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PROJECT SYNOPSIS

1.	**Name of the College:** THE OXFORD COLLEGE OF ENGINEERING
2.	**Project Title:** DEVELOPMENT OF AGRICULTURAL DRONE(FRUIT HARVESTING AND PRUNING TREES)
3.	**Reference Proposal No.:** 46S_BE_2743
4.	**Branch:** ELECTRICAL AND ELECTRONICS ENGINEERING
5.	**Theme (as per KSCST poster):** AUTOMATION OR NEW CONCEPTS IN AGRICULTURE (CULTIVATION, RAISING CROPS, IRRIGATION ETC.)
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9.	**Date of commencement of the Project:** 09 September 2022
10.	**Probable date of completion of the project:** 28 May 2023

“DESIGN AND DEVELOPMENT OF AGRICULTURAL DRONE’’

The Oxford College of Engineering & Technology

Department of Electrical & Electronics Engineering

Students

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INTRODUCTION

An unmanned aerial vehicle (UAV), commonly known as a drone is an aircraft without a human pilot aboard. Part of an Unmanned Aerial System (UAS), the UAVs are usually controlled remotely using a Radio transmitter and sometimes are even autonomous. The first use of these UAV's was to accomplish works considered too "dull, dirty and dangerous" for humans making it apt for military use. But their use is rapidly expanding to commercial, scientific, recreational, agricultural, and other applications such as policing, peacekeeping and surveillance, product deliveries, aerial photography, agriculture, and drone racing. UAVs are fundamentally closed-loop control systems that are either manual or autonomous systems. Feedback in UAS does vary with applications. The expansion of applications of drones is increasing rapidly, especially in the field of agriculture. This is seen as the biggest achievement of drone technology as they are now able to serve farmers for many purposes.

A drone can help farmers to save their money as well as crops by keeping an eye of failing plants. They can study the large-sized farmlands along with proper monitoring of irrigation systems. Farmers can now hope for all information updates quickly and drones can also help them to spray fertilizers, pesticides and water for crops at right times. By producing still images and multispectral images, nutrient deficiencies, pest damage, fertilizer needs and water quality can be identified. Hyperspectral images can be developed to analyses plant nutrients, plant diseases, water quality, and mineral and surface chemical composition. By using laser technology and with the help of lidar sensors produces elevation data that can create 3D models of farms. Thermal sensors can be used to track the surface temperature of land and plants.

Drones can also be used to develop optimal cropping patterns to make the best use of the land nutrients available. They can also be provided with extensions that can shoot the seeds into the farmland, by monitoring distance, according to the cropping pattern developed.

Our project aims to make use of drone systems for harvesting yield and provide a good monitoring system. Arecanut is generally harvested using conventional methods. These methods require human beings to manually climb up the tall trees to obtain yield. Semi-automated methods have been developed over the recent years wherein the machine that is set up on a tree moves up (the motion is controlled via remotes or mobile apps), harvested the yield, and then climbs down the tree. Semi-automated machines eliminate the risk of the manual climbers present in conventional methods, however, the machine set up consumes a significant amount of time. Our project tackles both these issues.

The integration of the cutting mechanism on the drone would provide us with the flexibility to analyses the yield and harvest it accordingly. It would also provide a solution to the scarcity of labour available during the harvesting period. This is an important point to be considered as areca nuts have a very short harvesting period for it to be of superior quality.

Kisan drones could be a disrupter in India’s traditional Agri-industry. It can make farming more intelligent, precise and productive.

OBJECTIVES OF THE PROJECT

- To know about Drone technology in agriculture that is shifted from traditional to neo standards.
- To empower farmer to adapt to specific environments and make mindful choices accordingly using agriculture drone.
- Harvesting mechanism using simple electronic components such as servomotors, brushless motors and speed controllers.
- To design low-cost agricultural drone.
- To reduce risk caused by pruning of trees.

Other objectives of using a drone for pruning can vary depending on the requirements:

- **Efficiency:** Drones equipped with pruning tools can expedite the pruning process by reaching inaccessible or hard-to-reach areas quickly. They can navigate through dense foliage or tall trees more efficiently than manual labor, saving time and effort.
- **Safety:** Pruning trees often involves working at heights or in hazardous conditions. By utilizing drones, workers can minimize their exposure to risky situations, such as climbing tall trees or using ladders. Drones can access difficult locations while keeping operators safely on the ground.
- **Precision:** Drones equipped with advanced imaging technologies, such as high-resolution cameras or LiDAR (Light Detection and Ranging), can provide detailed visual data of the vegetation. This allows for precise identification of branches or areas requiring pruning, ensuring accurate and targeted cuts.
- **Cost-effectiveness**: While drones require an initial investment, they can potentially reduce long-term costs associated with pruning operations. By streamlining the process,

minimizing labor requirements, and optimizing resources, drones can contribute to overall cost savings.

