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Contiguity of Unmanned Aerial Vehicles for Agricultural Approaches

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Abstract: ***Conventional techniques applied for the agricultural field work is being mechanized but is still not human friendly. Most of the traditional methods of sowing, surveillance monitoring, disease detection and post-harvest management involves a lot of drudgery and is time consuming and sometimes is also hazardous in nature when application of chemicals like fertilizers, weedicides, pesticides etc. is applied on the crop canopy. Utilization of drone techniques is newest invention that is being employed in doing agricultural activities as it leads to efficient performance and is time intensive for better agri-practices. The present study was an attempt to conceptualize the various agricultural techniques that can be performed through unmanned aerial vehicles. The features of quadcopter and hexacopter were also studied for flight uptake and payloads. The hexacopter was found better employed in agricultural activities like surveillance, monitoring, seed sowing, chemical application, disease detection and also in post harvest management of agricultural produce including storage, package and delivery of the products. Overall it was seen that utilization of drone technologies in agricultural work could be very productive and the gross income of the farmers and growers will also increase after implementation of this technology.***
Keywords: quadcopter, hexacopter, unmanned aerial vehicles, disease detection, post-harvest management

I. INTRODUCTION

The vehicle with artificial intelligence can work far-flung for various impetuses. Technology of drone in the country like India is of great importance as deficient labor, précised analysis and efforts lead to wastage of time, money and human power. These challenges are diversified with climatic changes, weed prevalence, poor soil quality and loss of soil nutrient along with invadation of insect population. All the chemicals usage in agriculture has overall devasted the environment and has reached to the limits of global concerns. The major effect of all problems is provocation which is the danger to food reliability leading to hunger of approx 850 millions of individuals that makes approximately 65% of the total population residing in India (Pathele et al. 2020). According to FAO 2018 report, in order to assess the threat and vandalization caused, it becomes a need to adopt the innovation technologies of unmanned aerial vehicles(UAV's) or drones as it can result in revolutionary step in contemporary agricultural practices. These unmanned aerial vehicles or drones help the growers to modernize the agricultural approaches and are high-tech solution for agricultural forecasting and monitoring of agricultural farms. Data collection of yield of crops, health of farm animals, quality of soil fertility and deficiencies and nutrient evaluation along with patterns of rainfall and weather changes are some application of UAV's are further utilized for more precise mapping of prevalent issues. In 2017, Goldman Sachs predicted that the 2nd largest implementation of drones will be in agriculture sector in upcoming five years. Drones also known as unmanned aircraft system or unmanned aerial vehicles generally can be termed as an object which is hovering with artificial intelligence and is regulated and controlled by software with flight planes in their systems embedded along with multiple sensors, camera and concoction of global positioning system with power source of LiPo rechargeable batteries.

II. ANALYSIS OF LITERATURE SITED

Mishra et al. 2018 along with a team consisting of leading UAV's designers, co-developers of UAV, CSIR National Aeronautical laboratory and Tata group of companies developed a model to stimulate sprayer design and operation. They also performed trials on agricultural field for validation of the developed technology basically on speed based flow control; terrain navigation auto-resumption post refueling was taken into account by the team for enhancing the automatic operation of the developed UAV's. Field tests were performed keeping the crop pattern, and pest characteristics foremost, then for system configuration, speed and altitude were accountable for good flight setting and for sprayer settings drift action influences the uniform coverage of sprayed chemical so that best penetration of the chemical occurs reducing the wastage of the chemical.

