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EFFICIENT AUTOMATION OF COCONUT LEAF MIDRIB SEPERATION

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Abstract-Coconut trees are everywhere in our country and we can use them in many ways. This project is about making a machine that takes out the middle part of coconut leaves. The primary objective of this endeavour is to introduce a modernized and less labour-intensive method for extracting midribs, thus enhancing the efficiency of this crucial process. Different parts of the coconut tree are useful for making things in industries and for medical purposes. The middle part of the coconut leaf, called the midrib, is good for making brooms, paper and strong fibers. These fibers are important in making things, but we don't have enough of them because it's hard to get the midrib out. Right now, people have to do it by hand, and it takes a lot of time and people. By inputting a single coconut leaf into our system, it undergoes a meticulous process where the leaves are expertly removed, leaving only the midribs as the final output. This cutting-edge technology not only simplifies the labour-intensive task of leaf removal but also ensures the consistent production of high-quality midribs, offering a versatile solution for various applications in an eco-friendly and sustainable manner.

I. INTRODUCTION

The coconut tree (Cocos nucifera) has long been revered as a fundamental source of sustenance, shelter, and diverse raw materials, making it an intrinsic part of human existence. From providing nourishment and beverages to offering durable fibers and versatile construction materials, coconuts have earned their place as an indispensable natural resource. Amid the numerous applications of the coconut, one particularly intriguing aspect is the ingenious creation of practical brooms from the tree's generously proportioned leaves. This innovation not only underscores human ingenuity but also addresses the challenge of efficiently utilizing fallen leaves, bypassing the laborious task of harvesting them from towering heights. The coconut's utilitarian prowess extends beyond broom-making, notably embracing the midrib – the central vein of the coconut leaf. Beyond its role in the crafting of brooms, the midrib has demonstrated its multifaceted significance, transcending conventional applications into the realm of medicine. Our exploration has unveiled a latent potential for the midrib to serve as a resilient material for composite production, owing to its robust composition boasting 30% cellulose and 16% lignin. This composition lends itself to reinforcement, rendering the midrib suitable for bolstering structural components like door panels, roofing sheets, and packaging materials. Nevertheless, the conventional extraction of midribs from coconut leaves poses a formidable challenge, characterized by its labor - intensive and time-consuming nature. In response, our study culminates in the development of a groundbreaking solution – a specialized midrib extraction machine. This ingeniously designed apparatus capitalizes on mechanization, employing the rollers and blades to separate the midribs from coconut leaves. By automating this process, we not only alleviate the burdens of manual labor but also expedite the extraction of valuable midrib resources.

II. Literature Survey

The paper "Design and Development of a Novel Machine to Separate Midribs from Coconut Leaves" presents an innovative approach to automate the process of separating midribs from coconut leaves, a task traditionally performed manually. The authors address the challenges of labor-intensive and time-consuming manual separation by proposing a novel machine that streamlines the process while maintaining the integrity of the coconut leaves. The machine's design and development are meticulously detailed in the paper. The authors discuss the key components, mechanisms, and engineering principles employed in the machine's construction. They emphasize the importance of preserving the structural integrity of the coconut leaves during separation to ensure their usability in various applications such as thatching, weaving, and handicrafts. "Design and Development of a Novel Machine to Separate Midribs from Coconut Leaves" introduces a significant contribution to agricultural and manufacturing practices. The proposed machine offers a solution to a labor-intensive process, enhancing productivity and promoting the sustainable use of coconut leaves. This innovation holds the potential to revolutionize industries reliant on coconut leaves while also reducing the strain on manual laborers. Further research and optimization could lead to broader adoption and even more refined versions of the machine.

The paper "Study of Physical Attributes of Indian Coconut Leaves for Efficient Midrib Separation" investigates the physical properties of coconut leaves in India to enhance the process of separating midribs from the leaves. By examining attributes such as flexibility, strength, and thickness, the study aims to establish connections between leaf characteristics and the ease of midrib separation. The findings could lead to more effective and sustainable utilization of coconut leaves in applications such as thatching, weaving, and crafts, benefiting industries and communities that rely on these resources.

