authors have no objection to its modification and manipulation for the purpose of optimization by other researches. The presentation here is a broad base and fundamental one.

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