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Dileep et al. 2020 studied and reviewed almost all categories of drone which can be employed in agricultural activities like livestock and poultry monitoring, sericulture, apiaries. The study was carried on the basis of characteristics of drones, work nature, costing and agricultural utility also. They also concluded that utilization of drones can attain great profit in GDP of the country through agriculture. Debangshi 2021 concluded that the soil and field analysis becomes a very efficient task in terms of determining crop health, vegetation catalogues, analyzing plant growth in lieu of height, plant density etc. plant inspection and monitoring , soil investigation and requirements of irrigation can be done easily to attain best approaches for agriculture. Also they focused on the fact that sowing seeds through pneumatic devices enhance seed growth rate and approximately 40000 seed can be planted with 90% emergence rate of seeds and spraying of chemicals like pesticides, weedicides, and fertilizers become easy while employing drones into these activities. Kushvaha et al. 2021 studied the concept of drone technology and analyzed the responses of farmers and legislators in agriculture and also concluded that enhanced cost efficiency and modern technologies needs a step towards proper strategies for monitoring and application of drones in agricultural fields. Sinha et al. 2016 advocated that utilization of UAV platform for growing agricultural needs can be encouraged through profitable agri-approaches and can be accomplished by integration of agricultural traditional knowledge with the technological advancement of artificial intelligence and creating an interface with multidisciplinary approaches of Information technologies, physics, electronics etc. so that sustainable growth in all agricultural farming systems can be promoted on large scale.

Drones or unmanned aerial vehicles are employed to perform various operations like monitoring and surveillance of crops, sowing of seeds at a large scale, application of chemicals such as insecticides, pesticides, weedicides and fertilizers in dry or liquid form in order to reduce the drudgery involved. The approach of this research was to get to the fact that what could be done to reduce the time and cost that is employed while performing the post harvest management practices of any fruit or vegetable crop and also limit the damage caused while performing post harvest operations like plucking or pruning in fruits and vegetables if we use drone for the purpose.

III. GENERAL CONSTRUCTIONAL DETAILS OF A QUADCOPTER AND A HEXACOPTER

The basic constructional frame of any quadcopter or hexacopter consists of major six units. These units are

1) Body frame unit
2) Controller unit
3) Propulsion unit
4) Camera and navigation unit
5) Power source unit.

The conceptual design of any quadcopter or hexacopter comprises of these units only which enables the UAV to pitch, roll, yaw and throttle, in order to receive signals and transmit the commands and also hover above the plant canopy at a reasonable height. The frame of the hexacopter or quadcopter is robust and is enabled to hold the power source unit i.e. Lipo batteries, camera and navigation unit as well as the controller unit. The propulsion unit comprises of the propellers which are attached to 4-6 brushless DC motors also known as BLDC. The propellers provide the lifting thrust and spin to the copter. There are different types of light sensors electronic speed controllers attached to make the quadcopter or hexacopter so robust that it can hover, capture images and change its path in case of any hindrance present in its way. Generally, these units are termed as DRONES- Dynamic Remotely Operated Navigation Equipment, which is navigated by pilot from the base or control room. The drones employed for agricultural approaches are termed as Agricultural drones.

A. Navigation Expanse in Drones

Technology and operators are two research areas in which drones or unmanned aerial vehicles get examined. The development process employs the technological advancement and the application of these technologies in system effective manner that are operations, basically devoid into onboard technology approach and Ground technology approach. The physical structure or robust design such as platform, configuration of payload and power sources such as batteries are included too, Along with the different sensors and devices including second line expanses of drones.

B. Calibration and Working of both Types of Drones

The control range of the hexacopter is observed to be 87-90 feet with a battery type –AA rechargeable batteries. The net weight of it was approximately 0.359kg of brand kiosales Model no. DJI Mavic Air 2 (fly combo.) the major function is fly hover and capture figures. The width, height and depth was seen 23 cm, 31 cm and 29 cm respectively.