The paper "Flexural and Impact Properties of Midrib of Coconut Palm Leaves Reinforced Polyester" explores the mechanical properties of coconut palm leaf midribs when used as reinforcement in polyester composites. The study focuses on assessing the flexural and impact characteristics of these composite materials, which could have implications for various engineering and manufacturing applications. It investigates the mechanical properties of composite materials made by incorporating coconut palm leaf midribs into polyester. The study's results could have implications for the development of eco-friendly and mechanically robust materials for various industrial applications.

The paper "Coconut (Cocos nucifera L.: Arecaceae): in Health Promotion and Disease Prevention" by Deb Mandal and Shyamapada Mandal, explores the potential health benefits of coconut (Cocos nucifera) and its various components. The authors focus on its traditional uses, nutritional value, and potential medicinal properties. In this paper, the authors likely discuss the diverse aspects of the coconut plant, including its fruit, water, oil, and other byproducts, which have been consumed and used for centuries across various cultures. They may delve into the nutritional composition of coconuts, emphasizing their rich content of healthy fatty acids, vitamins, minerals, and antioxidants. The authors likely highlight the traditional uses of coconut in folk medicine and its relevance to health promotion and disease prevention. They may explore the potential benefits of coconut consumption, which could include boosting immunity, promoting heart health, aiding digestion, and contributing to overall well-being.

The paper titled "Identification, Quantification and Characterization of Palm-Tree and Fruit Wastes" focuses on a comprehensive study involving the identification, quantification, and characterization of waste materials derived from palm trees and fruits. The research aims to provide a detailed understanding of the composition, quantity, and physical/chemical properties of these waste materials, which are abundant in regions where palm trees and fruits are grown. It provides a comprehensive analysis of waste materials derived from palm trees and fruits. Through identifying, quantifying, and characterizing these wastes, the study aims to contribute to improved waste management strategies, environmental sustainability, and the exploration of potential economic uses for these materials.

The paper titled "Load–Settlement Behaviour of Coconut Midrib Strip Geogrid Reinforced Granular Soil" likely investigates the mechanical behaviour of granular soil reinforced with coconut midrib strip geogrid. The research probably focuses on understanding how the geogrid, made from coconut midrib strips, enhances the load-bearing capacity and settlement characteristics of granular soil. It investigates how coconut midrib strip geogrid reinforcement affects the load-bearing capacity and settlement behaviour of granular soil. The research's findings could contribute to more effective soil reinforcement techniques, with potential applications in geotechnical engineering and infrastructure development.

The paper titled "Coconut (Cocos nucifera L.: Arecaceae): in Health Promotion and Disease Prevention," published in the Asian Pacific Journal of Tropical Medicine, explores the potential health benefits of coconut (Cocos nucifera) and its role in promoting well-being and preventing diseases. The authors investigate the nutritional and medicinal properties of different parts of the coconut plant. The paper likely delves into the traditional uses of coconut in various cultures and its significance in promoting health. It may discuss the nutritional composition of coconuts, emphasizing their content of healthy fatty acids, vitamins, minerals, and antioxidants. It aims to contribute to the understanding of how coconut could be utilized as part of a health-promoting diet and lifestyle, potentially offering insights into disease prevention and overall well-being.

The paper "Study of Physical Attributes of Indian Coconut Leaves for Efficient Midrib Separation" investigates the physical characteristics of coconut leaves in India with a focus on improving the process of separating midribs from the leaves. The research likely aims to enhance the efficiency and effectiveness of this separation, which is crucial for various applications including thatching, weaving, and crafts. It aims to enhance the understanding of the physical characteristics of Indian coconut leaves and their impact on the process of midrib separation. The research's outcomes could offer insights into more effective separation methods and contribute to the improvement of industries utilizing coconut leaves for various applications.

