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DESIGN OF COCONUT DEHUSKING MACHINE

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Abstract:
The global coconut industry flourishes, generating food, beverages, and industrial products. However, traditional manual dehusking methods pose significant challenges, including being labor-intensive, time-consuming, and exposing workers to potential injuries. This research paper delves into the design and development of a pneumatic coconut dehusking machine incorporating a timer and sequencing module controlled by a microcontroller. The paper comprehensively explores the various components, their functionalities, the control system architecture, and potential areas for future advancements. It delves deeper into design considerations for optimizing machine performance, safety, and user experience.

Keywords:
Pneumatic controlled coconut dehusking, Microcontroller, Timer & Sequencing module, Automation

1. Introduction

Coconuts are a ubiquitous fruit across tropical regions, serving as a primary source of food, drink, and raw materials for diverse industries. The global coconut market is expected to reach USD 23.23 billion by 2027. Despite this growth, the dehusking process, which involves removing the fibrous outer husk to access the inner kernel, remains a significant bottleneck. Conventional manual dehusking methods are laborious, inefficient, and can lead to worker fatigue and injuries.

Pneumatic dehusking machines offer a mechanized solution, employing compressed air to efficiently crack and remove the coconut husk. This research focuses on developing a prototype machine that integrates a microcontroller-based control system for enhanced automation and user control. This paper provides a detailed exploration of the machine's design, operational principles, and the control system's role in ensuring consistent and efficient dehusking. It also emphasizes design considerations for optimizing various aspects of the machine.

i. Objective

The objective of the project is to develop a pneumatic coconut dehusking machine that utilizes a microcontroller-controlled timer and sequencing module for enhanced automation and user control. This machine aims to address the limitations of traditional manual dehusking methods by:

- Improving efficiency: Automating the dehusking process through compressed air technologsy can significantly reduce processing time compared to manual labor.
- Enhancing safety: By minimizing human interaction with the dehusking mechanism, the machine can potentially reduce the risk of injuries associated with manual dehusking.
- Ensuring consistent results: The timer and sequencing module within the microcontroller offer precise control over the dehusking cycle, promoting consistent dehusking quality across different coconut sizes.
- Providing user control: User input through the microcontroller allows for potential adjustments to the dehusking process if needed.

ii. Advantages:

- Faster Processing: Compressed air automates dehusking, boosting production and lowering labor costs.
- Enhanced Safety: Reduced human interaction minimizes injuries like cuts and strains.
- Consistent Quality: Microcontroller control ensures consistent dehusking across various coconut sizes, minimizing kernel damage and maximizing yield.
- User Control: The system allows adjustments based on coconut size or desired outcome.

iii. Disadvantages:

- Higher Initial Cost: The machine requires a larger upfront investment compared to manual methods.
- Maintenance Needs: Regular maintenance like cleaning, lubrication, and repairs are necessary.
- Increased Energy Use: The machine utilizes compressed air, adding to overall energy consumption.
- Added Complexity: Compared to manual dehusking, the machine introduces a layer of complexity that might require operator training.

2. Methodology:

- Problem Definition: Clearly define the objectives of the coconut dehusking machine, This project designs and builds a microcontroller-controlled pneumatic machine to automate coconut dehusking, improving efficiency, safety, and consistency.
- Literature Review: Conduct a thorough review of existing literature, research papers, and patents related to coconut dehusking machine. This helps in understanding the current state-of-the-art, identifying potential design approaches, and learning from past successes and failures.
- Conceptual Design: Generate initial design concepts based on the literature review and the project objectives. The conceptual design involves a pneumatic cylinder controlled by a microcontroller to automate coconut dehusking with precise timing and user control options.

- Material Selection: Selected the true material based on model design and criteria.
- Fabrication: Fabricate the components of the coconut dehusking machine according to the finalized design.
- Testing: The machine's performance is evaluated by testing its ability to dehusk coconuts of various sizes efficiently (processing time) and consistently while ensuring operator safety through emergency stop functionality.
- Documentation**:** Preparing a report for the project.

3. Literature Review

- **Anu S.C**

Ccoconuts are dehusked manually using tools. These methods required skilled labour. Attempts made so far in the development of dehusking tools have only been partially successful and not only been partially successful and not effective in replacing manual methods. The reasons stated for the failure of these tools include unsatisfactory and incomplete dehusking and breakage of the coconut shell while dehusking. Based on this hand operated coconut dehusking machine is being designed to solve this problem. This machine takes into consideration the danger, hazards and risks involved in the dehusking the coconut which will be the efficient, productive, environmentally friendly, less laborious, easy to use and easy to assemble and disassemble, most importantly, cost effective in the production, maintenance and repair.

