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Design and Development of a Mechanical Coconut Dehusker for Efficient Processing

Dnyaneshwari V. Gophane[1], Anand D. Kamble [2], Suraj S. Gele[3], Rohan M. Rokade[4], Suraj N. Yadav[5], Kiran S. Bhoi[6], Ranjit N. Shembade[7]

[1]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[2]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[3]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[4]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[5]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[6]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur
[7]Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur

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Abstract - The manual removal of coconut saffron is a labor-intensive and time-consuming process that poses significant safety risks to workers. Traditional methods often result in inconsistent saffron removal, reducing the utility of coconuts in both religious and commercial applications, particularly in temples where large volumes are processed. This project presents the design and development of a mechanical coconut saffron remover aimed at enhancing productivity, safety, and operational efficiency for coconut farmers, temple authorities, and small-scale industries in India. The proposed device employs a manually operated mechanism, potentially utilizing multiple jaws to achieve uniform and effective saffron removal, accommodating variations in saffron hardness among coconuts. The design emphasizes simplicity, cost-effectiveness, and ease of operation, making it suitable for rural and industrial use. Key objectives include minimizing human effort, reducing safety hazards, and ensuring consistent saffron removal. With low maintenance requirements, the device offers a sustainable and practical alternative to manual methods, contributing to improved processing outcomes, better resource utilization, and enhanced livelihoods for individuals and businesses involved in coconut-related activities.

Key Words: Coconut saffron remover, Mechanical design, Manual operation, Productivity enhancement, Safety improvement, Temple applications, Cost-effective device, Small-scale industries, Coconut processing, Multi-jaw mechanism.

1. INTRODUCTION

Coconuts hold significant cultural, religious, and economic importance in India. They are extensively used in temples for offerings, as well as in households and industries for food, oil, and other products. One major challenge in coconut utilization, particularly in temples, is the removal of the coconut saffron—the fibrous inner layer attached to the kernel. Traditionally, saffron removal is performed manually using knives or sharp tools, which is labor-intensive, time-consuming, and poses considerable safety risks to workers. Additionally, manual methods often result in incomplete saffron removal, leading to wastage and limiting the utility of coconuts for rituals and further processing.

To address these challenges, this project proposes the design and development of a mechanical coconut saffron remover. The device aims to provide a simple, manually operated solution capable of efficiently removing saffron, especially in temples and coconut shops. The design incorporates multiple jaws or similar mechanisms to ensure effective and uniform saffron removal while accommodating variations in saffron hardness across different coconuts.

The proposed solution emphasizes ease of operation, safety, cost-effectiveness, and low maintenance, making it suitable for both small-scale and industrial applications. By reducing reliance on unsafe manual practices, the device is expected to improve productivity, ensure consistent saffron removal, and provide a practical tool for coconut processing in both religious and commercial contexts.

2. RESEARCH GAP

Despite the widespread use of coconuts in temples, households, and industries, the process of removing coconut saffron remains largely manual and underexplored in terms of mechanization. Current methods rely on knives or sharp tools, which are labor-intensive, time-consuming, and unsafe. Moreover, manual removal often results in incomplete or inconsistent saffron extraction, particularly in temples where large quantities of coconuts are processed.

While machines exist for other coconut operations such as dehusking, deshelling, and oil extraction, no dedicated device has been developed specifically for saffron removal. Existing machines are often costly, complex, and unsuitable for small-scale users such as temple authorities and farmers.

This highlights a significant research gap and underscores the need for a safe, simple, and cost-effective mechanical saffron remover that can enhance efficiency, reduce risks, and enable consistent coconut processing for both small-scale and industrial applications.

3. PROBLEM STATEMENT

The manual removal of coconut saffron is a labor-intensive, time-consuming, and unsafe process. Traditional methods using knives or sharp tools often lead to incomplete or inconsistent saffron removal, resulting in wastage and limiting the utility of coconuts in religious rituals and commercial applications. Existing mechanical solutions for coconut processing, such as dehusking and deshelling machines, do not address saffron removal and are often expensive, complex, and unsuitable for small-scale users.

This situation highlights the need for a simple, cost-effective, and safe mechanical device capable of efficiently removing coconut saffron, improving productivity, and ensuring uniformity for both small-scale and industrial applications.

