AUTONOMOUS PESTICIDE SPRAYING AND DISEASE DETECTION UAV PLATFORM FOR ARECA NUT AND PEPPER PLANTATIONS

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College **:** *Sahyadri College of Engineering & Management, Mangaluru*
Branch **:** *Interdisciplinary (Mechanical Engineering and Electronics and Communication Engineering)*
Guide(s) **:** *Prof. Ajith B.S*
Prof. Chandra Singh
Student(S) **:** *Pratham KB*
Shrinidhi I S
Raynol Menezes
K Rajmohan Kamath

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Introduction:

A quadrotors are distributing industries ranging from agricultural to transport, security, infrastructure, entertainment, search and rescue. Their maneuverability and hovering capabilities allow them to navigate through complex structures, inspected damaged buildings, even explore underground tunnels and caves, areas of irrigations, agricultural lands, fields, farms, cultivation, gardening and also for with horticulture. Yet current quadrotors still lack by ability to defend flight conditions and task, which is commonly observed in bird adaptive Agriculture has always been a component of India's enormous landscape, dating back to the Indus Valley Civilization. India is the world's second-largest producer of agricultural commodities. The Indian government has made a concerted effort to improve the amount of food grain available per population. India is expected to achieve its ambitious goal of triple farm revenue by 2022. Increased investment in agricultural infrastructure such as irrigation, warehousing, and cold storage is expected to propel India's agriculture sector forward in the next few years. Furthermore, the growing use of genetically modified crops will almost probably boost Indian farmers' output. India is poised to become self-sufficient in the production of pulses over the next decade, owing to continuous developments by scientists to secure early maturing varieties of pulses and a raise in the minimum support price. contributes the most to the output. Surveys were done among various farmer groups in various sections of the state. There has been a significant labor shortage to deal with pests and illnesses that affect Arecanut plantations. To avert infections, pests are dealt with by spraying authorized insecticides on the nuts.

The vast country of India has had agriculture as an integral part of itself from the days of indus valley civilization. India stands in the 2nd position as the producer of agricultural goods

in the world. Agriculture employed more than half of the Indian workforce in 2018 and generated 17–18% of the country's GDP. Over 70 percent of the rural households depend on agriculture. The population of India has more than tripled, while food grain production has more than quadrupled. There has been a significant increase in the amount of food grain accessible per capita. The ambitious target of tripling farm income by 2022 is projected to be met by India. The agriculture sector in India is predicted to gain traction in the next few years as a result of increased investment in agricultural infrastructure such as irrigation, warehousing, and cold storage. Furthermore, the increasing usage of genetically modified crops will most certainly increase production for Indian farmers. Due to a concerted effort by scientists to obtain early maturing types of pulses and a rise in the minimum support price, India is likely to be self-sufficient in pulses within the next several years.

Karnataka agriculture is one of the most important aspects of the Karnataka economy. Karnataka's terrain, such as the city's relief, soil, and climate, greatly encourages agricultural activity in the state. Karnataka's relief, soil conditions, and climate all play a role in crop production in the city. Agriculture is regarded as one of the principal jobs of Karnataka residents. The majority of people in Karnataka work in agriculture, particularly in rural areas. Agriculture has occupied around 12.31 million hectares of land in Karnataka, accounting for 64.6 percent of the total area. According to the 2001 census, farmers and agricultural laborers account for around 71% of all employment. Monsoon is the most important season for agriculture in Karnataka, as irrigation is used on only 26.5 percent of the total planted land.