- **Data collection**: Drones can capture aerial imagery, providing valuable data for analysis and monitoring purposes. By conducting regular aerial inspections, drone-based pruning operations can help identify tree health issues, disease outbreaks, or pest infestations. This data can inform decision-making for future pruning efforts and general vegetation management.
- **Environmental impact**: Drones offer a more environmentally friendly approach to pruning compared to traditional methods involving heavy machinery or excessive use of resources. By minimizing disturbances to the surrounding environment and reducing fuel consumption, drones contribute to sustainable practices.
- **Accessibility**: Drones equipped with specialized equipment, such as robotic arms or pruning attachments, can access areas that are challenging for manual pruning. They can reach tall trees, steep slopes, or areas with limited ground access, ensuring comprehensive pruning coverage.

METHODOLOGY

The methodology of using drones for pruning typically involves several steps to ensure an efficient and effective operation. Here is a general outline of the methodology:

- **Planning and assessment:** Begin by conducting a thorough assessment of the pruning site and vegetation. Identify the target trees or plants for pruning and evaluate their condition, size, and accessibility. Determine the specific objectives and requirements for pruning.
- **Drone selection and equipment setup:** Select a suitable drone model based on factors such as payload capacity, flight time, and maneuverability. Equipping the drone with necessary pruning tools, such as robotic arms with cutting attachments or specialized pruning equipment. Ensure that the drone's payload and equipment are properly calibrated and securely attached.
- **Flight planning:** Plan the drone flight path to cover the designated pruning areas. Consider obstacles, airspace regulations, and safety precautions during flight planning. Identify take-off and landing locations, as well as any intermediate waypoints, if needed.
- **Pre-flight checks:** Perform pre-flight checks on the drone and its components, including batteries, propellers, and sensors. Ensure that all systems are functioning correctly and that the drone is in compliance with relevant regulations. Calibrate the onboard sensors, if required, to optimize flight stability and accuracy.

- **Aerial data collection:** Fly the drone over the pruning site, following the planned flight path. Capture aerial imagery or use sensors, such as LiDAR, to collect high-resolution data of the vegetation. This data can help identify branches or areas that require pruning and assist in making informed decisions.
- **Pruning operation:** Once the areas for pruning are identified, maneuver the drone to the target branches or vegetation. Utilize the robotic arms or pruning tools to perform the necessary cuts. Ensure that the drone is stable and well-positioned to execute precise and controlled pruning actions. Monitor the pruning process using the onboard cameras or visual feedback.
- **Post-pruning assessment:** After completing the pruning operation, conduct a post-pruning assessment to verify the quality and effectiveness of the cuts. Inspect the pruned areas for any potential damage or incomplete pruning. Capture additional imagery or data if needed to document the results of the pruning operation.
- **Data analysis and reporting:** Analyse the collected data and imagery to assess the overall health and condition of the pruned vegetation. Identify any patterns, disease indicators, or long-term management recommendations based on the data analysis. Generate reports or documentation detailing the pruning operation and its outcomes.

Throughout the entire methodology, it is crucial to prioritize safety, follow local regulations, and ensure skilled operators handle the drone and pruning equipment. Regular maintenance and calibration of the drone and its tools are also essential for optimal performance and safety.

- Vertical Motion: -Drones use rotors for propulsion and control. Spinning blades push air down. As the rotor pushes down on the air, the air pushes up on the rotor. A drone can do three things in the vertical plane: hover, climb, or descend. To hover, the net thrust of the four rotors pushing the drone up must be equal to the gravitational force pulling it down. For climbing just increase the thrust (speed) of the four rotors so that there is a non-zero upward force that is greater than the weight. To descend decrease the rotor thrust (speed) so the net force is downward.

- Turning: -To rotate the drone, decrease the spin of rotors 1 and 3 and increase the spin for rotors 2 and 4. The drone body rotates. The entire force remains adequate to the gravity and therefore the drone continues to hover. The lower thrust of rotors is diagonally opposite from one another, the drone stays balanced. The drone will accelerate as fast as possible from the ground, depending on how fast the propellers rotate. The lift will remain constant so the drone doesn't change height, but the angular momentum is increased so the drone will turn in place.

