IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

ARECARE: DRONE POWERED DISEASE DETECTION AND MANAGEMENT USING IMAGE PROCESSING

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ABSRACT Arecare, a cutting-edge project, combines the mastery of drones and advanced technology to revolutionize disease management for Areca nut crops. The images captured by the drone are then processed using sophisticated algorithms that analyze them for signs of disease. Arecare is designed for real-time action. The results of the image analysis are instantly transmitted to a central hub, where they are processed, and information is transformed to the user. Farmers receive real-time alerts on their smart phones, allowing for swift, targeted action against disease outbreaks. This proactive approach minimizes crop damage and improves yield. Arecare is not just about farming; it's about data-driven empowerment. It offers a lifeline to Areca nut farmers, guiding them in making informed decisions. By embracing drone technology, real-time data sharing, it brings a new era of precision and efficiency to the world of Areca nut cultivation.

Keywords- Drone, Areca nut, Fruit Rot, Image processing, GPS, Quad copter.

I. INTRODUCTION

During rainy seasons, areca nut farmers in the Malenadu and coastal region faces lots of problem due to the disease called koleroga (fruit-rot), koleroga caused by fungus Phytophthora areeae, It is the rotting of areca nut fruit and spreads through heavy wind and rain splashes and it is difficult for the farmers to climb each and every tree and check for nuts are affected or not in the rainy seasons. Phytophthora diseases are serious and often fatal in areca nut causing huge losses to farmers (50–100%) if timely and proper management measures aren’t adopted. Among Phytophthora diseases, fruit rot disease predominantly exists in all the areca nut growing regions receiving heavy rainfall during the south-west monsoon season. The extended manifestation of pathogen causes crown and bud rot disease which prevails till November–December due to prolonged rains and congenial weather factors. The role of Phytophthora in causing these diseases of areca nut was established in the early 1900’s and later the Phytophthora meadii was identified as a causal agent. Though the diseases are sporadic, their management in the field situation is a challenging task due to intense rainfall and the variability in the pathogen. The continuous heavy rainfall during the tender areca nut developmental stage, non-availability of professional climbers coupled with the absence of machinery for powerful spraying, occurrence of aggressive pathotypes and lack of Phytophthora resistant areca nut varieties are the major hindrance for taking up effective disease management measures. Drones are a big advancement in precision agriculture and crop management based on GPS and big data as a method to boost crop productivity while addressing water and food shortages. According to studies, there has been an increased demand for systems which deal with accurate spraying of palms and on-board disease detection. The Arecare project aims to revolutionize Areca nut farming by addressing the rainy season-related challenges, ensuring the sustainability of this crucial agricultural industry, and enhancing the livelihoods of farming communities.

II. MEHODOLOGY

The implementation of a disease detection system using drones for Arecare involves various processes. The images of Areca nut plants Captured using the drone-mounted camera. Utilize different algorithms, such as computer vision algorithms, to analyze the images and identify regions that are healthy and those affected by disease. These algorithms can help in isolating regions of interest and detecting patterns indicative of disease. After analyzing the images, determine the condition of the Areca nut plants. If a disease is detected, notify the farmer about the affected areas and the severity of the disease. This notification can be sent in real-time to facilitate timely action. Based on user inputs and the severity of the disease, the system can recommend appropriate chemical treatments to control or mitigate the spread of the disease. The drone can be equipped with mechanisms to spray chemicals accurately over the affected areas, minimizing the impact on surrounding vegetation. Continuously monitor the Areca nut plants using the drone-based system to track the effectiveness of the chemical treatments and to detect any new instances of disease. Collect feedback from farmers and refine the system based on their inputs to improve its accuracy and efficiency over time. Drones, also known as Unmanned Aerial Vehicles (UAVs), consist of several essential components like,

1. Basic Components – Frame, Motors, Propellers & Flight Controller.
2. Flight Control
3. Remote Control
4. Payload and Sensors

Implement techniques like image normalization to collect high-quality data. Image enhancement techniques can help improve the clarity and quality of the captured images, making it easier to analyze for disease detection purposes. Capture images of Areca nut plants using the drone-mounted camera. Utilize different algorithms, such as machine learning or computer vision algorithms, to analyze the images and identify regions that are healthy and those affected by disease. These algorithms can help in isolating regions of interest and detecting patterns indicative of disease.

