iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IX **Month of publication:** September 2021

DOI: https://doi.org/10.22214/ijraset.2021.38030

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IX Sep 2021- Available at www.ijraset.com

E-Agriculture

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***Abstract:** In current era, modern technologies need to be used in agriculture in india to increase crop productivity because over 70% of the rural people depends upon the agriculture fields. Indian farmers are facing challenges such as crop monitoring, Soil and field analysis , estimation of soil conditions, Fighting infections and pests, irrigation monitoring , need of more human power and money etc., To overcome these agricultural challenges, agricultural drones are used in agriculture. Because of the applications of agricultural drone, it can be used easily where the equipment and labors are difficulty to operate in agricultural fields. To yield better crop quality and preventing fields from any sort of damage , agricultural drones are needed. Agricultural drones have a number of advantages over the more traditional agricultural methods. And moreover data processing applications are becoming less expensive and easier to use due to applications of agricultural drones. In this paper brief discussion about classification and importance of drones , application of agricultural drones, future use of agricultural drones etc., are discussed and finally concluded about the need of using modern technologies in agriculture fields .*

***Keywords:** Drones, agricultural drones, crop monitoring, crop spraying, pipeline inspection.*

I. INTRODUCTION

A drone is an unmanned aerial vehicle (UAV) or uncrewed aerial vehicle. No human pilot, crew or passengers on board are needed for this aircraft . Aerodynamic force is used to provide vehicle lift. Drones can fly autonomously or be piloted remotely. It can carry a lethal or nonlethal payload and can be expendable or recoverable. In addition it include a ground-based controller, communication system and UAV. Remote control is used to operate the flight of UAVs . Human acts as remotely-piloted aircraft (RPA) to operate the remote control . Drones were developed in the twentieth century for military purposes . It was adopted by the United States Department of Defense (DoD) and the United States Federal Aviation Administration (FAA). Airborne imagery , deliveries of product , drones usage in agriculture, Surveillance of people, places and vehicles , infrastructure inspections, , smuggling and drone racing are various applications of drones . Drones offers less stressful environment and it is used for better decision making. It never gets fatigue and presents safer environment. It can fly for longer hours in the air as long as the vehicle allows for it . There is no need for the qualified pilot to fly it, in the long run, drones can stay in the air for up to 30 hours and do repetitive tasks. It scans region precisely and performs repetitive raster scan of the region for day-after-day, night-after-night in the complete darkness or in the fog and under computer control. It also performs the geological survey, the visual or thermal imaging of the region. It measures cell phone, radio or TV coverage over any terrain very effectively . Drone pilots or operators can easily operate drone without any operational downtime. The drones have the ability to pinpoint more accuracy from greater distances.A drone can fly under any weather condition. Though drones are water resistant, image quality can be damaged if pictures are taken during rainy weather.

II. AGRICULTURAL DRONES AND ITS USES

The chief occupation and backbone of our country is agriculture . Now a days farmers are using drones that are specifically designed for agriculture purpose. To improve productivity in crops , modern techniques are adopted rather than traditional methods. Modern form of agriculture uses agricultural drones to reduce labour expenses and avoid time consumption. Agricultural drone technology are becoming more apparent to farmers. These drones are same as other type of drones but they are made specifically for agricultural purpose . Agricultural drones optimize agriculture operations and farm efficiency .It also increase crop production and monitor crop growth. To detect crop health , infrared sensors in drones are tuned and thus enables farmers to react and improve crop conditions locally with inputs of fertilizer or insecticides. It also improves management and effectuates better yield of the crops. Farmers can get rich picture of their agricultural field whenever it is needed . Digital picture of field are captured using Sensors and digital imaging capabilities to review irrigation problems, soil variation , pest and fungal infections in crops. Using agricultural drones, farmers can find the differences between healthy and unhealthy plants. Thus farmers can assess crop growth and production. Surveying of crops are done using agricultural drones that leads to rapid identification of problems.