The paper titled "Value Addition, Product Diversification and By-Product Utilization in Coconut" likely

explores strategies and opportunities for maximizing the utilization of coconut and its by-products to enhance value, diversify products, and minimize waste. The research likely focuses on the various ways in which coconut, a versatile and resource-rich plant, can be utilized beyond its traditional uses. It explores innovative ways to enhance the utilization of coconut and its by-products, aiming to increase value, reduce waste, and expand product offerings. The research's outcomes could offer valuable guidance for industries and stakeholders interested in optimizing the potential of this versatile plant.

The paper titled "Coconut Leaf Midribs as an Acoustical Panel–Feasibility Study through Impedance Tube Method" likely investigates the potential of using coconut leaf midribs as an acoustical panel material. The research probably explores the feasibility of utilizing these natural materials to enhance sound absorption or insulation properties in architectural and acoustic applications. It likely investigates the acoustical potential of coconut leaf midribs through experimental analysis. The study's outcomes could contribute to the development of innovative and environmentally friendly materials for improving sound quality and acoustic comfort in architectural and interior design contexts.

III. Proposed Methodology

This chapter focuses about the block diagram and the methodology followed to separate the midribs from the coconut leaves.

A. Block Diagram

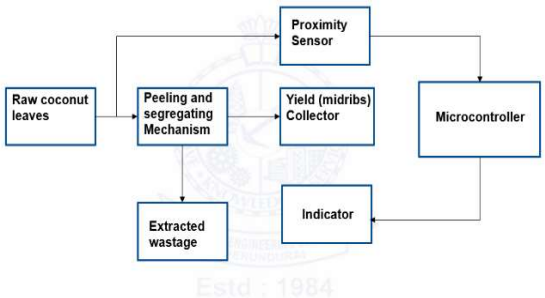

Fig 3.1.1

B. Existing Method:

The process of separating the midribs from the coconut leaves is done by the using the spiked rollers, which tends to break the midribs. The spiked rollers were used to remove the leaves from the midribs, the spikes in the rollers will affect the strength of the sticks which will result in the greater inefficiency in production. In this mechanism the coconut leaves need to be given in and out simultaneously for three to four times to get the midribs separated from the leaves, shown in figure 3.2. This tend to increase the risk of being injured by the spiked rollers while doing the midrib separation process.

C. Proposed Methodology:

Time In this project, we embarked on a comprehensive methodology to develop a specialized midrib extraction machine for coconut leaves. The process began with extensive research and data collection, delving into the composition of coconut leaves and the challenges associated with traditional manual midrib extraction. The subsequent stage involved the meticulous design and engineering of the machine, with a focus on materials, dimensions, and component specifications. Automation played a pivotal role in this endeavour, with the development of an efficient system to streamline the extraction process, incorporating safety features to ensure the well-being of operators. Roller and blade specifications were carefully determined to facilitate the movement of coconut leaves and enable efficient midrib separation.

Safety measures included the integration of blade guards, emergency stop mechanisms, and user-friendly controls. A working prototype of the machine was then constructed and rigorously tested with various types of coconut leaves to assess its effectiveness, efficiency, and safety. Based on the data collected during testing, the machine underwent optimization and refinement to ensure it operated with minimal waste and high efficiency across diverse conditions. Transitioning from the prototype phase, we moved on to manufacturing a production model, taking into account cost-effective manufacturing methods and scalability. The environmental impact of the machine was assessed, with a focus on energy consumption, waste generation, and ecological considerations. The entire development process was meticulously documented, encompassing challenges, solutions, and outcomes, and these findings will be shared through research publications, presentations, and comprehensive project reports.

IV. Hardware Description

In this chapter discuss about the components description which are used in the setup of coconut leaf midrib separation.

A. List of Components

- Base frame
- Rollers
- AC motor
- Proximity sensor
- Blades
- Indicator
- Arduino
- Blade Positioner.

