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DESIGN AND FABRICATION OF DEHUSKING THRESHER USING MECHANICAL AND SOLAR ENERGY

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1.ABSTRACT –

Maize (corn) is a fundamental component of animal feed and serves as a raw material for various industrial products, including corn starch, maltodextrins, corn oil, and corn syrup, as well as products in fermentation and distillation industries. Efficient processing of maize requires the separation of kernels from the cob, traditionally done using threshing machines powered by diesel or gasoline. However, the reliance on fossil fuels increases operational costs. This study focuses on the design and fabrication of a solar-powered corn threshing machine to provide an energy-efficient and cost-effective alternative.

Similarly, groundnuts are a vital agricultural product rich in oil and protein, widely used for cooking and animal feed. However, groundnut harvesting remains labor-intensive and expensive, discouraging farmers from its cultivation. The manual removal of groundnut pods is time-consuming, especially under high temperatures during the harvesting season. To address these challenges, this project also integrates a mechanical groundnut thresher to automate the pod removal process, reducing labor dependency, minimizing costs, and enhancing productivity.

The proposed dual-function dehusking thresher, utilizing both mechanical and solar energy, aims to improve efficiency, reduce operational expenses, and promote sustainable agricultural practices.

2. INTRODUCTION :

Innovation in industrial technology has significantly improved efficiency, safety, and productivity across various sectors, including agriculture. While some advancements result from years of research and development, the true measure of a device's effectiveness lies in its utility, convenience, and operational efficiency rather than its complexity or cost.

Traditional methods of corn husking in agriculture involve manual labor, where grains are separated by hand or broken into pieces. These methods are not only inefficient but also labor-intensive and time-consuming. Additionally, the safety and well-being of laborers remain a concern due to the physically demanding nature of the task. To address these challenges, an innovative mechanized corn husking machine has been developed to automate the process, reducing human effort while ensuring efficiency and safety.

This project presents a cost-effective and low-maintenance threshing device that leverages mechanical and solar energy to separate corn kernels from the cob. The proposed system is particularly beneficial in agricultural mills and farms where labor dependency is high. The machine features a teethed shaft mechanism, enabling efficient grain separation with minimal manual effort.

In terms of economic feasibility, the device is significantly cheaper to operate compared to manual labour, requiring only a single operator while ensuring high productivity. Its compact size and low operational cost make it a practical solution for small- and medium-scale agricultural operations. Moreover, maintenance requirements are minimal, with only periodic lubrication needed for smooth functioning.

This study aims to design and fabricate a solar-powered and mechanical dehusking thresher that not only enhances productivity but also promotes sustainability in agriculture by reducing reliance on conventional energy sources and manual labor.

3.LITERATURE SURVEYS :

1. Title: Solar Powered Corn Threshing Machine
Author: Garbin, Ricmart V., Caisip, Eloisa A., Lorzano, Christian Jered R., Mogol, Richard Aries F., Panopio, Jennifer Joy N.
Journal: International Journal of Advanced Research and Publications

Summary: Maize, or corn (Zea mays), is a member of the grass family (Poaceae) and one of the world's most vital cereal crops after wheat and rice. It is cultivated on all continents, providing foodstuffs for human nutrition and feeds for animals as well. Maize is also among the principal raw materials for the manufacture of starch, oil, protein, alcoholic beverages, food sweeteners, and, in the last couple of years, biofuel. Traditionally, maize processing was all done by hand, with simple tools—or even with hands—to remove kernels and strip skins.

Most of the farmers plant maize but find the imported threshing machines very expensive to purchase. They therefore use the manual methods of threshing which are laborious, inefficient, and result in a lot of wastage. Accordingly, a corn threshing machine was designed to shell maize and separate the grains from the cob. Traditional methods and manual shelling do not support large-scale operations since they cause fatigue and limit efficiency for commercial purposes.