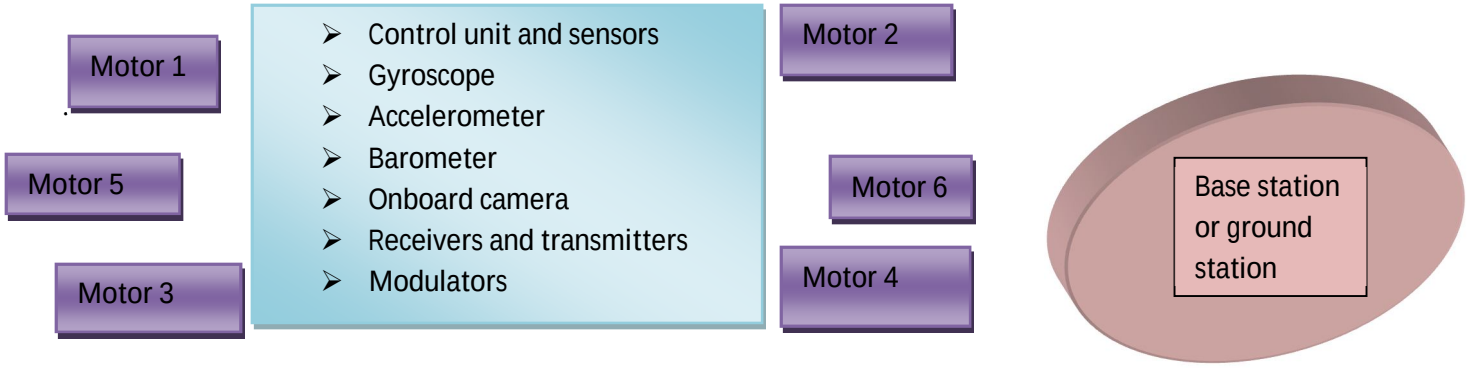


Fig 1 Block diagram for hexacopter

On calibration the GPS was set for the first time in order to make it move in the fields and it was made sure that 100 % batteries were not drained at the 1st flight. Similar calibration was done with the quadcopter also but it was found that the hexacopter has good control for yam, pitch hover and flight from the payload.

IV. APPLICATION OF QUADCOPTOR OR HEXACOPTOR IN FARMING SYSTEM APROACHES

The different farming system approaches directly or indirectly influences the population size of the surrounding. The Civil Aviation Ministry has established the leading ecosystem for drones in India and the digital Sky Platform or National Unmanned Traffic Management has implemented NPNT i.e. No Authorization No Take off policies. The drone regulations 2.0 have now opened new realms of implementation of Unmanned Aerial Vehicles or drones in agricultural farming systems. The certification of hardware and software for very safe and controlled operation as well as air space management by automated operations and visual track off sight operations are main focus for contribution of global set of norms for agricultural systems but higher cost of drone technologies, training integration and distribution of it and data gathering of the same. Major application of drones are in assessment of soil and field, establishing the plant while sowing the seeds during seed sowing, accurate and précised fertilizer and other chemicals needed to be sprayed for good production of grains and monitoring and surveillance of crop fields, management of irrigation requirements as well as crop health assessments and livestock monitoring and surveying of diseases if needed and also in post harvest management of crops. These applications are discussed in following heads:

A. Field Analysis and Soil - Plant Estimation

The soil analysis is a need aforetime the introduction of any farming season and also after crop planting. For enhancing the overall yield of crops, a proper plan of sown crop species, planting pattern and accurate time and amount of water and nutrient application is a must. Due to scarce labour, sowing of seeds in field is very drudgery required and labour intensive work. Drones can cover a hectare of land in merely 20 minutes for surveillance and capture images that can be used for soil and field analysis and also, sow seeds at appropriate depth requirement. Cost of seed sowing can be cut to 85-90% by employing drones or UAV's.

B. Précised Crop Spraying and Crop Monitoring

Conventional spraying techniques require labour and are very expensive as well as very tedious and hazardous work. Traditional spraying of different chemicals is not time specific or place specific and does not ensure the appropriate application of chemicals on plant sown areas. Most amount gets wasted during application. Drones or UAV's employed for application of fertilizers and other chemicals saves time, enhance crop growth and is labour intensive task as it applies site specific sprays on plant canopy with the help of various analogs and sensors. These sensors scan the plant canopy and apply chemicals in the form of mist or dust on targeted area only, enabling limited and précised use of chemicals. This is moreover 5-8 times easy to apply and avoids wastage of chemicals on field, ultimately saving the environment. Drones also helps in monitoring each crop plant individually ensuring and lessening the danger of spread of diseases in other nearby plants as detection of early pathogens is possible by using drones, helping and ensuring a massive scale survey of crops and agri- land at field levels. Time series animations help and reveal potential problems and enables best management of crops.

