

# Review on Design and Development of an Automated System for climbing and spraying pesticides on areca nut trees

**Chirag Devadiga<sup>1</sup>, Sarthak Salian<sup>2</sup>, Shashikumar C S<sup>3</sup>, Mr. Swaroop<sup>4</sup>**

Department of Mechanical Engineering, Mangalore Institute of Technology & Engineering<sup>1-3</sup>

Assistant Professor, Dept., of Mechanical Engineering,

Mangalore Institute of Technology and Engineering, Mangalore<sup>4</sup>

**Abstract:** Areca nut is one of the major commercial crops grown in southern parts of India. During the rainy season the areca nut crop gets attacked by disease due to fungi. This makes half the growth in areca nut crop to decompose and fall. The major reason in this sector is the lack of skilled labour and safety issues for spraying pesticides and harvesting.

To avoid direct contact of humans with pesticide while spraying the pesticides on a tree to tackle the problem of unavailability areca nut tree climbers are developed. The machine consists of a base frame. At the bottom of the machine there are two conical rollers that are connected to the motor drivers. These motor drivers are worked by a remote control to make the machine move up and down the tree and enough clearance is been maintained between the two wheels. The device has been tested for its performance and to make it safe, reliable, efficient and also reduces the problem in climbing and spraying areca nut tree to a good extent.

**Keywords:** Areca nut harvesting, tree climbing and spraying.

## I. INTRODUCTION

In Earlier days labours used to climb areca nut trees for spraying the areca nut and plucking it for various purposes. It used to become a big hurdle for them while climbing up and down the trees. They are used to handle it with great carefulness. But instead of that, we have developed an areca nut spraying and plucking device which is fully automated and can reduce the work of labours.

Areca nut spraying machines are used to apply pesticides, fungicides, or other chemicals onto the areca nut trees. These machines are typically equipped with a spray nozzle or a series of nozzles, along with a tank for holding the chemical solution. They are either handheld or operated using a backpack, allowing the farmer or operator to move through the plantation and spray the required amount of chemicals onto the plants.

is about 15m is a risky and difficult task. Due to continuous rain, the tree surface becomes slippery to climb. In the past, the pesticide spray was done manually by climbing the tree. Due to labour shortage and non-availability of skilled labour, people started developing machines to avoid the tree climbing manually.

Many researchers have developed devices using different ideas and designs. Each researcher used typical mechanisms in their device for climbing the tree. Some have used mechanical linkages and working without electricity, some others have developed semi-automatic tree climber and plucker attached with machine vision. The safety of the climber was on focus and many have avoided manual tree climbing in their device. Whereas some have developed automated robotic pesticide sprayer for areca nut.

## II. OVERVIEW OF THE DESIGN

An automated areca nut spraying system is designed to efficiently and effectively apply pesticides or other protective substances to areca nut trees. Areca nut, also known as betel nut, is a popular cash crop grown in several countries, particularly in South and Southeast Asia.

The design of an automated areca nut spraying system typically involves the following components:

### 1. Spraying Mechanism:

The system includes a spraying mechanism that delivers the pesticide or protective substance onto the areca nut trees. This mechanism can vary depending on the specific design, but it commonly involves a set of nozzles or sprayers positioned strategically to cover the tree canopy evenly.

**2. Pumping System:** The spraying mechanism is connected to a pumping system that supplies the liquid substance to be sprayed. The pump can be powered by electricity or a combustion engine, depending on the system's design.

**3. Tank and Mixing Unit:** The system incorporates a tank to store the pesticide or protective substance. This tank is typically located on the vehicle or equipment carrying the spraying system. In some designs, a mixing unit may also be included to prepare the pesticide mixture, combining it with water or other additives.

**4. Control System:** An automated areca nut spraying system often incorporates a control system to regulate the spraying process. This can include electronic controls, sensors, and timers to ensure precise application and avoid wastage.

**5. Vehicle or Equipment:** The spraying system is usually mounted on a vehicle or equipment that can move along the rows of areca nut trees. The vehicle may be manually operated or autonomous, depending on the level of automation in the design.

**6. Safety Features:** Safety considerations are crucial in the design of automated areca nut spraying systems. These may include features like protective enclosures around moving parts, emergency stop buttons, and proper handling and storage of the pesticide.