2. Title: design and fabrication of solar paddy threshing machine for agriculture purpose
Author: A B Nidagundia and R G Mulimanib
Journal: International Journal of Innovative and Emerging Research in Engineering
Year : 2017
Summary: Basmati rice (Oryza sativa) has great export potential and has been selected as one of the major agricultural commodities for sustainable export promotion, as emphasized by the Ministry of Commerce. While production has been increasing over the years, there are many problems confronting farmers, one of which is low net benefits. While high-yielding varieties and better crop management practices increase production, considerable losses during harvesting occur. Such post-production losses may be either physical or quantitative, resulting in a lesser weight or volume of final product obtained from harvested paddy.
The degree of these losses varies with the rice cultivar and the techniques of operation. Basmati rice is most sensitive to mechanical damage. Hand harvesting, although practiced widely, is laborious and influenced by cultural practice, plant density, lodging, soil conditions, and the skill of the labour. Lodged paddy and waterlogged soils can reduce the cutting rate by up to 50%.
Industrialization and migration to urban areas cause labour shortages, which further aggravate the plight of the paddy farmers. Additionally, commercially available harvesting and threshing machines are often not suitable for the tender basmati varieties; special attention therefore has to be paid to the material flow and operation requirements during threshing.

3. Title: Design and Manufacturing of Sunflower Threshing Machine
Author: Mr. Nikhil B. Patil1, Mr. Mithilesh P. Jadhav, Mr. Pranil S. Phutane, Mr. M.A. Mullani
Journal: international research journal of engineering and technology (irjet)
The main component required the fabricate the machine are extracting teeth shaft, pulley, tray, mesh, motor, v belt, pedestal bearing, spring etc.The sunflower is threshed in closed threshing unit by extracting teeth which are attach to rotating shaft where the seeds separated from flower and husk of the flower is removed. Finally clean seeds are collected in a tray this machine convenient for threshing process and reduce human effort as well as time.

4. Title: design fabrication and performance analysis of groundnut thresher
Author: rajasekar.m1, arunkumar. s2 ,divakar.s3 , santhosh kumar.r4
Journal: international research journal of engineering and technology (irjet)
Summary: Groundnuts, also known as peanuts, belong to the legume family and are often mistaken for nuts despite their classification as legumes. The plant is believed to have been first domesticated in the valleys of Paraguay and grows as an annual herbaceous plant, reaching a height of 30 to 50 cm. Its leaves are opposite and pinnate, consisting of four leaflets arranged in two opposite pairs without a terminal leaflet, each measuring 1 to 7 cm in length and 1 to 3 cm in width.
Peanuts are commonly referred to by various local names such as earthnuts, goober peas, monkey nuts, pygmy nuts, and pig nuts. India ranks as the second-largest producer of groundnuts globally and offers a variety of types, including Bold or Runner, Java or Spanish, and Red Natal, which are outlined in Table 1.

4.PROBLEM STATEMENT :

Challenges in Sunflower Seed Extraction

The extraction of sunflower seeds is a crucial step in sunflower farming, directly impacting both the quality and quantity of the final harvest. However, existing methods for sunflower seed extraction present significant drawbacks. Farmers typically rely on three primary techniques: manual methods, bullock trampling, and automatic threshing machines. Each of these methods comes with limitations related to efficiency, cost, and labor requirements.

Current Methods of Sunflower Seed Extraction

Manual Methods: Farmers traditionally extract seeds by hand or by beating sunflower heads with sticks. While inexpensive, this method is highly labour-intensive, time-consuming, and results in inconsistent seed quality due to potential damage.

Bullock Trampling: In some regions, farmers use livestock to step on sunflower heads, dislodging the seeds. Although slightly more efficient than manual methods, this technique is imprecise, causes seed damage, and requires significant labor and space.

Automatic Threshing Machines: Modern threshers use rotating drums or rollers to efficiently separate seeds. However, these machines are expensive to purchase, maintain, and operate, making them inaccessible for many small-scale farmers.

Identified Problems

Despite the availability of these methods, significant issues persist:
High Labor and Time Requirements: Manual and bullock-based methods are physically demanding and time-intensive, reducing overall farming efficiency.
Inconsistent Seed Quality: Traditional extraction methods often lead to damaged seeds, affecting market value and increasing post-harvest losses.
Cost Barriers: Automatic threshing machines are too expensive for small-scale farmers, leading to continued reliance on inefficient traditional methods.
Limited Adaptability: Existing methods may not work well across different sunflower varieties or field conditions, reducing productivity.