C. Irrigation Management and Crop Health Ratings

Traditional method of irrigation practices include flooding, drip or sprinkler irrigation methods. These all approaches require consistent water monitoring resulting in wastage incase not taken care off. UAV's or drones are equipped with certain sensors known as thermal sensors. These sensors have capability scan and detect areas with water deficient with the help of cameras. On proper monitoring, drones can be employed for appropriate and efficient application of water in moisture stressed areas and allows farmers and growers to precisely apply water in crop fields. Drones also utilize green visible light along with infrared light to scan crop for rating the growth of any particular pathogen like bacteria, protozoa, virus or fungus etc., with the help of spatial disease incidences and crop reflectance which is based on temporal variations seen in crop canopy, especially leaves. These two parameters help to detect occurrence of diseases in primitive stages of incubation and hence enables eradication of the diseases in initial stages foremost safeguarding the crops and enhancing the crop productivity.

D. Livestock Monitoring and Surveillance

Livestock management in agriculture plays a vital role increasing the net gross capita of the annual income of the country as well as of the individual farmers ,but surveillance and monitoring of livestock is a very tedious task for a livestock manager. Managing of livestock becomes easy if the drones are employed in monitoring. The livestock is tagged with a radio frequency identification tags known as FRIDs tags, which are certain sensors which monitor activity of animals like feedings , its movement in barns and exercising areas. It also tracks the animals with more precision and in minimum investment. For free range the livestock grazing, remote sensed fences which are more like a virtual obstacle created in spatial area, which inhibits the animal to walk across that virtual barriers. It can also help the manager to detect the animals in heat and provide proper environment for mating and can also monitor animals which are pregnant and maintain records of their each movements.

E. Post-harvest Management Techniques

Post- harvest management of crops is a major work employed by farmers. It includes, harvesting, threshing, packaging and storing of the crop produce or fruits and vegetables after the produce attains proper maturity. This maturity is sensed by the farmer by detecting the change in color, smell or other physio- chemical changes of the plant produce. Unmanned aerial vehicles or Drones can be employed in these operations by equipping the copters with appropriate sensors. These sensors can detect and count the flowers and fruits at orchards and keep track of records through capturing images, later processing those images. It can also be used in random sampling of the crop seeds and also detect any roughed seeds. The data captured through the drones can detect the diseases on the time of emergence or also before it and help in plant management. These routine tasks can be repeatedly performed with much greater speed and at a greater sample size and above all it is more précised in all cases. The moisture stress and changes in the physio-chemical cycles can be easily monitored and governed with the drones at the time of harvest of grains, fruits and vegetables along with the spatial data through the cycle. Packaging, storing and delivery of the same could be done with it too. Hence, enables the farmers and growers to enable the smart and précised form of agriculture from the time of sowing to harvesting using UAV's and Artificial Intelligence.