4. OBJECTIVES

The following are the main objectives of this project:

1. To design and develop a simple, low-cost, and manually operated coconut saffron remover.
2. To reduce human effort and minimize the time required for saffron removal compared to traditional manual methods.
3. To improve safety by eliminating risks of hand injuries during coconut processing.
4. To ensure uniform and complete saffron removal, regardless of variations in coconut hardness.
5. To enhance productivity and consistency in temples, small industries, and rural applications.

5. DESIGN AND METHODOLOGY

The development of the coconut saffron remover follows a systematic engineering approach. The process begins with a problem study and requirement analysis, where existing manual practices for saffron removal were examined to identify limitations such as safety risks, labor intensity, and inconsistent results. User requirements were gathered from temple authorities, coconut farmers, and small-scale processors to understand their needs and challenges.

The conceptual design stage involved generating multiple design ideas, focusing on a manually operated mechanism that uses multiple jaws or blades to achieve effective saffron removal while maintaining simplicity and cost-efficiency. Material selection was carried out considering factors such as strength, durability, corrosion resistance, and food safety.

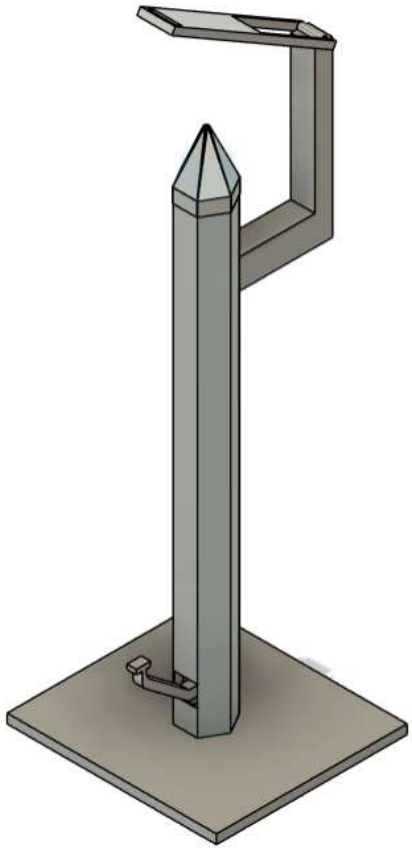

Fig: The Isometric view of the saffron remover

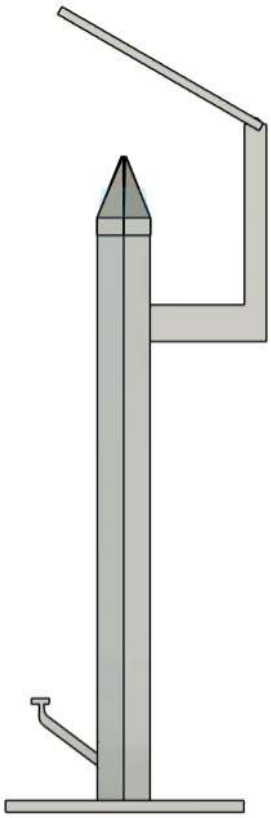

Fig: Front view of the Saffron Remover

A prototype was fabricated based on the selected design specifications. The prototype was then tested using coconuts of different sizes and hardness to evaluate performance in terms of time taken, ease of operation, uniformity of saffron removal, and safety. Design modifications and optimizations were made based on test results to improve efficiency, ergonomics, and user-friendliness.

Finally, the optimized design was validated through field trials in temples and small-scale industries to ensure reliability and practical usability. This methodology ensures that the device is simple, low-cost, safe, and accessible, fulfilling the objectives of reducing human effort, improving productivity, and enhancing consistency in coconut saffron removal.

6. WORKING PRINCIPLE

The coconut saffron remover operates based on the principle of mechanical force transmission combined with controlled cutting and scraping action. The device is designed to convert the small input effort applied by the user into a larger mechanical force that can effectively remove the fibrous saffron layer from the coconut. When the user presses the pedal, the input motion is transmitted through a system of levers or linkages to a set of jaws or blades arranged strategically around the coconut. These jaws move in a coordinated manner to press against and scrape the surface of the coconut uniformly, ensuring that the saffron is removed without causing damage to the hard shell or the inner kernel.

