iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VII **Month of publication:** July 2020

DOI: https://doi.org/10.22214/ijraset.2020.30657

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VII July 2020- Available at www.ijraset.com

Drone Assisted Arecanut Harvesting Module

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***Abstract:** Unmanned Micro Aerial Vehicle or Unmanned Aerial Vehicle (UAV), popularly known as Drone, is an airborne system or an aircraft operated remotely by a human operator or autonomously by an onboard computer. To design and fabricate an Areca Nut Harvesting Module, relevant literature was studied to better define the objective. Engineering design is a methodological process and thus design process was started from vehicle configuration, harvesting module configuration, propulsion system configuration, aircraft geometry and analysis of different rotor configurations. Once deciding on the final design of aircraft, lift and drag force distribution was done on the model. By calculating loading over the drone shear force diagram and bending moment diagram was plotted manually and compared with ANSYS. Fabrication began with the process of selecting the ideal material for the harvesting module, cutting the material into required dimensions and assembly of the final model that would be mounted on the drone. The harvesting mechanism makes use of simple electronic components such as servo motors, brushless motors and speed controllers.*
***Keywords:** Unmanned Aerial Vehicle, Agriculture, Areca Nut, Harvesting Module, Fixtures, Flycamp*

I. 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 UAV's 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.

UAV's are fundamentally closed-loop control systems that are either manual or autonomous systems. Feedback in UAS's vary with applications.

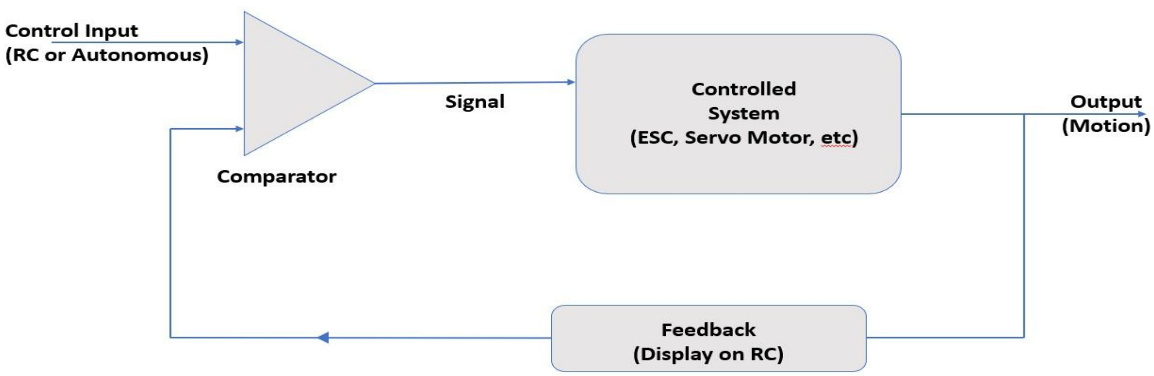

Fig 1 - CLOSED-LOOP CONTROL SYSTEM

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, fertiliser needs and water quality can be identified. Hyperspectral images can be developed to analyse 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.

Areca nut 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 analyse 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.

II. LITERATURE SURVEY

1) *Arecanut Farming In Southern India: A Case Study (September 2014)* – S Aaron Hegde and John Deal

This paper elaborates on the importance of areca nut in India and the challenges faced by areca nut framers concerning harvesting process.

2) *Design and Development of Areca Tree Climber – (September 2015)* - J.Sharana Basavaraja, Nagaraja R, Somashekar H Hegde

This paper elaborates on the product designed to climb the tree by human force applied on the pedals provided.

3) *Semi-automatic ARECANUT Tree Climbing and Harvesting Robot (2017)* - Eldhose Paul, Lovin Varghese, Ajo Issac John, George Jolly, Akash Paul Savio

This paper describes the robot designed such that it climbs up, cuts the areca nut bunch and climbs down. Rotating harvesting mechanism is used in this machine.

4) *ARECANUT Harvester/Sprayer* - Ratnagiri Impex (company)

This mechanism uses a 2-stroke petrol engine to climb up and down. It is used to harvest the yield and spray pesticides with the help of RC

5) *ARECANUT Harvesting and Pesticide Spraying Machine* – VSM Institute

With tests conducted on the prototype on an areca nut tree, it was found that the adopted technology makes the climbing of machine and pesticide spraying wireless.