**7. Power Source:** A reliable power source is essential for operating the climbing and spraying functions. Commonly used power sources include small engines, electric motors, or even human power (in some manual machines). The power source should provide sufficient energy to drive the climbing mechanism, spraying system, and any other auxiliary functions.

**8. Ergonomics and Operator Comfort:** Consideration should be given to the ergonomics of the machine, ensuring operator comfort during prolonged use. Adjustable seats, handlebars, and footrests can enhance operator convenience and reduce fatigue.

**9. Maintenance and Durability:** The design should take into account ease of maintenance and repair. Components that are prone to wear should be readily accessible for inspection, replacement, or lubrication. Additionally, using corrosion-resistant materials and protective coatings can increase the machine's longevity, especially in humid or corrosive environments.



Figure : Tree climber set up

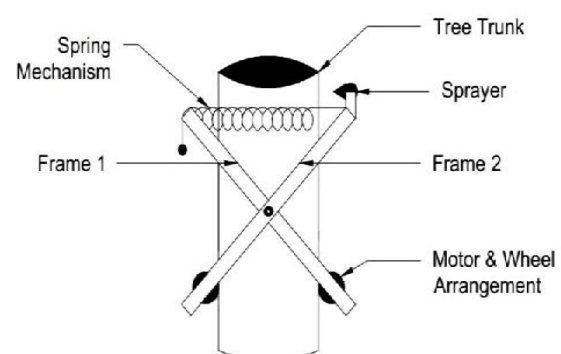
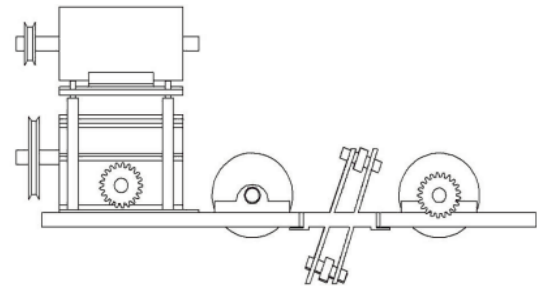
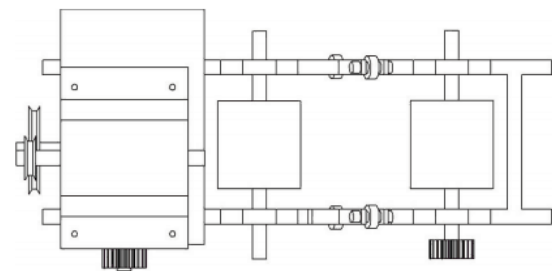


Figure : Parts of Areca nut Sprayer system



Front view



Top view

Orthographic views of Motorised Arecanut tree climber



**Figure :** Conventional Method of Spraying Pesticide

### III. METHODOLOGY

In this concept, the machine consists of a base frame. At the bottom of the machine there are two conical rollers that are connected to the motor drivers. These motor drivers are worked by a remote control to make the machine move up and down the tree and enough clearance is been maintained between the two wheels.

The device has been tested for its performance and to make it safe, reliable, efficient and also reduces the problem in climbing and spraying areca nut tree to a good extent.

#### IV. BLOCK DIAGRAM

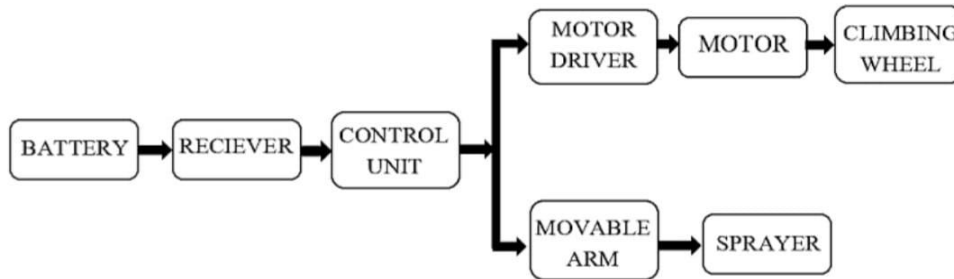


Fig 7 Block Diagram of Automated Areca Nut sprayer system

#### V. EXPERIMENTATION

We have used a frame of rectangular cross section and the material used is mild steel. The length of the frame was 45cm and we performed certain processes like welding of the sides, bending and also sheet metal operations to get its required shape.