B. Base Frame

Fig 4.2.1

Figure 4.2.1 – is the base frame of the specialized midrib extraction machine serves as the foundation for the

entire apparatus, playing a critical role in its stability and functionality. It is typically constructed from durable materials such as stainless steel or robust alloys, ensuring that it can withstand the rigors of the midrib extraction process. The design of the base frame is meticulously engineered to provide structural support for all machine components, including the rollers, blades, automation system, and the midrib collection unit. One of the primary considerations when designing the base frame is to maintain a stable and level platform for the machine. This is essential to prevent any unwanted vibrations or shifts during operation, which could compromise the safety and efficiency of the machine. The base frame is designed to accommodate the weight and motion of the moving parts without flexing or warping for that the height of the frame is 18 inches, the breadth of the frame is 18 inches and the width of the frame is 12 inches. Moreover, the base frame often includes mounting points for the machine's motors, gears, and the automation control system. These components need to be securely attached to ensure proper alignment and operation. The frame may also incorporate adjustable feet or levelling mechanisms to account for uneven surfaces, further enhancing stability. In addition to structural support, the base frame may include integrated channels or conduits for routing power cables, control wiring, and hydraulic or pneumatic lines, depending on the machine's specific design. This organized routing of connections helps maintain a tidy and safe workspace, reducing the risk of accidental damage to wiring or hoses.

C. Rollers

Fig 4.3.1

Figure 4.2 - Rollers are pivotal components in the specialized midrib extraction machine, guiding coconut leaves efficiently for midrib separation. Rollers are typically constructed from durable materials such as robust plastics these rollers ensure smooth leaf movement while preventing damage. They are strategically positioned, often in pairs, along the feeding path to guide the leaves and minimize blockages. The rollers' smooth surfaces safeguard the delicate coconut leaves from tearing or bruising during transit. Adjustable roller settings provide flexibility to accommodate various leaf sizes and types. In tandem with sensors and controls, the rollers are synchronized with the automation system to maintain proper timing and speed for leaf feeding, ensuring operational efficiency and reducing the risk of jams. Regular maintenance is essential for peak performance, including cleaning to prevent debris buildup and scheduled inspections to replace worn components. Safety mechanisms and guards are integrated into the roller system to prevent operator contact with moving parts, ensuring a safe working environment. In summary, rollers play a fundamental role in the machine's smooth operation, ensuring damage-free leaf feeding and efficient midrib separation while prioritizing safety and maintenance.

D. AC Motor

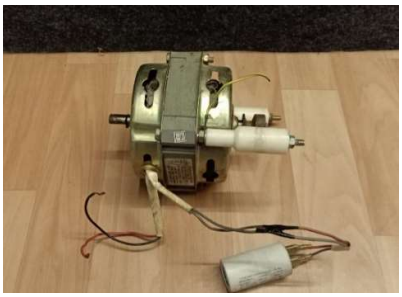

Fig 4.4.1

Figure 4.4.1 –shows the single-phase AC motor chosen for the specialized midrib extraction machine is designed for reliable and cost-effective operation. It operates on standard household voltages (typically 230V) and 50 Hz frequency, with the specific voltage depending on the region where the machine is used. The motor's power rating is carefully selected to match the machine's requirements, considering factors such as load, desired speed, and overall efficiency. The motor's efficiency, often expressed as a percentage, is optimized to reduce energy consumption and operational costs, the efficiency of this motor ranges from 60% to 70%. It may incorporate starting mechanisms like split-phase or capacitor-start for smooth initiation of rotation. Safety features, including thermal overload protection, are integrated to prevent overheating. Maintenance tasks, such as lubrication and periodic inspections, ensure continued reliable operation. Compliance with safety and efficiency standards in the applicable region is a key consideration when selecting the motor, guaranteeing its safe and reliable performance within the midrib extraction machine.

E. Proximity Sensor

Fig 4.5.1

Figure 4.5.1 - proximity sensors, used in the specialized midrib extraction machine, are devices that detect the presence of objects close to them. Proximity sensors available in different types, like inductive, capacitive, ultrasonic, and optical sensors, each suited for specific materials and applications. Proximity sensors operate by sending out signals and measuring their reflection or changes when an object is nearby. They're crucial for automating tasks in the machine, like ensuring the count of midribs extracted. These sensors are durable, adjustable for sensitivity, and require periodic maintenance to function optimally. They're a vital part of the machine's control system, making it more efficient and safer in an industrial setting.