6) *Design and Fabrication of Arecanut Tree Climber and Harvesting Machine (2019)* - Shivdeep D R

This paper elaborates on a mechanism that is battery powered. The developed prototype was able to climb the tree and harvest the yield. However, this product was not realized as there was a lot of room for improvement.

7) *Modern Agriculture Drones (2018) - Yuwalee Unpaprom, Natthawud Dussadeeb and Rameshprabhu Ramaraj*

This paper describes the use of the different types of agricultural drones for solving specific tasks such as the study of plant growth, creation of electronic maps, operational monitoring of crops, evaluation of germination and predicting crop yield.

8) *Design of a Drone with a Robotic End – EFFECTOR (2017)* - Suhas Varadaramanujan, Sawan Sreenivasa, Praveen Pasupathy, Sukeerth Calastawad, Melissa Morris, Sabri Tosunoglu

This paper elaborates about a drone that is integrated with a robotic arm which is used for plucking of fruits off trees from elevated positions. End effector consists of grippers in the form of suction cups.

9) *AUTOMATED ARECANUT CLIMBING AND HARVESTING MACHINE (2019)* - Suresh PV

This paper describes This petrol engine based harvesting machine consists of dumbbell-shaped rubber grip rollers which can be clamped on to trees of varying diameters.

10) *Manned Machine to Climb Arecanut Trees (2017)* - K Ganapathi Batt

A manned machine which works on a petrol engine. It can scale up and down the tree with ease with the help of levers.

III.METHODOLOGY

A. Material Selection

Table 1 – MATERIAL COMPARISION TABLE

PARAMETERS	ALUMINIUM	ABS
Density	2.7	1.0 – 1.4
Elastic Modulus, GPa	69	2.0 – 2.6
Elongation at break, %	3.4 – 20	3.5 – 50
Stiffness to weight: Axial Points	14	0.79 – 1.4
Stiffness to weight: Bending Points	50	30 – 44
Strength to weight: Axial Points	13 – 42	10 – 22
Strength to weight: Bending Points	21 – 45	24 – 37
Tensile strength: Ultimate, MPa	130 – 410	37 – 110
Thermal Expansion, µm/m-K	24	81 – 95
Thermal Shock Resistance, points	5.7 – 18	11 – 50

Considering various factors such as cost and availability of materials along with the analysis of the above comparisons, Aluminium was chosen as the material that would be used for the harvesting module.

B. Design Features

Different types of drones:

1) Multi-Rotor Drone
2) Fixed-wing drones
3) Single rotor helicopter
4) Fixed-wing hybrid VTOL

Considering all the above-mentioned parameters and the cost we decided to use the multi-rotor drones also called a quadcopter as the one we are using is has 4 rotors.

C. Propulsion System

1) ESC
2) Battery
3) Motor
4) Propeller

The above mentioned 4 parameters work in a combination only then the aircraft will remain stable when in flight. Even if one of these goes wrong there is a high possibility of the aircraft crashing or not performing efficiently.

D. FLY CAMP

Fly Camp is a start-up organisation established in 2009 by Devesh K Hegde, with its core in the research of drone-based applications for real-world problems. We are associated with Flycamp for obtaining drone for testing purposes.

E. Drone Specification

1) It is an asymmetric quadrotor.
2) Propeller size 10inches with pitch 5
3) All up weight inclusive of the payload ranges between 1.5 to 2kilos,
4) The expected Operating frequency 5.8ghz.
5) The frame is 400mm.
6) The diagonal distance from one motor to other is 16 inches

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F. Harvesting Module - Design

Table 2 - COMPONENTS TABLE

COMPONENT	WEIGHT
Spacer Body	62.5g
Washer	13.5g
Nut	11g
Blade	58.5g
Servo Motor	59g
Lead screw with nut	95g
Base	69.5g
Slider	180g
Brushless Motor	55g
L Clamp	16g