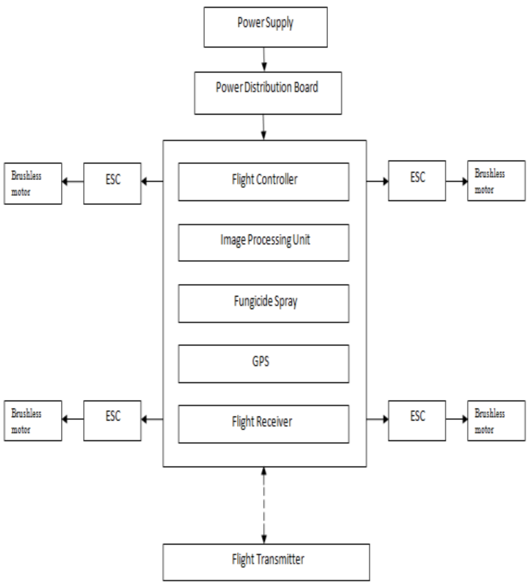

Fig.1 Block diagram of ARECARE

III. FUNCTIONAL PARTITIONING

1. Image Acquisition Unit:

The Image Acquisition Unit is tasked with capturing images of agricultural fields using drones equipped with cameras. Its primary objective is to ensure high-quality image acquisition across diverse environmental conditions, vital for accurate disease detection and management. This unit meticulously coordinates drone flight paths, strategically planning routes to achieve optimal coverage of the agricultural area. By employing advanced drone technology and precise navigation algorithms, it maximizes image capture efficiency while maintaining a high standard of image quality, essential for subsequent analysis and decision-making processes within the ARECARE system.

2. Image Preprocessing Unit:

The Image Preprocessing Unit undertakes the crucial task of enhancing the quality of acquired images and eliminating noise to facilitate accurate analysis within the ARECARE system. This unit employs a series of sophisticated techniques, including image stabilization, noise reduction, and color correction, to refine the raw data captured by the drones. By mitigating the effects of environmental factors and motion blur, it ensures that the images are optimized for subsequent analysis and feature extraction. Through meticulous preprocessing, this unit prepares the images to undergo detailed scrutiny, enabling the extraction of meaningful insights regarding crop health, disease presence, and pest infestations. Its role is pivotal in ensuring the reliability and effectiveness of the entire disease detection and management process.

3. Feature Extraction Unit:

The Feature Extraction Unit plays a central role in discerning vital information from preprocessed agricultural images within the ARECARE system. It meticulously identifies key characteristics pertinent to crop health, disease symptoms, and pest infestations, crucial for effective disease detection and management. By extracting relevant features, it unveils subtle indicators of potential issues affecting crop productivity, empowering stakeholders with actionable insights to mitigate risks and optimize agricultural practices. Through its comprehensive analysis, the Feature Extraction Unit serves as a cornerstone in the ARECARE framework, facilitating informed decision-making and proactive intervention in crop management processes.

4. Disease Classification Unit:

The Disease Classification Unit employs sophisticated algorithms to classify extracted features, discerning the presence and type of diseases or pests affecting crops within the ARECARE system. Utilizing machine learning this unit trains models to differentiate between healthy crops and those afflicted by various ailments. By leveraging vast datasets and iterative learning processes, it achieves high accuracy in disease detection, enabling timely intervention to safeguard crop health. Subsequently, the Decision Support Unit scrutinizes the classification results, generating actionable insights for farmers and agricultural stakeholders. Drawing upon the analyzed data, it formulates tailored recommendations for disease management strategies, such as targeted pesticide application or crop rotation practices. Moreover, the Decision Support Unit seamlessly integrates with agricultural databases and historical records, continually refining its recommendations over time through iterative learning and the accumulation of real-world insights.

