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Aerial Access Hoist Development for the Management of Tall Tree and Coconut Crops

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Abstract- India, the preeminent producer of coconuts, produced 19,247 million nuts in 2021-2022, accounting for around 31.45% of the worldwide total. The crop contributes around Rs. 307,498,000,000 to the nation's GDP. The coconut crop is subjected to many pests and diseases, resulting in a 10-15% reduction in production, which adversely impacts farmers' economic stability. Significant losses are attributed to pests such as the Rhinoceros beetle and the red palm weevil, resulting in crop mortality. The crops are physically treated by ascending the trees and applying pesticides to the affected crown region, resulting in human challenges such as direct exposure to hazardous chemicals and serious injuries that may cause lasting disability. Drones, as a contemporary technology, may assist farmers in revitalizing sick plants, therefore contributing to their economic development by saving time and costs while enhancing yield and production. This project focuses on developing a drone system for identifying sick coconut tree regions and administering insecticides and herbicides for pest and disease control. The apparatus employs an image-processing camera to capture images of coconut trees and identify pest and disease infestations. The insecticides and herbicides necessary for treating the afflicted regions may be applied using the drone's spraying mechanism. The technology guarantees enhanced accuracy and efficacy in pest and disease management while minimizing the human labor required for identifying and addressing afflicted coconut plants. Utilizing a drone outfitted with an image-processing camera is a more practical and cost-effective method for managing pests and diseases that impact coconut plants. Drones would facilitate the identification of infected areas through an image processing camera integrated with machine learning, enabling accurate disease detection. Simultaneously, the nozzles will activate solely upon disease detection, promoting effective and efficient pesticide application.

Keywords: Image Processing Camera, Insecticides.

INTRODUCTION

Mechanization is essential for the increasing commercialization of agriculture. The utilization of agricultural machinery is continuously increasing in Indian agriculture, enhancing productivity and efficiency through timely operations and improved precision in input application. In contrast, industrialized economies have achieved over 90% farm mechanization, while India's mechanization level remains between 40% and 45%. The use of agricultural mechanization in Indian agriculture is critically essential for advancing sustainable development. The adoption of mechanized solutions in Indian agriculture is influenced by several macroeconomic and intrinsic factors, including population growth, urbanization, an increase in agricultural trades such as tractors, enhanced agricultural credit development, labor migration, and shortages, alongside the agricultural, social, and economic growth drivers of mechanization. Currently, agricultural mechanization enterprises, especially those using the farming as a service (FAAS) model, are swiftly integrating technology with a focus on precision agriculture in India. To enhance the profitability of their hardware and secure a competitive edge, most manufacturers of agricultural equipment are now concentrating on integrating various technologies. Manufacturing businesses are using automation in their manufacturing lines. The primary aim of agricultural automation is to facilitate simpler, routine chores. Prominent technologies often used by farms include harvest automation, autonomous tractors, seeding and weeding systems, and drones. Drones are regarded as essential tools for farmers, now used for diverse purposes such as facilitating remote monitoring of small crop sections and whole fields, while also solving several issues within the agricultural industry. In recent years, the deployment of drones in agriculture has gained prominence, and some states are actively engaged in assessing the sustainability of this emerging technology in Indian farming.

The Significance Of Coconut In Horticulture And Its Progressions

Horticulture significantly contributes to the economy by creating job opportunities, supplying raw materials to various food processing companies, and enhancing farm profitability via increased output and export revenues from foreign currencies. Coconut accounted for about 31.45% of global output in 2021-22, yielding 19,247 million nuts. India is the preeminent producer of coconuts globally. The crop provides around Rs. 307,498 million to the

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nation's Gross Domestic Product (GDP). The coconut is referred to be the "Tree of Life" due to its complete contribution to human use. From supplying an incredibly nutritious and tasty seed to producing materials for landscaping, construction, and furniture, as well as coir, fiber, medicinal products, oils, tonics, beverage components, and even dye and facial wash. Similar to a premier global athlete, the coconut palm remains robust and steadfast throughout varying climatic conditions, exhibiting resilience and a well-structured growth pattern. It requires comparatively minimal amounts of compost, fertilizers, pesticides, environmental conditions, and water to sustain a healthy lifecycle while producing yield. Approximately 12 million Indians depend on coconut agriculture for their sustenance. Coconut plays a crucial role in the regional economy of Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, with an estimated 1,950 million hectares cultivated, whereas other states account for about 160 million hectares. Approximately 3.16 million households in these four states engage in coconut agriculture.