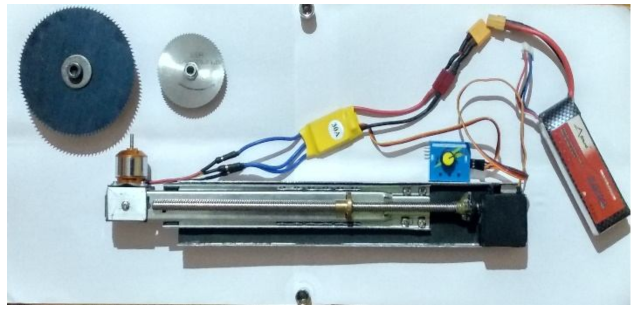

Fig 2 - COMPONENTS OF THE MODULE

Fig 3 – 3D MODEL OF THE MODULE

6. TESTING

Fig 4 - TESTING

Having an idea of what materials to use, we decided on a few components such as servos, lead screws, and a brushless DC motor and a wooden plank to support our mechanism. A conventional lathe was used to test the cutting force required for the material using the lathe tool dynamometer and also to verify our calculations.

IV. WORKING

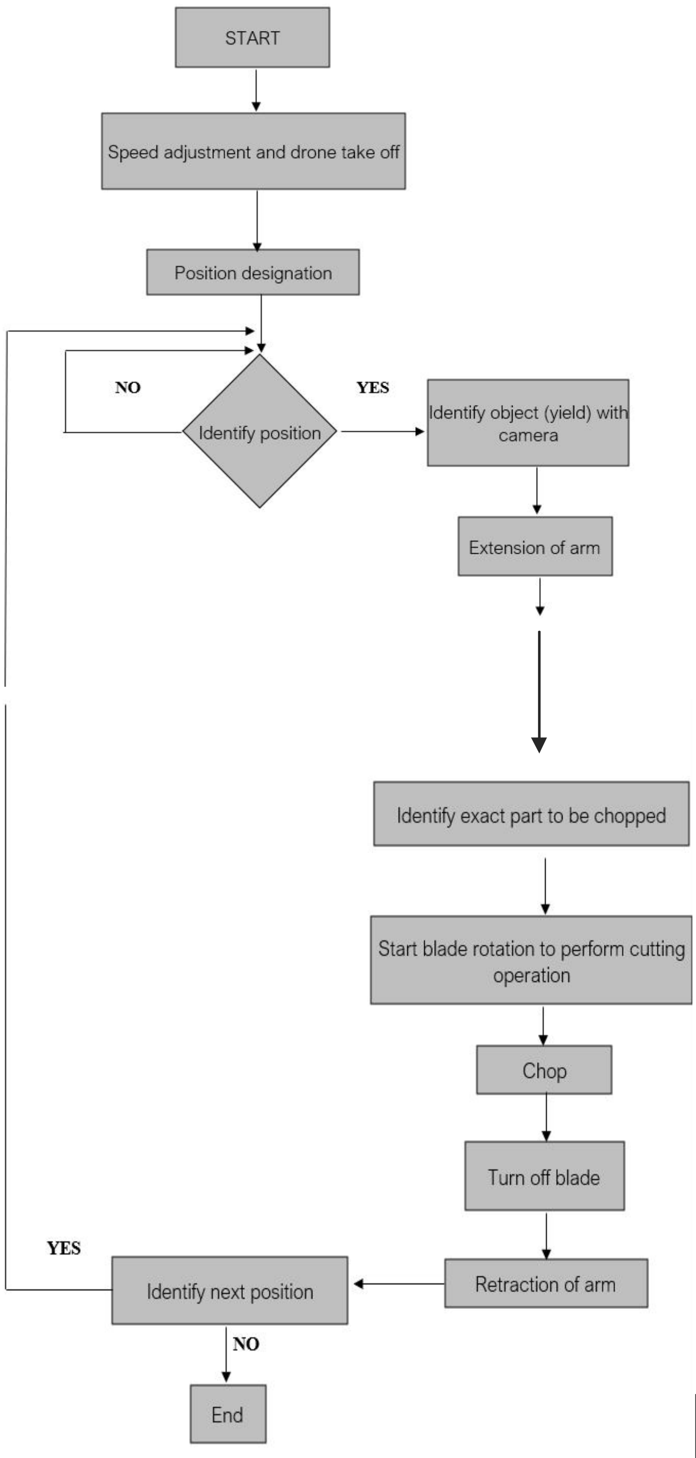

Fig 5 - WORKING FLOW CHART

V. FUTURE SCOPE

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:

A. It can be implemented for harvesting a multitude of crops apart from areca nut with the required modifications.
B. Fabrication techniques can be improved.
C. Incorporation of advanced autopilot systems for better usage.
D. 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.