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Fig 1 . Agricultural Drone

Agricultural small drones without specific technology can range from 2 to 3 lakhs and higher technological drones starts from 17 lakhs .It depends on the drone capability and size. Drones with fixed wings have longer flight time and can cover more field in one flight. It can cover up to 12km with 50 min flight time .Drones optimize the use of inputs such as seed, fertilizers, water to react more quickly to threats like weeds, pests, fungi to save time crop scouting with validate treatment to improve variable-rate prescriptions in real time and estimate yield from a field.

III. CLASSIFICATION OF AGRICULTURAL DRONES

Generally drones can be classified as multi rotor drones, fixed wing drones , Single-Rotor Helicopter, Fixed-wing hybrid based on weight ,engine type, maximum flight altitude, degree of operational autonomy , agricultural drones

1) *Multi-Rotor:* It is the simplest form of drones with feature such as framing the photography from the top view. It achieve more accurate results by controlling over the positions from where they take photography but it is less endurance and speed. Since it is less endurance and speed , it is used for only some agricultural activities.
2) *Fixed-Wing:* Fixed-wing Rotor drones operates with wing like structure .Its method of take-off is different from the other drones. Inertia has to be given by some external force to take off at initial stage , hence it is limited in use only for some agriculture activities.
3) *Single-Rotor Helicopter:* A single Rotor helicopter drones have more advantages than other type of drones. To sustain more endurance, it is fixed with the gas controlled system. It has larger rotor blades , so it spins less and efficiency of the system will be more. Because of this, it is more efficient than other kind of drones. Since it has long rotor blades, it has more advantages in agricultural fields.
4) *Fixed-wing Hybrid:* It is also known as VTOL (Vertical Take-off and Landing). It has combined features of UAV (Unmanned Aerial Vehicle) and the ability to hover in one place and thereby retaining hybrid features. Because of this feature, it is able to take off from one place and to sustain over some area vertically .

IV. APPLICATIONS OF AGRICULTURAL DRONES

Agriculture Farmers and agriculturists prefers to use cheap and effective techniques to regularly monitor their crops.. Various applications of agricultural drones are power and pipeline inspection, Soil and field analysis, Planting, Crop spraying, Crop monitoring, Irrigation, Estimating soil condition , Planting future crops, Identification of infections and pests,

1) *Power and Pipeline Inspection:* Agricultural drones are used to inspect power lines, wind turbines, and pipelines used in agriculture .
2) *Soil and Field Analysis:* Agricultural drones are used at the initial stage of the crop cycle to produce precise 3-D maps for early soil analysis, useful in planning seed planting patterns. Irrigation and nitrogen-level management are improved by soil analysis after planting is done.