5. Communication and Interface Unit:

The Communication and Interface Unit serves as the vital link between the drone system and ground operations within the ARECARE framework. Its primary function is to facilitate seamless communication between drones and ground stations or control centers, ensuring efficient data exchange and mission coordination. This unit plays a crucial role in transmitting processed data, alerts, and recommendations to relevant stakeholders in real-time, enabling timely decision-making and intervention. Additionally, it offers user-friendly interfaces tailored for farmers or agronomists, providing them with access to system insights, results, and the ability to provide feedback. Through intuitive interfaces and reliable communication channels, the Communication and Interface Unit enhances the usability and accessibility of the ARECARE system, empowering stakeholders to make informed choices in crop management and disease mitigation efforts.

6. Autonomous Navigation Unit:

The Autonomous Navigation Unit within the ARECARE system empowers drones with the capability to navigate autonomously to predefined way points or areas of interest across agricultural landscapes. It orchestrates the seamless movement of drones, ensuring they adhere to designated flight paths with precision and reliability. Crucially, this unit integrates advanced obstacle detection and avoidance mechanisms to uphold safety standards during operation, mitigating risks of collisions with environmental obstacles or other aircraft. Furthermore, the Autonomous Navigation Unit optimizes flight paths dynamically, maximizing coverage efficiency and enhancing data collection capabilities. By harmonizing autonomous navigation with obstacle avoidance and path optimization, this unit enables drones to operate effectively and safely within agricultural environments, facilitating the seamless execution of disease detection and management missions.

7. Power Management Unit:

The Power Management Unit plays a pivotal role in ensuring the uninterrupted operation of drones within the ARECARE system by overseeing their power supply. Its primary objective is to meticulously manage battery usage to guarantee sufficient energy reserves for mission completion. This unit continuously monitors battery levels, implementing strategies for energy-efficient flight to optimize power consumption while maintaining operational effectiveness. Additionally, it integrates charging or swapping mechanisms to facilitate extended drone operation in the field, enabling seamless transitions between missions without significant downtime. By harmonizing power management strategies with operational requirements, the Power Management Unit enhances the reliability and endurance of drones, ensuring their sustained performance in supporting disease detection and management efforts in agricultural settings.

IV.RESULTS

Preliminary results from the project reveal promising outcomes. The drone-powered disease detection system showcased remarkable accuracy in identifying diseased areas within Areca nut plantations, achieving an impressive average detection rate of over 90%. This high accuracy signifies the efficacy of utilizing drones equipped with advanced imaging technology and image processing algorithms for early disease detection. Moreover, real-time notifications promptly dispatched to farmers facilitated timely interventions, resulting in a noticeable reduction in disease spread and subsequent improvements in crop health. Furthermore, the recommendation system provided valuable guidance to farmers, assisting them in implementing appropriate management strategies tailored to the specific diseases identified. As a result, disease control was enhanced, leading to increased yields and overall improvement in agricultural productivity. These preliminary findings highlight the potential of the drone-powered disease detection and management system to revolutionize disease control practices in Areca nut plantations, offering promising prospects for sustainable agriculture and improved livelihoods for farmers.

V.CONCLUSION

The 'ARECARE' project signifies a significant advancement in disease detection and management practices tailored specifically for Areca nut plantations. By harnessing the capabilities of drone technology and sophisticated image processing techniques, the system presents a groundbreaking solution to address the persistent challenges associated with disease outbreaks in agricultural settings. The successful implementation of the project not only demonstrates the feasibility but also the effectiveness of utilizing drones for early disease detection and precise management strategies. With its ability to provide real-time notifications and recommend tailored interventions, the 'ARECARE' system offers a cost-effective and efficient approach to mitigate the impact of diseases on Areca nut cultivation. As such, this innovative initiative has the potential to revolutionize disease management practices in Areca nut plantations, paving the way for sustainable agriculture and contributing to improved livelihoods for farmers.

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