VI. CONCLUSION

The materials have been considered based on a detailed evaluation of properties and appropriately chosen for the fabrication of the harvesting module.
Analysis of the cutting force and the torque were done accordingly and the module was designed and fabricated
We had also applied for funding from KSCTC regarding our project.
The final product is similar to the 3D model that we had designed
The company FLY CAMP will consider the project for further developments and improvisation

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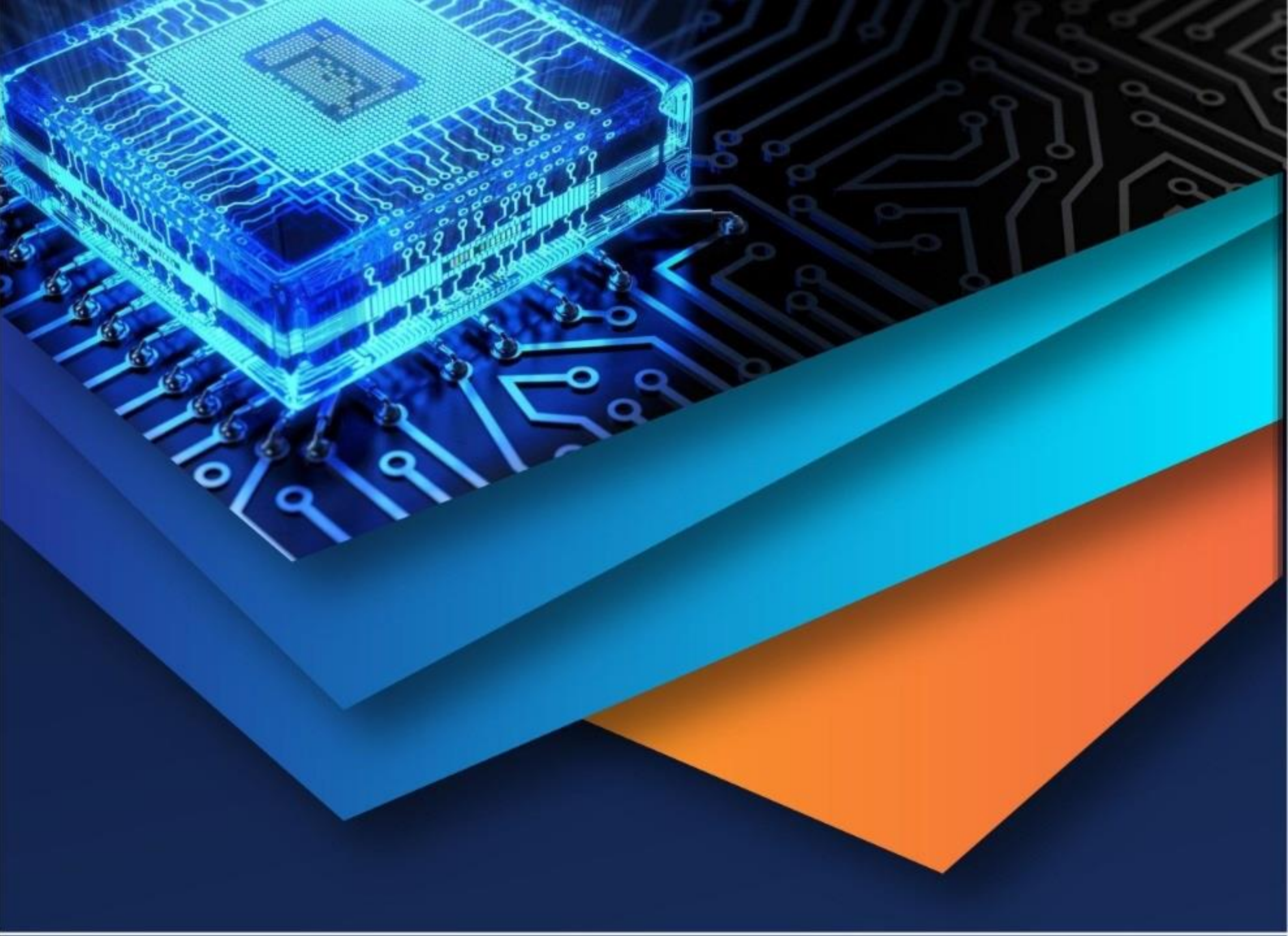

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