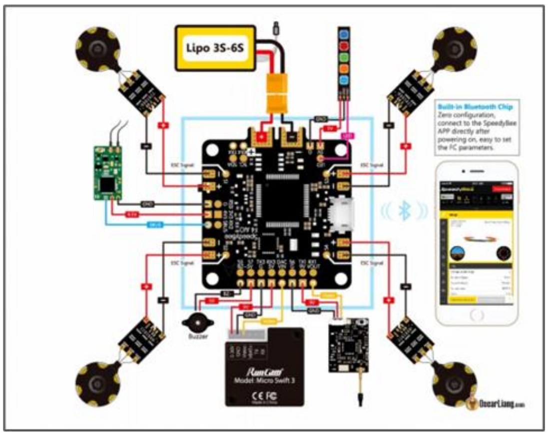
- Forwards and Backwards: -To move forwards or backwards, slow down two rotors on one side of the drone and speed up the two rotors on the other side. The drone tips slightly towards the slower side and moves in that direction. This is according to Newton's 3th law of motion that every action has an equal but opposite reaction. To move sideways or backwards, we just use the same principle on the other sides of the drone.
- Altitude: -Altitude means object's orientation with respect to the local level frame (horizontal plane) and true north. This includes 3 components: Roll, Pitch and Yaw.

  Roll: Move to Left or Right Compared to the Front.

  Pitch: Moving Forward or Backwards.

  Yaw: Rotation about the centre.
- Chain Saw Mechanism: -A chainsaw is a portable saw that cuts through wood or wooden objects by the use of "teeth" running in a circular motion around a guiding bar. The "teeth" on the blade of a chainsaw is a metal chain that has notches or grooves at certain intervals to cut through even the hardest types of wood with ease. The speed of the blade depends on horsepower of the chainsaw possesses and speed of chainsaw engine responsible is for.
- Sliders Crank Mechanism: -The slider crank mechanism is a particular four-bar linkage configuration that converts linear motion to rotational motion, and vice-versa.

Components:



