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AN AFFORDABLE AND INNOVATIVE DUAL COCONUT DEHUSKING MACHINE

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Abstract:

Coconut, scientifically known as Cocos nucifera, is a versatile and tropical fruit widely cultivated for its myriad uses. Revered for its distinct combination of refreshing water, nutrient-rich meat, and oil-rich kernel, the coconut plays a pivotal role in various cultures and industries. Several machines are employed for the de-husking of coconuts, each designed to streamline and automate the traditionally labor-intensive process. Some common machines include, manual coconut de-husker, motorized coconut de-husker, industrial Coconut de-husking machine. These machines vary in terms of scale, complexity, and automation level, catering to diverse needs in coconut processing based on the scale of operations. These machines have several limitations that are: regular maintenance, required high skilled labor, high initial cost also and more time consumption in some machines. In this project work a semiautomatic dual coconut de-husking machine is being fabricated which will overcome these above limitations. By using this machine two coconuts can be de-husked at a time. The machine will be driven by using a 0.5HP motor and the power to the de-husking tools will be provided through a reduction gear box. Approximately 12 coconuts can be de-husked by using semiautomatic dual coconut de-husking machine, thus increasing productivity. The machine is fabricated with low cost so as to make it affordable to all.

Keywords: Coconut, de-husker, semi-automatic, low cost.

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1. Introduction

Coconut (Cocos nucifera) is one of the world's most useful and important perennial plants with multiple uses for thousands of years, Coconut has considerable significance in the national economy of Nigeria in view of rural employment and income generation. It belongs to the family areca cease Philippines are the world largest producers of coconut. It is found in the tropic and subtropic areas. Coconuts are large, dry drupes, ovoid in shape, up to 381mm long and 305mm wide. The coconut is smooth on the outside greenish or yellowish in color. Within the outer shell is a fibrous husk 25-50mm thick. The inner shell is brown and hard, surrounding the white coconut meat. The coconut husks have to be removed for the usage of coconut The coconut husk is made up of coir which is light weight, elastic, strong and has high durability. Coconut plays an important role in the economic, social and cultural activities of millions of people in our country. India is a major producer of coconut in the world Traditional areas of coconut cultivation in India are the states of Kerala, Tamil Nadu, Karnataka, Pondicherry, Andhra, Goa, Maharashtra, Odessa, West Bengal, Gujarat, islands of Lakshadweep and Andaman & Nicobar. Coconut provides food, edible oil, industrial oil and health drink to humanity. All parts of coconut tree are useful in one way or other and the crop profoundly influences the socioeconomic security of millions of farm families.

2. Literature Review

Rahul Sabale et.al [1], said that, there are many farms equipment's which are developed for the post harvesting operations. The de-husking of a coconut is regarded as the most time consuming, tiring, and difficult operation to perform. Traditionally this task of de-husking was performed by using different hand tools. By hand tools the de-husking depends on the skill of worker and involves training. The mechanized or the power operated machines are also developed to eliminate the drawbacks of manual tools. Such a tools and machines are developed all over the world and a very few have become popular, rest got vanished due to their limitations.

Sharanbasappa et.al [2], said that, by and large coconuts are de-husked physically utilizing either a cleaver or a spike. These techniques require talented workers and are tiring to utilize. Attempts made so far in the improvement of de-husking instruments have been just mostly fruitful and not compelling in supplanting manual techniques.

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Abishek.D et.al [3], said that, the Motorized type of remover for agriculture is a Mechanical gadget which is generally utilized in agricultural works. The Motorized coconut husk remover for agricultural needs reduces the time and labour in evacuating the husk. The purpose behind the improvement and the presentation of the motorized coconut husk remover in agricultural is explained briefly in further cases of literatures.

Vijay Kumar G Tile et.al [4], said that, the fundamental goal of this machine is to evacuate the coconut shell and to dispense with the talented work associated with de-husking. The coconut external shell is a stringy husk one to two inches thick. This paper manages the structure and creation of pneumatic worked coconut de-husking machine. This venture is planned for delivering a proficient and progressively affordable machine for coconut industry. One conventional strategy utilized for coconut de-husking is utilizing a cleaver. This is finished by utilizing human vitality.

Shrinivas et.al [5], in 2012 said that, the reason for this machine is to avoid people engaged with de-husking the coconut and to totally computerize the de-husking and crown evacuating process. Despite the fact that coconut de-husking machines have just been exhibited in the work and furthermore in some little scale ventures, the procedure is either manual or self-loader.

H Azmi et.al [6], said that, A coconut de-husking machine contains two rollers with spikes, chain drives, presser, clearers, shafts and belting framework was created for little scale generation in provincial territories. Execution test investigation indicated that the machine de-husks coconut edible part with no nut breakage or on the other hand bending of the separated fibre length.