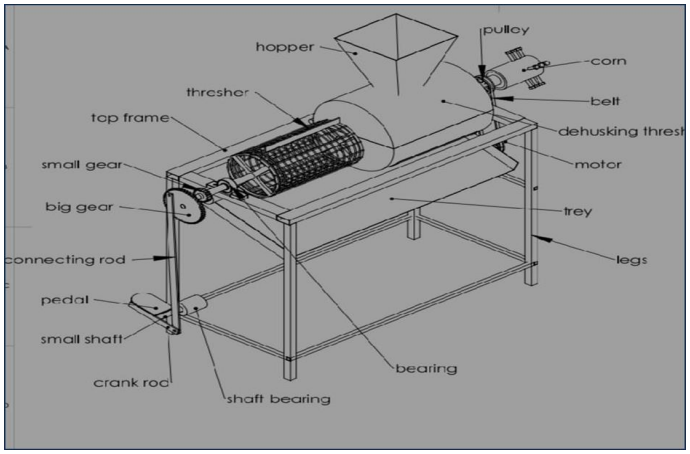
The Need for a New Solution

Given these limitations, a new sunflower seed extraction machine is necessary—one that is efficient, affordable, and accessible for small-scale farmers. The key goals for this machine are:
Improving Efficiency: Reducing labour effort and processing time.
Lowering Costs: Designing an affordable alternative to costly threshing machines.
Enhancing Seed Quality: Ensuring gentle extraction to prevent damage.
Increasing Flexibility: Making the machine adaptable to different sunflower varieties and farming conditions.

Objectives

1. 1.Develop a fully mechanical sunflower seed extraction device.
2. 2.Ensure economic viability by designing an affordable and accessible husking and threshing machine.
3. 3.Prioritize safety in design and operation.
4. 4.Create an easy-to-operate machine that can be used by all farmers, regardless of technical skills.
5. 5.Reduce human effort through automation and mechanical assistance.
6. 6.Enable multi-operation functionality, allowing the machine to be used year-round for different tasks.
7. 7.Utilize renewable or wasted energy sources where possible to enhance sustainability.
8. 8.Simplify farming tasks through an intuitive design.
9. 9.Ensure cost-effective operation by minimizing maintenance and power requirements.
10. 10.Enhance agricultural productivity by assisting farmers in improving seed extraction efficiency.
11. 11.Promote teamwork and innovation by encouraging collaboration in the development process.

5.PROPOSED METHODOLOGY :



The proposed sunflower seed extraction machine operates using a hybrid mechanism, integrating both motorized and pedal-powered systems. This dual-power approach ensures flexibility, making the machine both energy-efficient and accessible for farmers in areas with limited electricity supply.

Working Mechanism

The machine's operation is based on a mechanism similar to that of a sewing machine, allowing multiple functionalities. The core components include:

1.Dual Power Source:

- •Electric Motor: Provides consistent and efficient power for high-speed operation.

- •Pedal Mechanism: Acts as an alternative power source, ensuring functionality even in the absence of electricity.

2.Pulley and Gear System:

- •The machine employs two pulleys—one large and one small—to regulate the speed of the output shaft. The larger pulley reduces the rotational speed, ensuring controlled and effective seed extraction.
- •A gear system (comprising large and small gears) is incorporated for the pedaling mechanism, allowing efficient transmission of power when using manual operation.

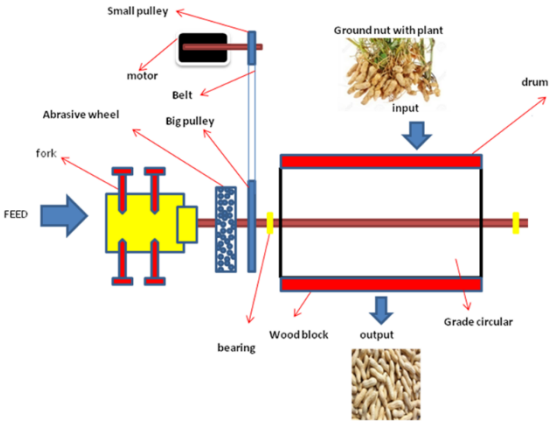
3.Threshing Drum:

- •The rotating drum mechanism facilitates the separation of sunflower seeds from the flower heads with minimal damage.
- •The drum rotation speed is optimized through the pulley system to achieve the required output efficiency.