A retrospect of preceding Areca nut treatment prompts an innovation that would alter the state of medicine spraying as it is currently. The impetuous nature of the authorities and medicine sprayers is detrimental and undermining to the masses of palms in and around the world. The astounding lack of education of farmers on their own plants is mortifying and degrading of the farmers' tremendous work. A look, let alone a study of the plantations in an array, suffice to furnish us with a conclusive detail of ignorance. In addition to sorting applications, Image processing can be used for pest management detection of insects, identification of nutrient deficiencies and plant content, fruits quality inspection, grading of agricultural products like fruits vegetables, crop and land estimation and object tracking

Objectives:

- To survey the estimated produce of Arecanut and Pepper produced in India
- To design and develop a hexa-copter
- To develop of nozzle delivery system for sustainable pesticide spraying
- To automatically map the area of plantation and to plan the path

Methodology:

Maneuvering: The drone camera initializes SLAM-aided positioning of Areca palm inventory. Every individual palm is an unmarked entity. Geolocation of Areca palms is done using the CNN models. Each palm is GPS tagged with its set of coordinates as well as an

unmarked label. The coordinates of the individual palms are relayed as a MAVLink message to the PX4 system. These coordinates are stored as entries in the database. Synchronously, the frames are fed to a neural network to determine if any of the palms contain rotten or decayed fruits. The palm is sprayed by the nozzle which calculates the trajectory of spraying. The pressure of the spray is kept as a constant at the nozzle. The status of the entity is changed to marked and the sub-instance is designated with a diseased or undiseased label. An Areca plantation usually has straight lines of palms. The drone follows a pulse train pattern with the palms as verticals and the gaps as horizontals. The pulse train movement ensures no tangling of the tether to the ground station.

During the horizontal movements, the airborne adjustable nozzle on the drone is configured to match up with the trajectorial target of the fruit. The nozzle roulette consists of an array of custom-made nozzles that can be set to match the needs of either Pepper plants or Areca fruits. The process is autonomous i.e., free of human intervention except for the initial placement of the drone at a viable location. Since the drone movement is in the form of a pulse train, it can cover all angles of the palm. To ensure that there is no palm that is sprayed more than once, the database is checked before spraying.

Ground Station: The ground station is the hub for processing, power and water supply. The components of the ground station are the Ground Control Station (GCS) software, the pesticide storage container and the pump for spraying the pesticide.

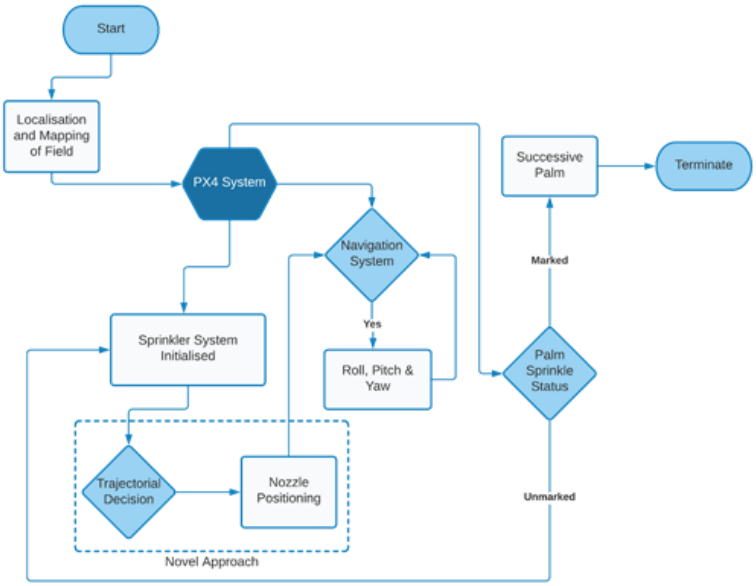
The drone is tethered to a power supply on the multirotor itself . The approximate flight time with each charged attempt came about 30 minutes .

Communication System: The GCS software monitors the position of the drone through telemetry. The trajectory of the drone and the coordinates are relayed to the ground station through MAVlink messages. The PX4 system is the backbone of communication. It is host to the MAVLink sender and receiver threads,