K.P.Kolhe et.al [7], said that, all the parts of coconut like coconut husk, shell, copra, coconut water are valuable. The de-husking unit will have a couple of tube-shaped rollers with tines (cutting pins) on its surface. These rollers will pivot in inverse bearing with various speeds so the tines will enter into the husk and tear it away from the shell. The proper tearing of husk from shell occurs when the coconut offers good mesh with the tynes and it depends on the depth of insertion of nut into rollers and profile of tynes. Also, the suitable profile of tynes is required for effective de-husking.

ABI Varghese et.al. [8] In this research paper author given that De-husking of Coconut is the most difficult post harvesting operation relevant to coconut. A big problem associated with coconut processing was its de-husking. All Manually operated husking tools Make Use of a combination of Principles i) a Wedge and ii) Lever. The earliest of the modern coconut husking

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tools is a Foot operated coconut husking Machine. In this machine two wedges are used one in movable. Movable wedge operated with the help of lever which de-husk the nut.

3. Methodology

Project work starts with study of research papers and collection of information about the project as shown in the above flow chart. After collecting all the relevant information's and short coming of previous work designing of semiautomatic dual coconut de-husking machine was made with the help of CAD software using Solid Edge.

The material used for the fabrication of the project whole project is mild steel along with the help of motor and gearbox system. The motor is connected to the reduction gear box with the help of belt. The shaft is connected to gearbox and in this machine two coconut de-husking tools are connected to the shaft with the help of chains. When motor drives the gear, coconut de-husking process takes place. The methodology flow chart is as shown in Fig. 1.

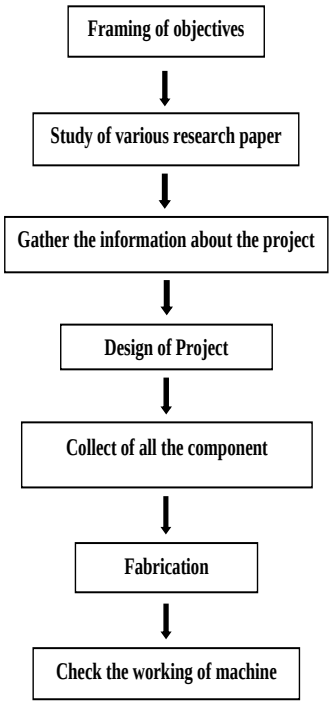

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Fig. 1. Flowchart of Methodology

4. Design

Solid Edge is powerful and comprehensive Computer-Aided Design (CAD) software that empowers engineers and designers to bring their ideas to life. Solid Edge offers robust 3D modeling capabilities, allowing users to create complex parts and assemblies.

It supports parametric modeling, which enables the creation of intelligent models with defined dimensions and relationships. Users can create 3D shapes using a variety of tools, including extrusion, lofting, sweeping, and more. The 3D and 2D Models are shown in Fig. 2 & Fig. 3

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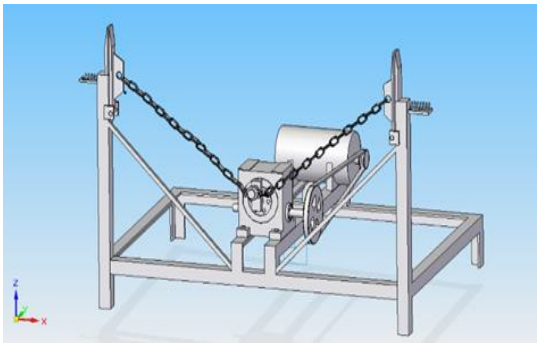

Fig. 2. 3D Model

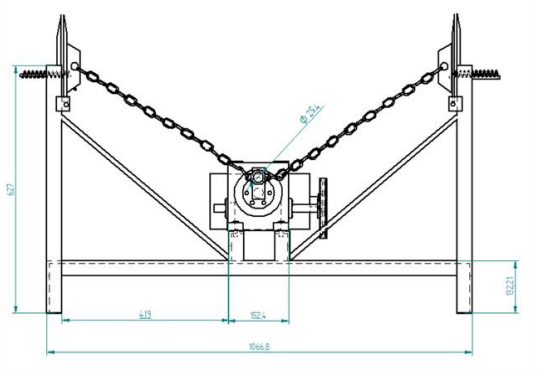

Fig. 3. 2D Model

1) Reduction gear box speed = n1/n2

n1= Motor speed

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n2= Gear box input speed

(1440/30) = 48rpm

2) Velocity of belt:

V= (πdn/60000)

V= ($\pi * 150 * 1440/60000$) = 11.30m/sec

3) Power Capacity:

