DESIGN AND DEVELOPMENT OF A LOW-COST SEMI-AUTONOMOUS ARECANUT GATHERING MACHINE

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Keywords:

Arecanut collector, automation, ESP32, Arduino Uno, Blynk IoT, conveyor belt, rotating brush, bin swapping, smart farming.

Introduction:

1. Agriculture is a major income source in India, with arecanut cultivation important in Karnataka and Kerala. After drying, farmers manually collect arecanuts, which is slow, tiring, and risky in wet conditions.
2. This project proposes a low-cost automated arecanut gathering machine using an ESP32. It operates in manual and automatic modes via the Blynk app. A rotating brush collects the nuts, a conveyor transports them, and they are stored in a bin—reducing labor, time, and fatigue.

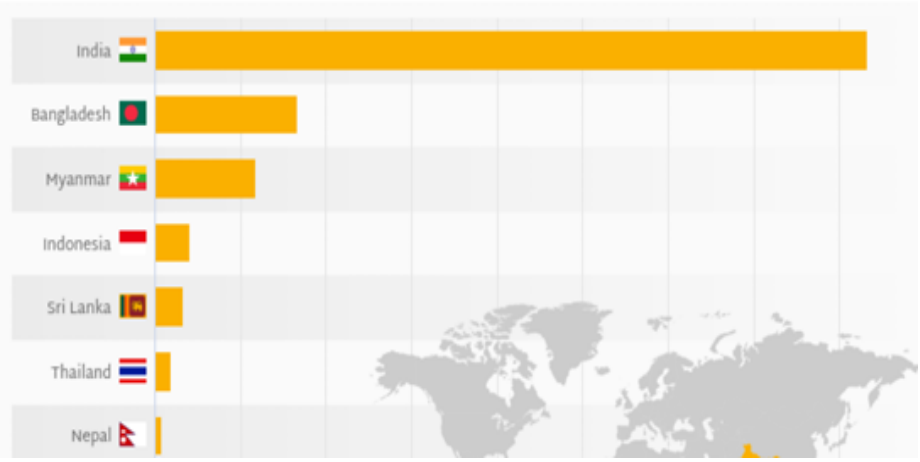

Figure 1: Area of Arecanut in Different countries

Objectives:

1. To develop a robot that operates in two modes: manual and automated.
2. To create a template in Blynk application to switch between these modes.
3. A conveyor belt and brush mechanism is used for gathering arecanuts from the ground.
4. To implement an automatic storage bin replacement system using a servo motor and Arduino.

Methodology:

The system integrates IoT, automation, and motor control using ESP32 (master) and Arduino Uno (slave) for efficient arecanut collection and storage.

- Power System: Separate batteries (9V for Arduino, 12V for motors) ensure stable operation.
- Control System: ESP32 controls movement and communication via Blynk, while Arduino handles bin replacement through I2C.
- Navigation: Ultrasonic sensors detect obstacles and guide movement in automatic mode.

Working Process:

- User selects manual or automatic mode using Blynk app.
- In automatic mode, the robot follows an S-shaped path to cover the field.
- A rotating brush collects arecanuts and transfers them to a conveyor belt.
- The conveyor moves nuts into the collection bin.

Automatic Bin Replacement:

- Ultrasonic sensor monitors bin level.
- When full, servo motors seal, remove, and replace the bag automatically.
- This enables continuous operation with minimal human intervention.

Result and Conclusion:

The machine automates arecanut collection using an Arduino-controlled system with rotating brushes, a conveyor belt, and sensors to efficiently gather nuts without damage. It includes a servo-based automatic bin replacement system that swaps full bins with empty ones via Blynk control, enabling continuous operation without human effort. Designed for stability and reliability in various terrains, it reduces labour, time, and cost, making it suitable for small-scale farming and improving overall productivity.

References:

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Project Outcome & Industry Relevance:

The project successfully developed a low-cost semi-autonomous arecanut gathering machine aimed at reducing manual labor in agriculture. The system integrates ESP32 and Arduino controllers to perform efficient collection, transportation, and storage of arecanuts. By automating repetitive tasks such as picking and bin handling, the machine significantly reduces time, effort, and physical strain on farmers. The use of a rotating brush and conveyor mechanism ensures minimal damage to the nuts while maintaining good collection efficiency.

The project is highly relevant to the agricultural industry, especially in regions like Karnataka and Kerala where arecanut farming is prominent. It supports small-scale farmers by providing an affordable and practical solution. Additionally, the system demonstrates the potential of IoT-based automation in agriculture, contributing to increased productivity and modernization of farming practices.

Working Model vs. Simulation/Study:

The project is implemented as a working hardware model rather than just a simulation. All components, including motors, sensors, conveyor system, and control units, were physically tested in real-time conditions. Compared to simulation, the working model provided better insights into real-world challenges such as terrain handling, power management, and mechanical stability. This hands-on implementation ensures the system is practical, reliable, and ready for further development.

Project Outcomes and Learnings:

- Gained practical knowledge of ESP32 and Arduino integration.
- Learned motor control, sensor interfacing, and IoT-based communication using Blynk.
- Understood mechanical design aspects like conveyor systems and rotating brush mechanisms.
- Improved problem-solving skills through real-time hardware troubleshooting.
- Developed knowledge in automation for agricultural applications.
- Learned system integration of hardware and software components.

Future Scope:

The future scope of this project includes:

- Integration of a camera sensor to classify arecanuts from other nuts during harvesting for improved accuracy.
- Improvement in battery efficiency for longer operation time.
- Improvement of the collection process by implementing a heat sealing mechanism for automatic bag sealing.
- Enhancement of the robot to not only collect but also spread arecanuts for drying purposes.