There are a wide range of diseases that can affect an Arecanut palm. The most common are Yellow Leaf Disease and various types of rot. Humans cannot determine the latter without climbing palms and examining the bunches. We begin by defining bounding boxes around the Arecanut and then determining which class it belongs to. When two or more bounding boxes overlap, an intersection of union provides a bounding box that entirely surrounds the object. Each bounding box is assigned a value between 0 and 1, which describes the likelihood of the object's existence in that region. This generates an unintentional probability map that aids in object detection.The Xavier initialization method is used to maintain a constant variance across each layer of learning. The Xavier initialization method is computed as a random value with a homogeneous probability distribution (U) between -(1/sqrt(n)) and 1/sqrt(n), where ‘n’ denotes the number of node inputs. This is done to avoid unneeded and unreasonable weights that would require thousands of iterations to compensate for the loss. Larger penalties applied toward a larger number of iterations result in a higher loss score. It is possible to create an optimization algorithm that works with smaller weights. This is precisely

what an L2 approach accomplishes. The L2 method works by keeping the weights close to zero but never actually reaching zero.

Simultaneous activation layers necessitate high performance acceleration, which GPU-accelerated processing greatly improves. NVIDIA® Jetson Nano™ supports the CUDA® Deep Neural Network library (cuDNN). The cuDNN library is ideal for routines that must be repeated, such as activation layers. The Intel® RealSense™ D435i provides a 1280x720 active stereo depth resolution. The ROS running on the Jetson Nano™ connects the depth camera video input to the executable scripts. To name a few, these include arecanut numeration, bunch deviation from nozzle spray target coordinate, and palm indexing.



Block diagram of Process Flow

The RealSense™ D435i coupled with the NVIDIA® Maxwell™ architecture with 128 CUDA cores GPU built-in to the Jetson Nano™ and enhanced by the OpenCV 'dnn' module increases the object detection by more than 15 times the conventional module. Algorithms with maximum leverage on this stance created by the combination are: Single Shot Detector (SSD), You Only Look Once (YOLO) and Faster-RCNN. The essential difference between the algorithms lies in YOLO running over an Artificial Neural Networks (ANN) library and the rest run on Convolutional Neural Networks (CNN). This greatly increases the ability of Faster R-CNN to have higher accuracies at smaller datasets while YOLO is sufficiently lower. The only drawback of R-CNN is the heavy computational toll. YOLO is much faster than SSD owing to its fleeting acknowledgement.

Palm indexing entails flying to an altitude where the palm heads are larger than the threshold set and photographing, stitching, and numbering palms. The palms could be assigned an ID at random or indexed, either of which would suffice for later spray status recording. Palm indexing also serves as a kind of survey by providing a count of palms. Following the creation of the palm database, each areca palm is mapped as unmarked. The palm's unmarked status indicates that it has not been sprayed with pesticides. The drone flies to the farthest palm in the set boundary and begins spraying pesticides. The Areca Bunches are identified by using adaptive thresholding for color toning, followed by masks and calculated HSV values. When an Areca bunch is detected, its deviation from the nozzle is checked using simple 2D Cartesian geometry. This deviation is communicated to the PX4 system via an MAVROS message, which prevents the drone from changing position and activates spray when the

drone is in line with the bunch. The drop rate varies with the amount of rot and/or infection. Every palm that is sprayed after the first is marked as sprayed. If a disease is found, the palm is labeled as infected. The spraying function is turned off and the drone lands when the indexed palms match those marked.

Image of Drone Spraying Pesticide

Image of Drone Spraying Pesticide

Conclusion:

This project has been aimed to understand and monitor the effects of human activities as well as other parameters on cultivation of areca nuts. We intend this project to be effective in proper mapping of the areca plantations and effective spraying of the pesticide. According to our implementation, we can conclude the following:

● Time spent for spraying each can be reduced to a mere 10 seconds.
● Operational cost for a large area will be considerably cheaper than manual labor.
● Farmers will not have to depend on the irregular labor industry and lose precious crops.
● Pesticides will be used efficiently resulting in no contamination of water sources.
● We would be driving the technology towards betterment resulting in greater government involvement.
● Diseases can be avoided and/or mitigated entirely

Scope for future work:

- Create a reliable database of diseases for education.
- Add additional spray modules to the drone to aid other areas of agriculture.
- Accurate survey and yield count.
- Disease prediction and control.
- Effective pesticide spraying
- Increase manufacturing capabilities to deploy more drones.