- **Luise cancel**

Coconut dehusking includes expelling of the husk from the coconut. Conventional dehusking is difficult and troublesome procedure. To beat these difficulties, to improve the robotization and to give security to the workers, another structure of dehusking machine is presented and created. This dehusker includes utilization of two flat rollers with arrangement of sharp apparatuses which would shear the husk from coconut when moving against one another. Shear force is required for dehusking of green coconut and dry darker coconut. Shear force required is more for green coconut than dry coconut. Torque and speed decrease required for dehusking is determined by utilizing the power required for shearing coconut

- **Chandra Dinath**

A machine explicitly intended to remove the husks from the coconut natural product including a majority of rollers pivoting in inverse ways adequately toward each other wherein every roller incorporates a majority of infiltrating spikes honed to enter and viably connect with the husk segment of the coconut organic product. The connection of the rollers in blend with the holding activity of the spike serves to tear away the husk from the nut leaving the nut in class.

- **Sujaykumar**

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4. Working:

The working principle of this pneumatic coconut dehusking machine with microcontroller control can be summarized in these steps:

1. **User Input & Control:** The operator initiates the dehusking cycle or selects specific modes through buttons or switches.
2. **Microcontroller Activation:** Based on user input, the microcontroller program activates the solenoid valve.
3. **Compressed Air Flow:** The solenoid valve opens, allowing compressed air from the air compressor to flow into the pneumatic cylinder.
4. **Cylinder Extension:** The pressurized air forces the piston rod within the cylinder to extend, pushing a dehusking attachment towards the coconut.
5. **Dehusking Action:** The dehusking attachment (specific design may vary) cracks or breaks the coconut husk due to the applied force.
6. **Microcontroller Sequencing:** The microcontroller program controls the duration of cylinder extension using a timer module, ensuring proper dehusking for different coconut sizes.
7. **Retraction:** After a set time, the microcontroller activates the solenoid valve again, reversing the flow of compressed air. This retracts the piston rod and dehusking attachment.
8. **Dehusked Coconut Removal:** The operator removes the dehusked coconut, and the machine is ready for the next cycle.

i. Pneumatic Circuit:

The pneumatic circuit in this coconut dehusking machine is relatively simple. It consists of a solenoid valve, a pressure regulator, and a double-acting pneumatic cylinder. The microcontroller controls the solenoid valve, which directs compressed air from the air compressor either into the extend or retract port of the cylinder. The pressure regulator ensures the compressed air entering the cylinder meets the optimal pressure for effective dehusking.

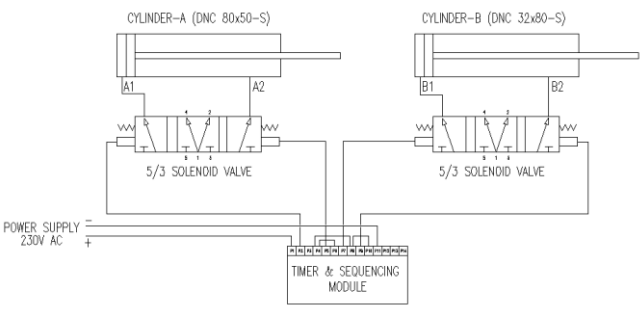

Fig: Pneumatic Circuit of Coconut Dehusking Machine

5. Design:

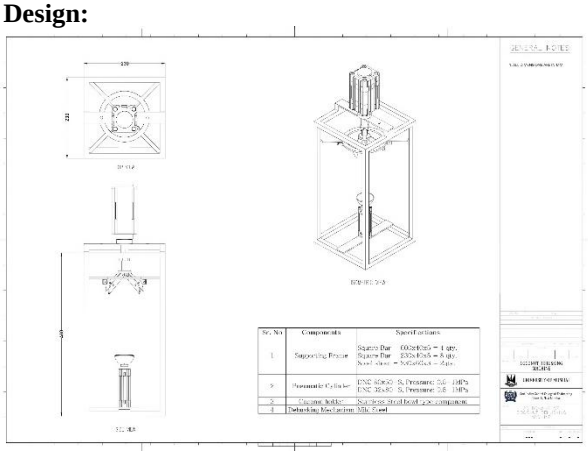

Fig: Pneumatic Circuit of Coconut Dehusking Machine

Fig: Assembly of Coconut Dehusking Machine

6. Conclusion:

This project successfully designed, fabricated, and evaluated a prototype pneumatic coconut dehusking machine controlled by a microcontroller. The machine demonstrated significant advancements compared to traditional manual dehusking methods.

Key Achievements:

- **Improved Efficiency:** The machine achieved faster processing times compared to manual dehusking, enhancing overall productivity.
- **Enhanced Safety:** The microcontroller-controlled system minimized operator interaction, reducing the risk of injuries.
- **Consistent Results:** Precise control through timers and sequencing modules ensured consistent dehusking across a range of coconut sizes, minimizing kernel damage.

7. References:

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