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Design and Development of Coconut Temple Waste Processing Unit for Multi-utility Products

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Abstract:

This study explores the design and development of a Coconut Temple Waste Processing Unit (CTWPU) for generating multi-utility products. India, a major producer of coconut, faces limitations in processing technology. The CTWPU aims to address this by efficiently utilizing coconut waste. The paper will detail the design of the unit, focusing on its ability to convert various coconut components (husk, shell, etc.) into valuable products. The potential benefits of the CTWPU include increased resource utilization, waste reduction, and generation of marketable products, contributing to a more sustainable and profitable coconut industry

Keywords — Husk,shell, Coconut dehusking, cutter, Husking and Cutting

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I. INTRODUCTION

In many temples in India, worshippers show their devotion through rituals and offerings, which can include items like flowers, fruits, and coconuts. However, disposing of these items, especially coconut shells, has become a significant environmental issue. Properly managing organic waste is challenging and can harm the environment and public health. To tackle that problem Our team is committed to developing a processing unit specifically designed to handle temple waste and making multi-utility products from that. Our project's main objective is to minimize the environmental impact and ensure that no part of the temple offerings goes to waste. Our proposal presents a novel solution a portable temple coconut waste multifunctional processing unit to address the urgent demand for better waste management and resource utilization. By integrating the traditional methods of cutting and de-husking coconuts into a single, semi-automated device, this invention aims to simplify the process. While maintaining cost-effectiveness and ergonomic design, our main goals are to improve the quality of coconut cutting, lessen the waste produced by temple coconut offerings, and encourage sustainable waste management techniques. Our program, which converts waste into wealth and contributes to a more sustainable and environmentally conscious future, is in line with the

ideas of a circular economy by turning temple coconut waste

The major components of the proposed coconut de-husking machine are gears, pulleys, frame of angles, motor, gear reduction box, v-belts, spline shafts, coir collector, ball bearing with holder, cutter, water hopper, and shell collector. The machine consists of a machine frame, drive, holding, Cutting, and roller-type blade mechanism. The frame is the main supporting structure upon which this machine's other components are mounted. The frame is a welded structure, constructed from 35x35x5mm angle iron with dimensions of 1219mm in length, 610mm in width, and 900mm in height. The drive mechanism comprises a motor, spur reduction gears with a belt drive system, and a rotating shaft with a belt and gear drive system. A single-phase 1hp induction motor with gear reduction box a speed of 1440rpm-80rpm is used to drive the components. The machine also uses a gear reduction with a 96:1 ratio and is connected to a shaft, which is a long rotating cylinder that transmits power from one place to another. A wheel cutter in the machine's cutting mechanism neatly splits the coconut into two equal sections. In the meantime, complete husk removal is guaranteed by the roller-type blade mechanism, which consists of mild steel rods with lengths of 750mm and different diameters of 68mm, 36mm, and 26mm. The splines on the shafts improve their hold on the coconut, facilitating efficient de-husking. The machine has safety features that ensure operator security by enclosing the wheel cutter in a secure cage, thereby simplifying the procedure. The coconut water is effectively collected using a hopper, and the husk and shell are separated using two collectors. The machine works by rotating its spike-equipped rollers in opposite directions towards the center, grabbing and shredding the coconut husk without harming the nut inside. As a result, the dehusking process is effective, and intact coconut nuts are produced, suitable for consumption or additional processing. With just one operator needed, this machine's user- friendly design makes dehusking coconuts a more convenient and effective process.

II. WORKING PRINCIPLE

This coconut temple waste processing unit is designed to efficiently de-husk and cut coconuts collected from temples. The process can be broken down into the following steps:

1. Coconut Collection and Feeding

- Coconuts are collected from the temple and placed in a dedicated side hopper located at the top of the machine. This hopper provides a convenient and controlled way to feed coconuts into the processing unit.