LITERATURE SURVEY

Miguel Alonso Tzec-Simá et al. (2022) examined the coconut palm (Cocos nucifera L.) in pantropical areas facing many challenges, including the management of diseases and pests. Diseases such as bud decay caused by Phytophthora palmivora and lethal yellowing induced by phytoplasmas of types 16SrIV-A, 16SrIV-D, or 16SrIV-E, along with pests like the coconut palm weevil, Rhynchophorus vulneratus (Coleoptera: Curculionidae), and the horned bug, Oryctes rhinoceros (Coleoptera: Scarabaeidae), are managed through the application of pesticides, pheromones, and cultural control methods. These procedures may not guarantee annihilation, since some causative agents have developed resistance or are lodged in contaminated tissues, making them difficult to eliminate. This audit integrates flow genomics, transcriptomics, proteomics, and metabolomics to elucidate the pathosystems associated with the coconut palm, emphasizing findings from omics studies that may serve as future targets for disease and pest management in coconut cultivation.

Kanchana Daoden and colleagues (2021), This study develops a model for agricultural spraying drones aimed at controlling coconut beetle weevils by directly targeting coconut shoots, with a primary focus on enhancing spraying systems to reach the tops of the coconuts and maximize coverage of the leaf area. The aforementioned strategies aim to reduce the waste of synthetic compounds and supplements applied in areas where traditional labor methods cannot access a significant portion of the coconut stalk, namely the coconut inflorescence, which will develop into part of the coconut fruit. The findings study developed a drone based on the concept of continuous video data combined with high-quality IP cameras to ascertain the location of coconut inflorescence. It has a six-arm design, twelve propellers, a load capacity not exceeding 40 liters, four high-pressure pumps, and eight nozzles. The research team devised the autopilot system, enabling the robot to learn and recognize its function inside a certain environment. The following test revealed that it can discharge 4.5-5.2 liters of water per minute, with a splash sweep width of 0.5-1.2 meters for fixed spraying, and a breadth of 6.5-8 meters for general spraying. An adversary of the impact framework operates continuously on a 14S battery with a capacity of 22,000 mAh. This model can spray an area of 13-18 rais (2.08-2.88 hectares), maintain flight for 22 minutes on a single battery, and is compared to traditional drone spraying. This development was seen to save 20-25% of the utilized synthetic components.

Orapadee Joochim et al. (2021) concentrated on developing an agricultural drone for the application of fertilizers and pesticides on coconut plantations. The created drone is capable of analyzing and identifying pests on coconut trees using sensor image processing to address the challenges associated with comprehensive pest management strategies. The problems are as follows. The use of a long stick connected to the hose and pesticide spray from below results in over 75% of pesticide droplets reaching the ground. The use of synthetic compounds in the storage compartment is not permissible for coconut trees under 12 meters in height, particularly for fragrant coconut trees under 5 meters tall, due to material accumulation concerns. The pesticide is ultimately restricted by using a level of fertilizer above the recommendation. Farmers mostly apply pesticides indiscriminately to all coconut trees, without consideration for which plants are infested with pests. The built drone may be used to tackle all three aforementioned difficulties. In the first phase of enhancement for pest detection, the implemented software can identify the coconut tree leaf that is likely to exhibit a problem. The robot is capable of traversing to assess and identify the problem area, dispensing from the apex of the trunks, and targeting a specific location, hence reducing chemical expenses.

Agricultural areas are treated with insecticides and urea, facilitating the monitoring of crop growth. Physically applying pesticides might impact the one administering the application. Consequently, these unmanned aerial vehicles are used to disseminate insecticides and other liquids. Drones can survey vast expanses of terrain. The drones do tasks more swiftly than humans. Nonetheless, the hardware presents significant challenges for the personnel. Consequently, we are addressing drones that may assist agriculture and simplify operations for farmers. UAV systems can provide continuous imagery and sensor data from agricultural fields, which is more time-efficient compared to manual inspection by foot or vehicle. Although it was challenging to inspect by car without damaging the crops. The use of drones results in minimal harm and completes tasks in a shorter timeframe. Dhapitha Nesarajan et al. (2020) advocated the identification of pest attack locations, the supplementation of deficiencies in coconut leaves, and the testing of illnesses. Monitoring of coconut leaves has been conducted after the application of pesticides and manure, using advanced AI and image-processing techniques. In contrast to human experts, a programmed recognition system will be useful and the most efficient method for identifying diseases in coconut leaves. Consequently, in this work, we developed an Android application to identify pests based on their behavioral patterns, insect diseases, and nutritional deficiencies in coconut plants. All datasets for image processing technology underwent preliminary procedures, including conversion from RGB to greyscale, segmentation, scaling, and both horizontal and vertical flipping. Following the completion of the aforementioned steps, the arrangement was executed by analyzing many algorithms in the literature review. SVM and CNN were selected as the most effective classifiers, with accuracies of 93.54% and 93.72%, respectively. The outcome of this assignment will aid ranchers in enhancing coconut production and will undoubtedly revolutionize the agricultural sector.