#### VI. RESULTS

The machine was successfully designed and fabricated. The machine was able to grip to the tree and climb up and down. The harvesting mechanism was successfully operated and it was able to cut down the areca nut bunch and spray pesticides to areca nuts. It has the following advantages like can climb large heights, do not require skilled labour, no risk involved, ease of handling, low maintenance cost. The robot operates on 12V 2000mAh battery and climbs the required height very quickly. Once the robot reaches the required height it stays there without slipping. The sprayer covers a wide angle and sprays pesticide to the areca nut bunch on the nearby tree up to a radius of 15 to 20 meters. After spraying is done it smoothly descends the tree. This robot reduces the time and also dependence on labour. A solenoid valve is used to stop or resume the flow of pesticide. All the above functions of the robot are controlled by remote.

#### VII. CONCLUSION

After testing the machine on the areca nut tree, it has been found that, the design is efficient in climbing the tree very smoothly without damaging the tree. The climbing mechanism and spraying unit was working according to the requirement. The design is simple and appealing to the majority. An unskilled labour can also operate the machine safely and efficiently. In conclusion, the development of areca nut sprayers and climbing machines has aimed to improve efficiency, safety, and ease of use in the agricultural practices associated with areca nut cultivation.

Areca nut sprayers have undergone advancements to automate the process of spraying pesticides or fertilizers on areca nut trees. These developments have resulted in portable, lightweight sprayers that deliver precise amounts of chemicals, reducing waste and environmental impact. The integration of motorized or battery-powered systems, adjustable spray patterns, and ergonomic designs has enhanced their functionality and usability.

Overall, the continuous development of areca nut sprayers and climbing machines has contributed to improving the efficiency, safety, and productivity of areca nut cultivation practices. These advancements have benefited farmers by reducing labour-intensive tasks, increasing precision, and enhancing overall agricultural operations.

#### VIII. FUTURE SCOPE

The mechanism for harvesting areca nut will surely bring about a revolution in the traditionally labour-intensive areca nut collection industry. Since the machine has to work for hours, it is made less power consuming. The maintenance requirement of the device is very less making it very convenient to use. Future scopes for areca nut sprayers and climbing machines include:

1. Technological advancements: There is potential for further technological advancements in both areca nut sprayers and climbing machines. This could involve the integration of smart sensors, automation, and artificial intelligence to enhance their functionality and precision.
2. Improved ergonomics and user-friendliness: Future developments may focus on designing sprayers and climbing machines that are even more ergonomic and user-friendly. This could involve adjustable features, enhanced comfort, and intuitive controls to reduce operator fatigue and improve overall usability.
3. Sustainable and eco-friendly designs: There is growing emphasis on sustainable agriculture practices. Future developments may include the integration of eco-friendly materials, energy-efficient mechanisms, and reduced chemical usage in areca nut sprayers. Climbing machines could also be designed to minimize environmental impact and promote sustainable harvesting techniques.
4. Safety enhancements: Safety remains a priority, and future scopes may involve further improvements in climbing machine designs to ensure secure attachment, stability, and accident prevention. Incorporating advanced safety features such as emergency stop mechanisms and intelligent fall detection systems could be explored.
5. Integration of data analytics: The incorporation of data analytics and precision farming techniques could provide valuable insights for optimizing areca nut spraying and harvesting processes. By collecting and analysing data related to tree health, growth patterns, and chemical requirements, farmers can make informed decisions and enhance overall crop management practices.
6. Customization and adaptability: Future scopes may involve developing areca nut sprayers and climbing machines that can be easily customized or adapted to suit varying tree sizes, shapes, farming practices. This could improve their versatility and make them applicable to a wider range of agricultural scenarios.

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at specific intervals were provided. The proposed design by Mani had the location of centre of mass of the device outside the tree and it fused both spiral and straight climbs. An arm was provided in order to fulfil the harvesting requirement. The bunch of nuts is located by a camera which is fixated to the arm. The cutting is done by a saw after a clear view of the nuts is obtained. The entire mechanism was controlled by remote control.

- [15] Justin Gostanian ,et.al [8], discussed about the design, construction, and testing of machine to climb trees. The primary goal was to design and build a machine that could successfully climb a tree. After researching existing climbing machine designs, a machine prototype was built using concepts from the existing designs. The machine proved to be partially successful, being capable of gripping a tree and staying on, but could not move. Though not entirely successful, the project identified many important aspects in a tree climbing machine design.
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