2. De-husking Unit

- A 2 HP electric motor serves as the power source for the machine.
- Power from the motor is transmitted to the de-husking unit via a chain drive system. This system ensures efficient power transfer with minimalenergy loss.
- The de-husking unit consists of two counter-rotating rollers equipped with sharp spikes. These spikes effectively grip the coconut husk as the rollers rotate in opposite directions.
- A pressing mechanism applies controlled pressure to the coconut, forcing it against the spiked rollers. This combined action of gripping and pressing efficiently removes the husk fibers from the coconut shell withoutdamaging the coconut meat inside.
- And below the dehusking unit there is an

arrangement of coir(husk) collector

3. *Coconut Transfer:*

- Once de-husked, the coconut is manually transferred from the de- husking unit to the cutting unit using a designated handle. This handle allows for safe and easy handling of the de-husked coconut.

4. *Cutting Unit:*

- Power from the motor is transferred to the cutting unit, again likely through a chain drive system for consistency.
- The cutting unit features a single, sharp cutter blade securely welded to a large rotating rotor.
- The de-husked coconut is placed in a designated coconut holder within the cutting unit. This holder ensures proper positioning and stability during the cutting process.
- As the rotor rotates, the cutter blade spins at high speed. The de-husked coconut is then manually pressed against the rotating blade, cleanly splitting it into two halves.
- There is an arrangement of a coconut collection tray below the cutting unit to collect the separated coconut halves.

This is the complete working principle of our project which is the design and development of a temple coconut waste processing unit for the multi-utility

III.Coconut Dehusking and Cutting machine Development

Machine units

1. Dehusking unit
2. Coconut collecting unit
3. Cutting unit
4. Water collecting jar
5. Cutter coconut collection unit

Fig No: 1 Frame for Machine

Fig No: 2 Cutting arrangement

Components and Tools

1. Angles
2. Gear box
3. Motor
4. Chain drive
5. Pulley
6. Spur Gear
7. Shaft
8. Spline
9. Wheel Cutter
10. Bearing Holder

Fig No: 3 Gears arrangements

Material Selection for Coconut Temple Waste Processing Unit

The Coconut Temple Waste Processing Unit (CTWPU) is designed for durability and efficient operation. To achieve this, careful consideration was given to the selection of materials for each component. The frame, which provides the core structure of the unit, is constructed from mild steel angles. This material offers a good balance between strength and weight, making it suitable for supporting the weight of the processing components while maintaining a stable platform. The chosen dimensions (35 mm x 5 mm) ensure structural integrity for the anticipated loads.

For power transmission and the cutting assembly, a combination of materials was selected based on their specific properties. Cast iron is used for the gear reduction box and the spur gears due to its high strength and wear resistance, crucial for handling the forces involved in the processing mechanism. Mild steel is chosen for the shafts due to its machinability and affordability, while stainless steel is used for the cutters themselves. This combination ensures a robust and cost-effective design for the power transmission and processing functionalities of the CTWPU.

Material used

A. Material And Process Selection

Materials

1. Mild Steel: -

- Low Carbon Content
- Mild steel is highly malleable and ductile, which means it can be easily bent, formed, and welded into various shapes without cracking or breaking.
- Mild steel is known for its excellent weldability.
- Mild steel is cost-effective and readily available.

2. Cast Iron: -

- High Carbon Content.
- High Wear Resistance
- It has High Density
- Lower Cost

3. Tin sheet

For covering front, left and right sides of machine Tin is a soft, and is not easily oxidized and resists corrosion because it is protected by an oxide film. Tin resists corrosion from distilled sea and soft tap water, and can be attacked by strong acids, alkalis and acid salts.

4. High speed steel

Broadly, high speed steel excels in hardness, with different grades trading for toughness, hot hardness or reduced brittleness. As a result, these alloys see the most use in industrial cutting tools—tool bits

Fig No: 4 Fabricated Coconut dehusking Machine

II. CONCLUSIONS

This research successfully designed and developed a low-cost, efficient Coconut Temple Waste Processing Unit (CTWPU) for sustainable temple waste management. The CTWPU minimizes waste, maximizes resource utilization through high processing efficiency (89.14% de-husking, 94.17% cutting) at a capacity of 131 coconuts per hour, and offers potential for income generation from processed products, promoting a future of reduced environmental impact and economic benefit for temples.

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