Karan Kumar Shaw and colleagues (2020), Concentrated on the design of a drone equipped with a spraying apparatus featuring a 12 V pump, a 6-liter storage tank, four nozzles for fine atomization, an octocopter configuration, an appropriate landing mechanism, eight Brushless Direct Current (BLDC) motors with compatible propellers to generate the necessary thrust of approximately 38.2 KG at full RPM, and a suitable lithium polymer (LI-PO) battery with a current capacity of 22,000 mAh and a voltage of 22.2 V to fulfill essential current and voltage specifications. A First-Person View (FPV) camera and transmitter may also be installed on the robot to monitor the spraying system and assess insect infestations on plants. This pesticide-spraying drone reduces the time, labor requirements, and expenses associated with pesticide application. This kind of drone may also be used to aerosolize sanitizing liquids over buildings, water bodies, and densely inhabited areas by adjusting the pump's flow rate.

Shantanu D. Munghate et al. (2020) concentrated on the mechanical design of the octa-copter framework for spraying operations, considering future modifications. The component assessment has been completed by the 3-liter liquid payload inside the tank, while the thrust-to-weight ratio in selection was maintained at 3:1. The robot is designed in CATIA V5, while the analysis results have been obtained in ANSYS 19.2. The strategy was regarded as optimal in the analysis of the consequences of CFD, primary, and definitive elements. Abraham Chandy et al. (2019) investigated a precision agriculture technique to identify several pests in coconut trees using the NVIDIA Tegra system on chip (SoC) in conjunction with a camera-equipped drone. The drone traverses the coconut tree, gathers images, and processes the data using a deep learning algorithm to identify diseased and pest-infested plants. The deep learning technique employs a collection of example pest datasets. The artificial intelligence (AI) algorithm is also capable of unsupervised learning from unstructured images. The data is sent straight to the farmer's sophisticated mobile device via wi-fi. This facilitates the optimal treatment of pest-infested trees and enhances their production.

Rahul Desale and colleagues (2019), The designer has selected the elements for the UAV's configuration. The components include a lightweight PVC pipe structure, a 1000 kV BLDC motor (980 g thrust), a 30A ESC, 9-inch propellers, a 6500 mAh battery, a KK 2.1.5 flight controller, a radio transmitter and receiver, nozzles, and a 9V sub-pump. The inventor recommends using a 2:1 push-to-weight ratio for the design.

METHODOLOGY

Figure 1 presents a comprehensive summary of the technique used throughout the study effort.

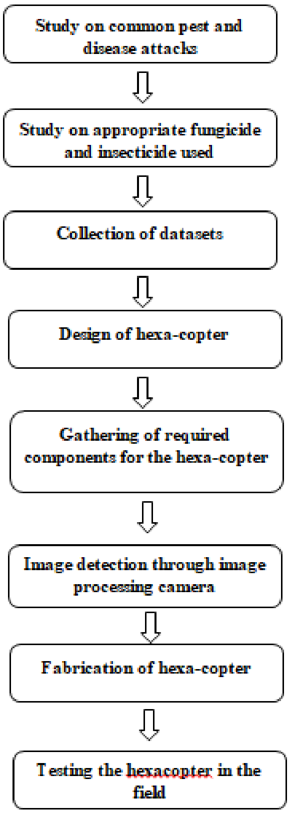

Figure 1: Methodology Flowchart.[1]

This chapter presents an overview of the experimental procedures used during the whole process. Each method comprehensively details the execution of the process, offering a clear understanding and delineating every step undertaken. The flowchart below (Figure 2) illustrates the experimental process.