T=(9.55*106*P)/n

P= Motor power in KW

N = Motor speed in RPM

T= (9.55*106*0.372)/1400 = 2.53KNm

4) Equivalent pitch diameter:

de= d*kd

d= The small diameter factor

kd= pitch diameter of the small pulley

(50*1.4) = 57mm

5) Power capacity:

KW= $(0.61 * V - 0.09 - (26.68\ de) - 1.04 * 10{-}4 * v\ 2)\ 0.7335 * v$

V= Velocity of belt

de = Equivalent pitch diameter

KW= $(0.61 * 11.30 - 0.09 - (26.68\ 57) - 1.04 * 10{-}4 * 11.302)\ 0.7335 * 11.30$ KW

= 2.83 KW

6) No. of belt required:

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N=(P*Ks)/(Kl*Ka)

P= 0.372 Kw

Ks=Correlation factor 1

Kl= Correlation factor length

Pitch length of belt = 2C+1.57(D + d) +(D − d) 2 /4C

C= Center distance of two pulley

D= Major diameter pulley

d= Minor diameter pulley

KL= 2*4000 +1.57(150 + 50) +(150 − 50) 2 /4*400= 1007.82m.m

Kl=0.88

Ka = Correlation factor for arc of Contact

θs = 2 sin −1 (D − d)/2C

θs = 2 sin −1 (150 − 50)/2 ∗ 400 =179.43°

Ka = 0.75 N= (0.372*1)/ (0.88*0.75) =0.95≈1

7) Spring Stiffness calculation:

K = (W/δ)

W= Load in kg

δ = Deflection = (Final length − initial length in m.)

K= (9.81)/ (185-150)*10−3 = 280.28 N/m

K= (19.62)/ (235-150) *10−3 = 230.82 N/m Average= (230.82+280.28)/2= 255.82 N/m

Major Components:

1. ½ HP Motor
2. Reduction Gear Box

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3. V-belt
4. Pulley
5. Metal Mesh
6. Extension Spring
7. Metal Chain
8. GI Sheet Metal
9. L Angular Bar
10. Bolts and Nuts

5. Working principle

The Semi-automatic Dual Coconut De-Husking Machine can be operated with the help of motor and gear box system. At the heart of the coconut de-husking machine's operation lies the motor and gearbox assembly, which provides the necessary mechanical power and torque to drive the de-husking mechanism. The motor converts electrical energy into rotational motion. The gearbox is a crucial component that helps regulate the speed and torque output from the motor to the de-husking mechanism. It consists of a series of gears that transmit power from the motor to the de-husking mechanism while adjusting the speed and torque as needed. The machine is loaded with coconuts by the laborer for de-husking. The coconuts are manually placed on the tip of the tool. When motor drives the gear, the speed will be reduced to required ratio. The shaft which is connected to the gearbox will rotate and chain connected to the gearbox shaft and tip of tool will also rotate along and due to this the tool moves forward & in backward motion. The tools alternatively will de-husk the coconut simultaneously. Once the de-husking process is complete, the husk of the coconut which is collected at the base of the machine is removed or put aside.

6. Results and Discussion

In this portion, the project's outcomes are presented in a clear and concise manner. This involves the use of tables, graphs, or any other appropriate visual representations to convey the data effectively.

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A. De-husking Efficiency

The efficiency of the de-husking coconuts was evaluated by measuring the percentage of successful de-husking. A total of 100 coconuts were subjected to the de-husking process. Output is 50% more than manual de-husking. This indicates that the semi-automatic dual coconut de-husking machine is more efficient compared to manual de-husking.

B. De-husking Time

The time required to de-husk a coconut using the Semi-automatic system was compared to the traditional manual de-husking method. In 30 minutes, we can de-husk 200 coconuts by semi-automatic machine but manually de-husking process it will take 60 minutes. This indicates that the semi-automatic dual coconut De-Husking machine significantly reduced the de-husking time, making the process more efficient

C. Husk Removal

After de-husking, the effectiveness of the removing the husk completely from the coconut was assessed. Visual inspection and manual examination of the de-husked coconuts revealed that process achieved a high level of husk removal. Only minimal traces of husk remained on the coconut, which could be easily removed by hand or through further processing steps

The time required for de-husking 100 coconuts

1) Semi-automatic machine = 30 minutes

2) Manually = 60 minutes

Efficiency = ((60-30)/60) *100 = 50%

Productivity is 50% more than manual de-husking based on operational time.

Efficiency and Productivity of Manual and Semi-automatic Machine

From the below chart, manual de-husking is typically less efficient due to the physical effort and skill required. It can be slower and vary depending on the individual's experience. Productivity with manual de-husking depends on the worker's skill and endurance. Experienced workers can process more coconuts, but the overall productivity is generally lower compared to semi-automatic methods as shown in Fig. 4 and also Table 1.