F. Blades

An 18mm paper cutting knife features a blade with a width of 18mm, making it ideal for precision cutting tasks.

These knives commonly employ high-quality steel or stainless-steel blades, ensuring durability and sharpness for clean and p thickness of 0.1mm to 0. t or serrated, depending ments, while ergonomic h ring extended use. Figure used in this project. Saf ds and lock mechanisms idents. Many models have ntenance, and upkeep. Witl heets of paper or thin cardboard, 18mm paper cutting knives are versatile tools suitable for various applications, from trimming documents to crafting projects. Brands and models vary, impacting overall performance and durability, and pricing can range depending on the features and quality offered. Always exercise caution and adhere to safety guidelines when handling and storing these knives, given the sharpness of the 18mm blade.

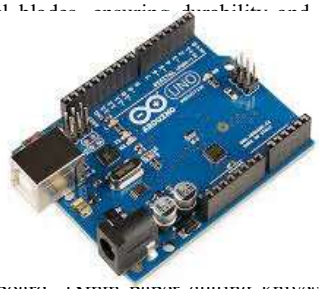

Fig4.6.1

G. Indicator

Fig 4.7.1

Figure 4.7.1 - Indicating lamps are versatile visual signalling devices used across various applications, each with its own set of specifications. These lamps can be of different types, including incandescent, LED, or neon, and are designed to operate at specific voltage levels and current ratings, such as 12V, 24V, or 220V, to ensure compatibility with the electrical circuit. The choice of colour, which can be red, green, yellow, blue, or white, is crucial as it conveys specific messages or status updates. Brightness, typically measured in candelas for LEDs, should be considered to meet visibility requirements. The mounting type, size, and shape of the indicating lamp must align with the equipment's installation and aesthetic demands. For outdoor or harsh environments, an Ingress Protection (IP) rating is important to indicate resistance to moisture and dust. Additionally, assessing the lamp's operating temperature range, life expectancy, and any necessary certifications, such as UL or CE, ensures the lamp's suitability for the intended application.

H. Arduino

Fig 7.8.1

Figure 4.8.1 - The Arduino is a popular open-source microcontroller platform that provides a versatile and accessible way for both beginners and experienced electronics enthusiasts to create interactive and embedded projects. Arduino boards are available in various models, with the Arduino Uno being one of the most common. These boards typically feature an Atmel AVR microcontroller, digital and analog input/output pins, a USB interface for programming and power supply, and various communication interfaces like UART, I2C, and SPI. Arduino is known for its user-friendly and open-source development environment, which includes the Arduino IDE for programming using a simplified version of C/C++. It offers a supportive community, extensive libraries, and a wide range of shields and accessories to expand functionality. Arduino boards are widely used in robotics, IoT applications, home automation, and educational settings, making them a go to choice for prototyping and building interactive electronic projects.

I. Blade Positioner

Fig 4.9.1

Figure 4.9.1 – Represents the blade positioner. It is actually a wire tightner used for tightening the wires or cables. Here we have used it to fix the position of the blades. The blades are screwed to the holes in the blade positioner. By screwing the blades to the positioner, it can hold the blades tightly in the position so that the blades never moves or miss aligns when the coconut leaves are pushed towards the blade with a force to separate the midribs from the leaves. It also helps in improving the output efficiency as it holds the position of the blades firmly.

V. Results and discussion

This chapter deals about the results of midrib separation and the final broomstick making.

A. Result:

The project has yielded a successful outcome in the form of an innovative midrib extraction machine, incorporating a PIC controller and a range of components to enhance the efficiency and automation of midrib extraction from coconut leaves. This achievement is marked by several key advantages. First and foremost, the machine significantly reduces the need for manual labor, expediting the extraction process and subsequently increasing overall productivity while lowering operational costs. The automation inherent in the system ensures consistent and standardized midrib extraction, thereby enhancing the quality and reliability of the final product. The incorporation of safety features, such as proximity sensors, contributes to a safer working environment and minimizes the risk of accidents. In terms of economic benefits, the automation of the extraction process offers significant potential for enhancing productivity and reducing labour costs in coconut farming communities and related industries.