The design ensures even distribution of force across all contact points, which allows the device to handle coconuts of varying sizes, shapes, and hardness. By applying controlled pressure, the jaws remove the saffron efficiently, reducing wastage and maintaining the quality of the coconut for both religious offerings and commercial purposes.

Being manually operated, the device does not require electricity or any external power source, making it highly suitable for rural areas, small-scale industries, and temple settings. The mechanical advantage provided by the lever and jaw system reduces the physical strain on the user, allowing safe and prolonged operation. This principle of operation not only ensures uniform saffron removal but also enhances overall productivity, minimizes processing time, and provides a safer alternative to traditional manual methods, which often involve knives or sharp tools that can cause hand injuries.

In summary, the working principle combines manual input, mechanical force amplification, and coordinated multi-jaw action to deliver a safe, efficient, and consistent method of coconut saffron removal, suitable for both small-scale and industrial applications.

7. ADVANTAGES

- The mechanical coconut saffron remover significantly reduces labor and human effort by efficiently performing the repetitive task of saffron removal.
- It speeds up the saffron removal process, enabling larger quantities of coconuts to be processed in less time.
- The device improves safety by eliminating the need for knives or sharp tools, thereby reducing the risk of hand injuries during operation.
- It ensures consistent and uniform saffron removal, maintaining the quality of coconuts for both religious and commercial purposes.
- The device is low-cost, durable, and requires minimal maintenance, making it practical and accessible for small-scale users, temples, and rural applications.

8. APPLICATIONS

- The device can be used in temples for mass coconut offerings, allowing temple authorities to process large quantities of coconuts efficiently and safely.
- Coconut farmers can use the remover for post-harvest processing, reducing manual effort and increasing productivity while preparing coconuts for sale or further use.
- Small-scale coconut product industries can incorporate the device into their operations to ensure uniform saffron removal, improving the quality of coconut-based products.
- Households can benefit from the device for personal coconut processing, making it easier and safer to prepare coconuts for cooking or other domestic purposes.
- Rural areas without reliable electricity can utilize the manually operated device, as it does not require external power and is suitable for use in low-resource settings.

9. FUTURE SCOPE

- The coconut saffron remover can be further developed into a motorized or semi-automatic version to handle larger volumes of coconuts more efficiently.
- Adjustable mechanisms can be incorporated to automatically accommodate different coconut sizes and variations in saffron hardness, ensuring uniform removal in all cases.
- The device can be scaled up for small industries and commercial use, increasing its applicability beyond temples and households.
- Portable and lightweight versions can be designed for easy use in rural areas, improving accessibility for farmers and small-scale users.
- Advanced features such as sensors or partial automation can be integrated to enhance precision, reduce wastage, and improve overall efficiency.
- Using food-grade, corrosion-resistant, and durable materials can further improve hygiene, longevity, and sustainability of the device.

10. CONCLUSION

The mechanical coconut saffron remover offers a practical and efficient solution to the challenges associated with traditional manual saffron removal. By providing uniform and complete removal of the fibrous layer, it significantly reduces human effort and processing time, while minimizing safety risks associated with knives and sharp tools. Its simple, low-cost, and low-maintenance design makes the device accessible to a wide range of users, including temple authorities, small-scale industries, rural households, and coconut farmers. The device has demonstrated consistent performance, durability, and adaptability across coconuts of varying sizes and hardness, ensuring reliability in real-world applications. Overall, this project contributes not only to improved productivity and better utilization of coconuts but also to enhanced safety and livelihoods for those involved in coconut processing. Furthermore, the design lays a strong foundation for future advancements, such as motorized or automated versions, adjustable mechanisms for different coconut sizes, and the incorporation of advanced materials, which can further increase efficiency, precision, and usability.

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BIOGRAPHIES

Dnyaneshwari Vitthal Gophane is a student in the Department of Mechanical Engineering at SVERI's College of Engineering, Pandharpur. She has a keen interest in mechanical design, small-scale industrial machines, and agricultural processing devices. She has worked on projects focused on improving efficiency, safety, and productivity in traditional manual processes. Her research emphasizes practical, cost-effective, and user-friendly mechanical solutions for rural and industrial applications. She aims to contribute to innovations that enhance resource utilization and support local industries.