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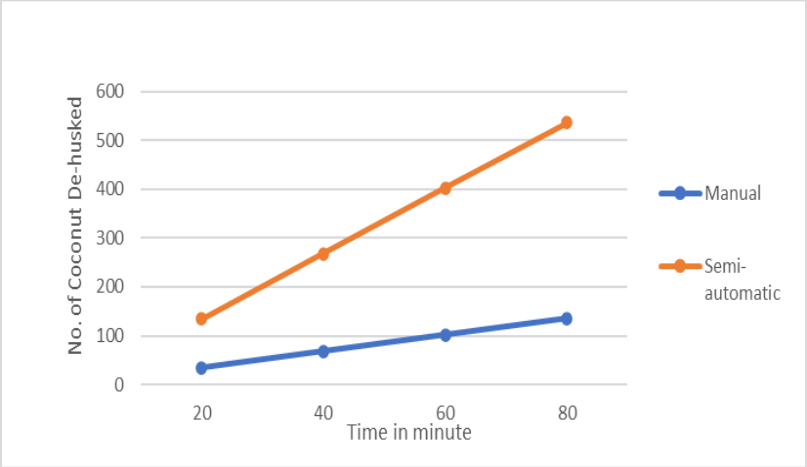

Fig. 4 Productivity v/s Efficiency

Below Table 1 shows the comparison between manual de-husking and Semi-automatic de-husking machines for 1 hour.

Sl. No.	Method of De-husking	No. of Coconut De-husked	Time Required (minutes)
1	Manual	136	60
2	Semi-automatic	400	60

Efficiency and Productivity of Pneumatic tupe and Semi-automatic Machine

From the below chart again, it is concluded that semi-automatic dual coconut de-husking machine is more efficient than pneumatic type de-husking machine. In this semi-automatic machine two workers can work at a time and produces 7-8 coconuts per minute. Hence, for 8 hours, 3200 coconuts can be produced and consumes 3units of power. But in the case of pneumatic type, 3-4 coconuts can be de-husked per minute. Hence for 8 hours 1900 coconuts can be produced. Mainly it requires large quantity of power because of using compressor and it consumes 9units of

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power. Overall compared to pneumatic type, semiautomatic dual coconut de-husking machine is more efficient and consumes less power as shown in Fig 5.

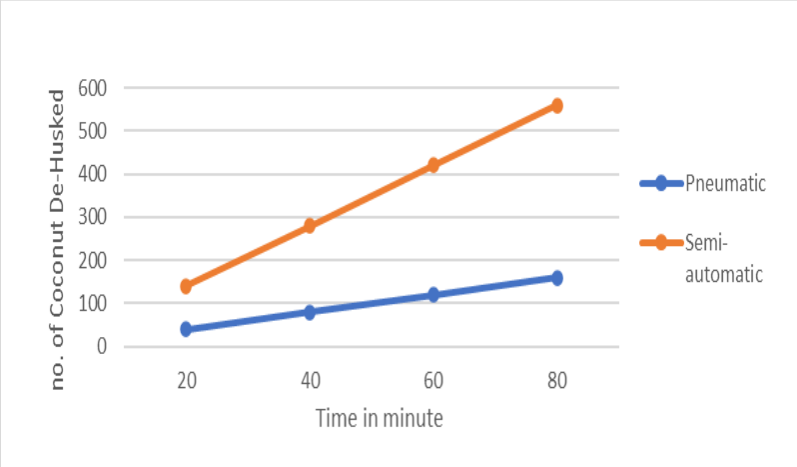

Fig. 5 Productivity v/s Efficiency

6. Conclusion

In conclusion, the development and implementation of the semi-automatic dual coconut de-husking machine with a gearbox and motor represent a significant advancement in the field of agricultural machinery. Through this project, several key objectives were achieved, including increasing efficiency, reducing manual labor, and improving safety in coconut de-shelling operations. The integration of a gearbox and motor system into the design of the machine has proven to be highly effective in achieving these objectives. Additionally, the use of a gearbox and motor has allowed for precise control over the speed and torque of the de-shelling mechanism, ensuring consistent and reliable performance.

One of the primary benefits of the semi-automatic coconut de-shelling machine is its ability to reduce manual labor and associated health risks for workers. Traditionally, coconut de-husking has been a labor-intensive task, often requiring workers to use sharp tools and exert significant force to remove the husk from the coconut. This process can lead to injuries such as cuts, strains, and repetitive motion injuries. By automating this process, the machine helps to minimize the physical strain on workers and create a safer working environment.

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Furthermore, the successful implementation of semi-automatic coconut de-husking machines relies on effective training and support for operators. Proper training is essential to ensure that operators understand how to safely and effectively operate the equipment and troubleshoot any issues that may arise. By using the coconut de-husking machine it has significantly reduced the time and effort required to process coconuts, thereby increasing overall productivity.

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