V. CONCLUSION

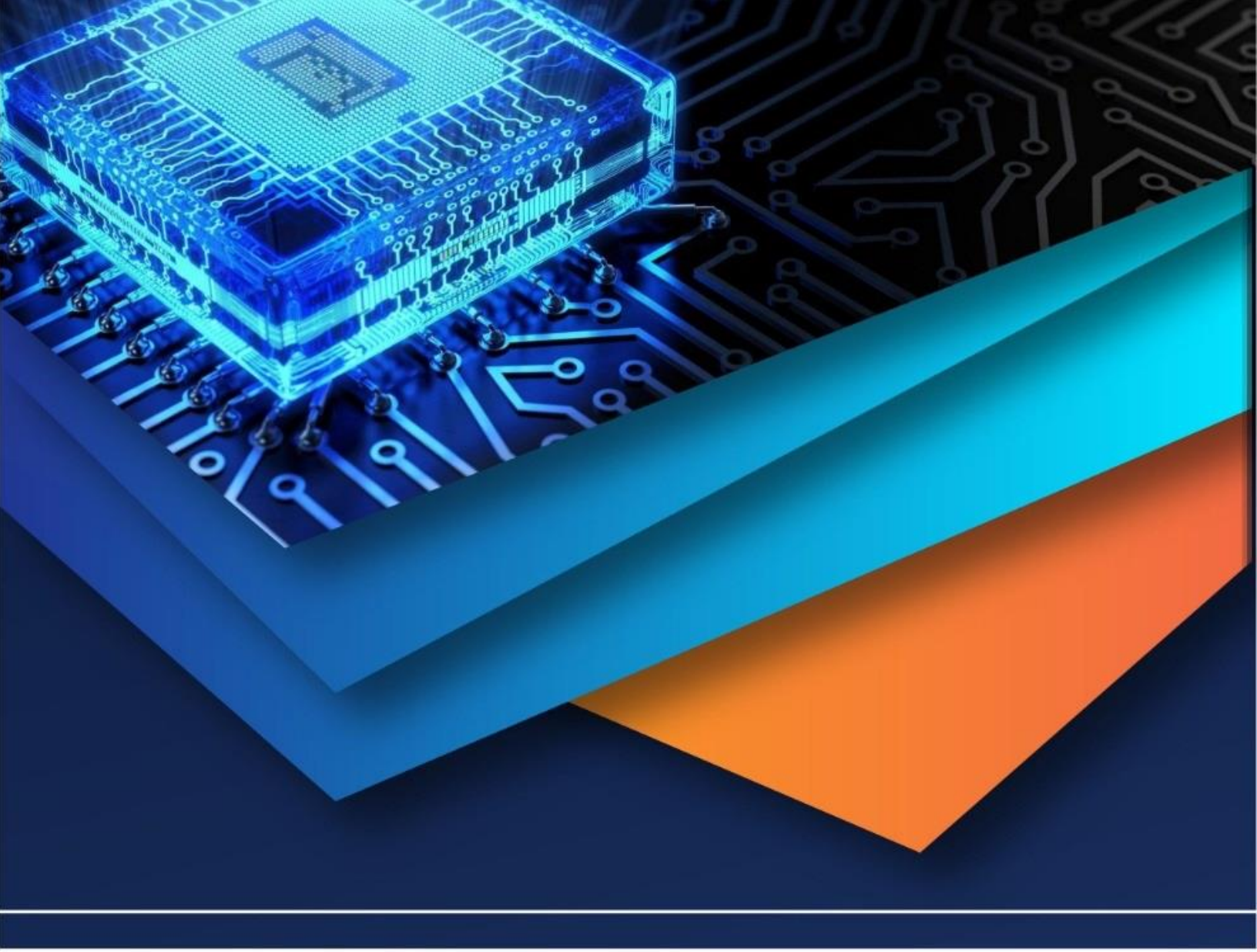
In the present study, hexacopter was studied which was equipped with different features. The overall efficiency was seen on different categories and was compared with quadcopter efficiency and was found that the stability and efficiency of hexacopter was much better that the quadcopter. The hexacopter like UAV's serves best for the remote areas once the GPS for the work is set and can cover a wide range of 1-5 hectares in merely 1-2 hrs of work. It was also found that the drones can be employed to study and record different activities of the crops from the date of sowing till harvesting and packaging of the crop produce and can also study weather attributes and differentiations, crop infections and pathogens before emergence of the disease at broad scale and can be utilized for studying the soil properties and enhancing the soil productivity and fertility. Hence Drones can be used in for various applications like data collection, report formulations, surveillance of animals, crop activities and information's related to chemical application can be easily performed without any major constraints and these utilizations will surely increase the productivity of the national income and hugely bring profit in GDP from agriculture.

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