Identification Of Common Insecticides And Pesticides Utilized

Pests and illnesses impacting coconut palms may be addressed with various pesticides and insecticides. It is essential to note that these substances should be used just as a last resort after all other choices have been exhausted. Below are many examples of pesticides and insecticides used in the management of diseases and pests affecting coconuts:

• Chlorpyrifos: This is a broad-spectrum pesticide often used to control pests such as caterpillars, scales, and coconut mites.

Carbaryl: This broad-spectrum pesticide is effective against several pests that impact coconuts, including the coconut leaf beetle and the coconut rhinoceros beetle.

Copper-based fungicides are used to address fungal diseases such as bud rot and leaf spot. Mancozeb is a fungicide effective against fungi responsible for diseases such as stem canker and leaf spot.

• Neem oil: A natural pesticide effective against several pests, including mites, scales, and aphids.

• Spinosad: It is a biopesticide generated by the fermentation of a soil bacteria. It is effective against several pests, such as fruit borers and leaf miners.

When using pesticides and insecticides, it is essential to meticulously review the manufacturer's guidelines and adhere to the prescribed amounts. To mitigate drift and contamination, it is essential to don protective gear while managing these compounds and to refrain from using them during windy or rainy conditions. Ultimately, it is essential to adhere to local pesticide application regulations and guidelines.

Alternative Prevention Strategies

Physical preventive approaches are often used since they help reduce the reliance on harmful chemicals and pesticides that may negatively impact the environment and human health; these tactics are essential for protecting coconut trees from diseases and insect infestations. Physical preventive methods may enhance sustainable agriculture by safeguarding the ecology and the vitality of coconut trees. Several used methodologies are,

• Pruning: To inhibit the proliferation of diseases and promote vigorous development, remove any dead or diseased branches from the tree.
• Tree wrapping: Encase the coconut tree in plastic or other materials to safeguard it from pests such as coconut beetles and other insects.
• Mulching: Apply organic materials such as leaves or coconut husks around the tree to retain moisture and inhibit weed proliferation.

If physical methods like as tree wrapping or netting are improperly installed, they may pose risks and injure workers. These procedures may require employees to labor outside for extended periods in hot, humid conditions, hence increasing the likelihood of heat stress and other heat-related illnesses. Certain materials used in physical preventative methods, such as burlap or netting, may elicit allergic responses in workers. Failure to adhere to appropriate procedures may render physical preventive measures, such as trimming or tree wrapping, extremely demanding and can result in back discomfort or strain. The risk of infection may also be heightened by cuts or wounds resulting from trimming or other physical preventive measures. The figure illustrates the physical techniques used to avert insect and disease infestations.

Trimming of the diseased coconut branches

Therefore, the deployment of herbicides and insecticides on sick and pest-infested coconut trees may be executed using a drone. This will reduce the danger of accidents and illnesses to humans, decrease maintenance time, and prove more successful than physical approaches in avoiding diseases and insect infestations in coconut palm plants. Additionally, it aids in keeping the tree from depositing dust on the ground.

COLLECTION OF DATASETS

The dataset for the project has been compiled from many sources. The dataset delineates the affected region of the coconut palm plants. Images of pests (insects, mites, bugs, beetles, etc.) and the affected regions of the tree, including the crown and leaves of the coconut, are gathered. Figure 16 illustrates the sample data gathered for the research.

Figure 16: Dataset collection.[1]

Conclusion

The application of insecticides and pesticides to the crown of the coconut palm tree as well as other areas of the tree is the approach that describes this technique. It is possible to minimize the amount of risk, as well as the amount of effort, time, and financial resources that are required to apply pesticides to agricultural areas. This unmanned aerial vehicle has the capability of distributing antiseptic compounds over buildings, bodies of water, and locations with a high population density. It is possible to obtain spray application rates ranging from 10 to 50 liters per hectare by adjusting flight patterns and optimizing swath width. By changing the flight patterns and the effective swath width, it is possible to achieve application rates ranging from 10 to 50 liters per hectare. The findings of the experiment shed light on the potential commercial use of unmanned vehicles for the spraying of specialty crops in an area that is distinguished by high-value agriculture. In order to obtain a hybrid performance (facilitated deployment), it is possible that the advantages of human aerial spraying (high efficiency) and ground-based spraying might be included into the processes of unmanned aerial vehicle spraying (UAV spraying).

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