Furthermore, the scalability of the project's design and automation can be tailored to meet the demands of different production levels and geographic regions. In summary, the project's result is a holistic solution that not only addresses the challenges of midrib extraction but also underscores the core values of efficiency, safety, sustainability, and economic viability in the processing of coconut leaves. This results section combines a wealth of visual evidence and data to underscore the tangible advantages of our innovative midrib separation solution. It reinforces how our system enhances operational efficiency, reduces costs, eliminates human errors, and ensures consistent product quality, making it a significant advancement in the process of midrib separation and making broomsticks.

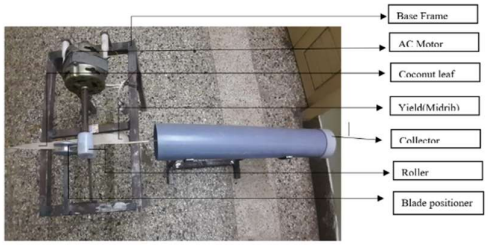

Fig 5.1.1

Figure 5.1 illustrates the prototype design, wherein a combination of midrib sensors and integrated controllers has been employed for the precise separation of midribs from coconut leaves. This innovative system exemplifies a sophisticated approach to midrib extraction, offering both precision and automation in the process, ensuring efficient and accurate results. The deployment of midrib sensors in conjunction with advanced control mechanisms represents a notable advancement in our quest for enhanced efficiency in midrib separation from coconut leaves

Fig 5.1.2

Figure 5.1.2 provides a visual representation of the midrib yields obtained as the output of the midrib separation process. These results signify the successful culmination of the separation process, where the individual midribs are efficiently extracted from the coconut leaves. This output demonstrates the effectiveness and precision of our system in achieving the desired outcome, further underlining the value of the innovative technology applied in the midrib separation process.

Fig 5.1.3

The extracted midribs can be used to make broom, each broom may consist of 30 to 40 midribs. These 30 to 40 midribs will be tied together with a rope or they can be strapped together to get a final product as a broom as shown in the Figure 5.1.3

Time in hours	Number of Midribs Extracted	
	Traditional Method	Machine Output
1	300	720

Table 5.1

Table 5.2 illustrates a remarkable achievement in the domain of midrib removal from broomsticks. Our solution enables the efficient extraction of 720 midribs in just one hour, a substantial improvement compared to the manual process, which typically yields 300 midribs within the same time frame. This advancement not only augments production efficiency but also alleviates the physical strain and labour-intensive aspects of the task, thereby enhancing the well-being of the workforce. It signifies a noteworthy progression in optimizing

the broomstick manufacturing process, delivering advantages in both output and worker welfare.

VI. Summary and Conclusion

This project represents a significant advancement in the field of coconut leaf processing, specifically in the area of midrib extraction. we have successfully engineered a system wherein a single input, represented by a single coconut leaf, yields a remarkable output of 720 midribs in an hour (Table 5.4). This substantial increase in efficiency significantly outpaces the manual process, which typically yields only 300 midribs under the same circumstances. Recognizing the industrial demand for higher production volumes, we are poised to advance to the next phase of development. We scope further to enhance and optimize our system to achieve even greater midrib output, ensuring it meets the requirements of large-scale industrial applications. This endeavor represents a significant step forward in streamlining the midrib extraction process and catering to the increased production needs of our industry. As, we move forward into the next phase of our project, we intend to expand the scope and functionality of our system. In addition to the midrib removal process, we aim to incorporate additional features for counting the number of broomsticks processed. Furthermore, we will scope to automate the entire mechanisms by bundling and packaging the end product, resulting in a finished broomstick ready for distribution.

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