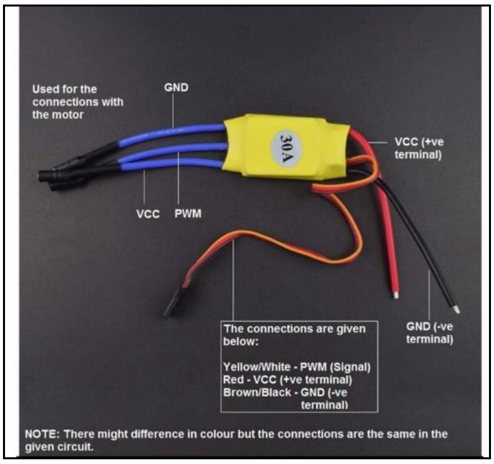
Flight controller

RC Controller

FPV Camera Module

GPS Module

Propeller

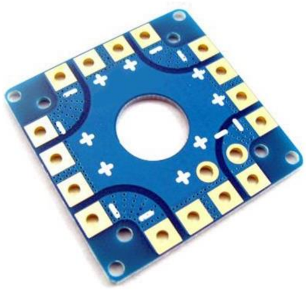


ESC

BLDC Motor

LI-PO Battery

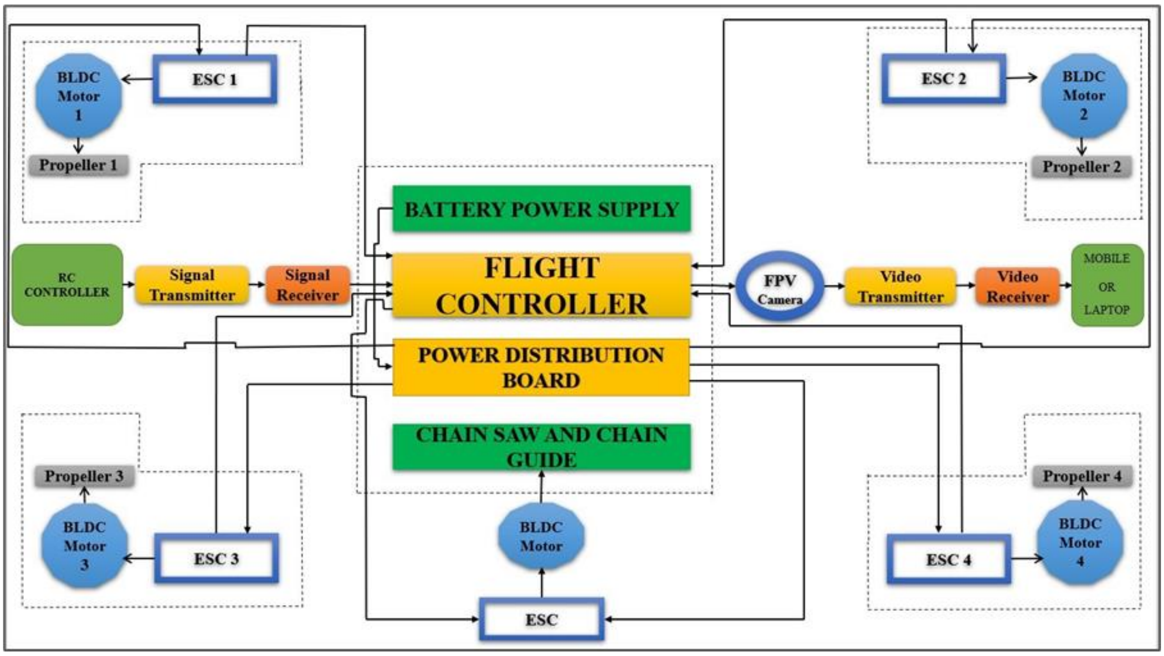
Power Module



Power Distribution Board

Chain and Chainsaw Guide

BLOCK DIAGRAM



RESULTS AND CONCLUSION

Productivity, efficiency and profitability are always top of mind in any agriculture business. That makes resource management critical. Supply has to meet demand. With risks from supply chain disruptions, weather, crop disease and other threats, farmers, ranchers and other small business owners in agriculture industries are increasingly turning to technology like agricultural drones for help. Today, agriculture technology – often called AgTech – is transforming the agriculture industry through the use of tech innovations like high-resolution imagery, ground heat mapping and more.

Drones in agriculture have become a powerful tool for monitoring crops and livestock by delivering more expansive and higher resolution imagery and enabling more detailed data gathering.

This machine is having many advantages which will help farmers to an extent. The proposed machine will improve the collecting rate of areca nut. It also reduces labour charge and saves time. It also has the following advantages over the manual collection:

It can be implemented for harvesting a multitude of crops apart from areca nut with the required modifications.

Fabrication techniques can be improved.

Incorporation of advanced autopilot systems for better usage.

Weight of the harvesting module can be reduced further which will increase the battery life. Our project has a lot of scope for further improvement. Benefits resulting from the use of this mechanism will make it pay for itself within a short period and it can be a great companion for any agriculturist.

HARDWARE MODEL

WHAT IS THE INNOVATION IN THE PROJECT?

The drone is equipped with real-time monitoring systems that allow farmers to observe the pruning operation remotely. Live video feeds and data streams provide farmers with instant feedback on the progress and effectiveness of pruning activities, enabling them to make adjustments or intervene if necessary.

APPLICATIONS & SCOPE FOR FUTURE WORK

The application and future scope of drones used for pruning are diverse and promising. Here are some specific areas of application and potential future developments:

- **Precision Agriculture:** Drones equipped with advanced sensors and imaging technologies can provide detailed data on crop health, nutrient deficiencies, and pruning requirements. The future may see the integration of artificial intelligence (AI) and machine learning algorithms to analyse collected data and automate pruning decisions, resulting in more precise and efficient pruning operations.

- **Large-Scale Plantations**: Drones can be particularly beneficial for pruning operations in large-scale plantations, such as orchards or vineyards. They can quickly cover vast areas, identify specific branches for pruning, and optimize resource utilization. In the future, autonomous swarm drones may work collaboratively, leveraging AI algorithms to coordinate and execute pruning tasks in a synchronized manner.
- **Urban Green Spaces:** With urbanization and limited space, maintaining trees and green spaces in cities is essential. Drones can assist in pruning trees in parks, along roadways, and within urban landscapes. As urban areas continue to grow, drones may play an even larger role in the management and maintenance of urban vegetation, ensuring healthy tree growth and addressing safety concerns.
- **Automated Pruning Systems:** Future developments may focus on creating autonomous or semi-autonomous pruning systems. These systems could utilize advanced robotics, computer vision, and machine learning algorithms to identify branches for pruning, position the drone precisely, and execute the pruning cuts with minimal human intervention. Such systems would increase efficiency and reduce the need for skilled operators.
- **Environmental Monitoring:** Drones equipped with sensors can monitor vegetation health, identify disease outbreaks, or detect invasive species. Future advancements may involve the integration of multispectral or hyperspectral imaging sensors that can provide more detailed information about plant health and stress levels. This data can be used to optimize pruning strategies and promote overall ecosystem well-being.
- **Integrated Ecosystem Management:** Drones have the potential to play a broader role in ecosystem management beyond pruning. They can aid in tasks such as seed dispersal, pollination support, and invasive species management. By integrating different capabilities into a single drone platform, the scope of ecological applications could expand significantly.

As technology continues to advance, drones used for pruning will likely become more sophisticated, efficient, and integrated with other systems. They will enable data-driven decision-making, optimize pruning techniques, and contribute to sustainable vegetation management practices.