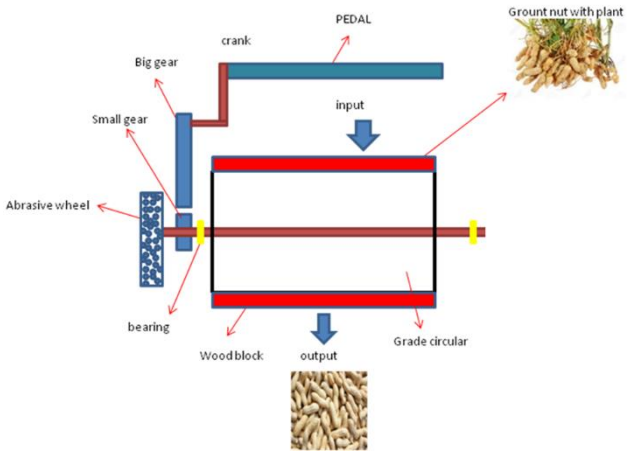
Advantages of the Hybrid System

- •Energy Efficiency: The machine can operate using electrical or manual power, reducing dependency on electricity
- •Year-Round Usability: The multi-functional design allows for continuous use, independent of seasonal constraints.
- •Cost-Effectiveness: The manual pedaling option reduces operational costs, making it accessible to small-scale farmers.
- •User-Friendly Operation: Simple mechanical controls ensure ease of use for farmers with minimal technical knowledge.

Motor Mechanism:



Pedal Mechanism:



6.COMPONENTS :

1. Shaft
Material: Mild steel
Operation: cutting, facing, turning, threading.

2. Fasteners
Material: Mild steel
Operation: Fitting.

3. motor
Material: assembly
Operation: Fitting

4. Bush
Material: mild steel
Operation: cutting, machining, Fitting

5. Bolt & nut
Material: mild steel
Operation: Fitting

6. frame
Material: -mild steel
Operation: welding

7. battery
Material: assembly
Operation: Fitting

8. switch
Material: assembly
Operation: Fitting

9. solar panel
Material: assembly
Operation: Fitting

7.FUTURE SCOPE :

The hybrid dehusking thresher developed in this project has significant potential for expansion and adaptation across various agricultural sectors. While initially designed for sunflower seed extraction, the machine's versatility, cost-effectiveness, and dual-power operation open avenues for broader applications in small-scale farming, agro-processing, and rural industries.

Potential Enhancements and Applications

1.Adaptability for Multiple Crops:
•The machine's threshing mechanism can be modified to handle other crops such as groundnuts, maize, and paddy, making it a multi-functional agricultural tool.

2.Integration of Advanced Technologies:

- •Future versions could incorporate automation with sensors to improve efficiency and precision.
- •The addition of a solar power optimization system could enhance energy efficiency, making the device more ecofriendly and cost-effective for farmers with limited access to electricity.

3.Improved Design and Efficiency:

- •Refinements in the drum mechanism and seed collection system can reduce seed damage and increase extraction speed.
- •Use of lightweight, corrosion-resistant materials will enhance durability while keeping production costs low.

4.Commercial Viability and Scalability:

- •The machine can be mass-produced and marketed to small and mid-scale farmers as an affordable alternative to expensive automatic threshers.
- •Government subsidies and agricultural assistance programs can facilitate wider adoption, particularly in developing rural economies.

5.Sustainability and Economic Impact:

- •The low operating cost and minimal maintenance requirements make it an economically viable long-term solution.
- •Encouraging local fabrication and assembly can promote employment opportunities in rural areas.

8. CONCLUSION :

Developing this hybrid dehusking thresher was a challenging yet rewarding journey, especially given our initial lack of experience in designing and fabricating agricultural machinery. Throughout the process, we encountered various technical, mechanical, and design challenges, but rather than seeing them as obstacles, we embraced them as opportunities to learn and innovate. By applying continuous research, iterative problem-solving, and collaborative teamwork, we not only refined our design but also enhanced our technical knowledge and practical skills in engineering and fabrication.

Upon completion, we rigorously tested the machine in our college workshop, evaluating its performance, efficiency, and usability. The results were highly promising—the machine functioned as intended, demonstrating ease of operation, manoeuvrability, and practicality. This success validated our design approach and confirmed that we had developed a cost-effective, user-friendly, and efficient solution for small-scale farmers.

Looking ahead, we see significant potential for further enhancements and commercialization. Key areas for improvement include scaling up the design to increase its capacity, making it suitable for larger farming operations, and integrating advanced features to improve efficiency and adaptability for different crops. With further development and refinement, this machine could become a widely adopted agricultural tool, providing farmers with an affordable, sustainable, and high-performance alternative to traditional and expensive seed extraction methods.

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