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3) *Planting:* Agricultural drones are used as planting systems to improve an uptake rate up to 75 percent and decrease planting costs by 85 percent. These drones are used to shoot pods with seeds and to plant nutrients into the soil to sustain plant life by providing all the nutrients necessary for it .
4) *Crop Spraying:* Drones scan the ground and spray the liquid in correct amount by modulating distance from the ground and spraying in real time for even coverage. Thus it reduces the amount of chemicals penetrating into groundwater and increase efficiency. Aerial spraying by agricultural drones can be five times faster than traditional machinery.
5) *Crop Monitoring:* Crop monitoring in vast fields is a great challenge for farmers . Due to unpredictable weather conditions, monitoring challenges are exacerbated and thus it drive risk and field maintenance costs.
6) *Irrigation:* Drones with hyper-spectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements. Additionally, once the crop is growing, drones allow the calculation of the vegetation index, which describes the relative density and health of the crop, and show the heat signature, the amount of energy or heat the crop emits.
7) *Estimating Soil Condition:* One of the major applications of the drones are checking the condition of the soil. In the traditional approach of farming there are various steps involved in examining the soil, like visiting the ground manually with physical equipment and examining the prototype of soil for various factors, Where the drone consists of various censors and well developed equipment's for examining the soil accurately, and thereby giving correct reports.
8) *Planting Future Crops:* In agriculture, the drones are not only used for providing the weather report or other activity reports but also physically can capable to plant seeds in the soil. Recently some of the Drone manufacturing companies are experimenting over this activity, in view of providing smooth, fast and effective smart agriculture methods.
9) *Planting Seeds by Spraying:* Agricultural drones are used to plant seeds in the soil by the method of spraying, and spraying even water on the seeds which are planted with out human intervention .
10) *Fighting Infections and Pests:* Another most important category of agriculture is the identification of infections and pests in the farming area. Agricultural drones can also help in identification of infections and pests, and the amount of inflammation can also be identified, and spraying suitable amount of medicine on the crops which got infected, thereby reducing the human effort.
11) *Agriculture Spraying:* Since drones are the flying machines, to use these drones in agriculture suitably for smart farming, spraying technique can be adopted. The sensors in the drones will collect the information from agricultural lands, and based on the necessity the fertilizers and pesticides will be sprayed on the required crops. The drones are also capable of identifying the crops which got infected, the amount of infection, and based on the amount of infection, the fertilizers will be sprayed on particular crops, and leaving the healthy crops without spraying the pesticides.
12) *Crop Surveillance:* In the process of agriculture, monitoring the health of the crops is a necessary activity. In this context, in traditional approach, frequent visits will be given by the farmer's agricultural lands and monitors the status of the crops. But if the agricultural lands are huge, monitoring all the crops on daily basis is a very tough task for the farmers, in such cases drones are more capable of visiting all the lands and thereby monitors the crops and information can be maintained periodically.
13) *Mapping/Surveying:* Agricultural drones are used to map or survey crops .It is equipped with flight planning software that helps the user to draw around the area to be covered. Then, the software makes an automated flight path and make shots of covered area.The drone takes pictures using onboard sensors and the built-in camera, and uses GPS to determine when to take each shot.

V. FUTURE USE

In future , uses of agricultural drones will be increased rapidly due to the development of technologies and costs fall . Nearly 80% of the agricultural market will comprise of drones. There is a large capacity for growth in the area of agricultural drones. With technology constantly improving, imaging of the crops will need to improve as well. With the large amount of data captured by , the drones , the farmers are able to analyze their crops and make educated decisions on how to proceed given the accurate crop information. In future , Software programs for analyzing and correcting crop production have the potential to grow in this market. Farmers will fly a drone over their crops, accurately identify an issue in a specific area, and take the necessary actions to correct the problem. The Agricultural drones will help the farmers to focus more on the overall task of production instead of spending more time in surveying their crops. Both the purchase and maintenance costs of modern drones make them too expensive for small farms in developing nations. Technologies such as cloud computing, computer vision, artificial intelligence, machine learning, deep learning, and thermal sensors will be employed in agricultural drones for effective analysis of agriculture data.

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VI. CONCLUSION

Agricultural drones are no different than other types of drones. The application of the UAV are simply changesd to fit the needs of the farmer. Each kind of drone has its own and unique features when it comes to operation. The use of drones will grow significantly in farming as they offer a wide range of applications to improve precision agriculture. Agricultural drones are best suited in agriculture as expected that a tool for studying, analyzing the environments, temperatures, humidity of the agricultural land. Various types of agricultural drones can be used in agriculture process for different applications depending on the features of the drones. Due to various factors, such as economic Factors , Labor Issues ,Varying Climate Conditions , Lack of Knowledge ,Tight Bonding with Traditional Techniques agricultural drones are used to some extent in agriculture. Thus India is facing great challenges to adopt recent and modern techniques used for usage of agricultural drones. Though there are great challenges in using agricultural drones in all aspects of agriculture, applications of agricultural drones in agriculture has become essential .

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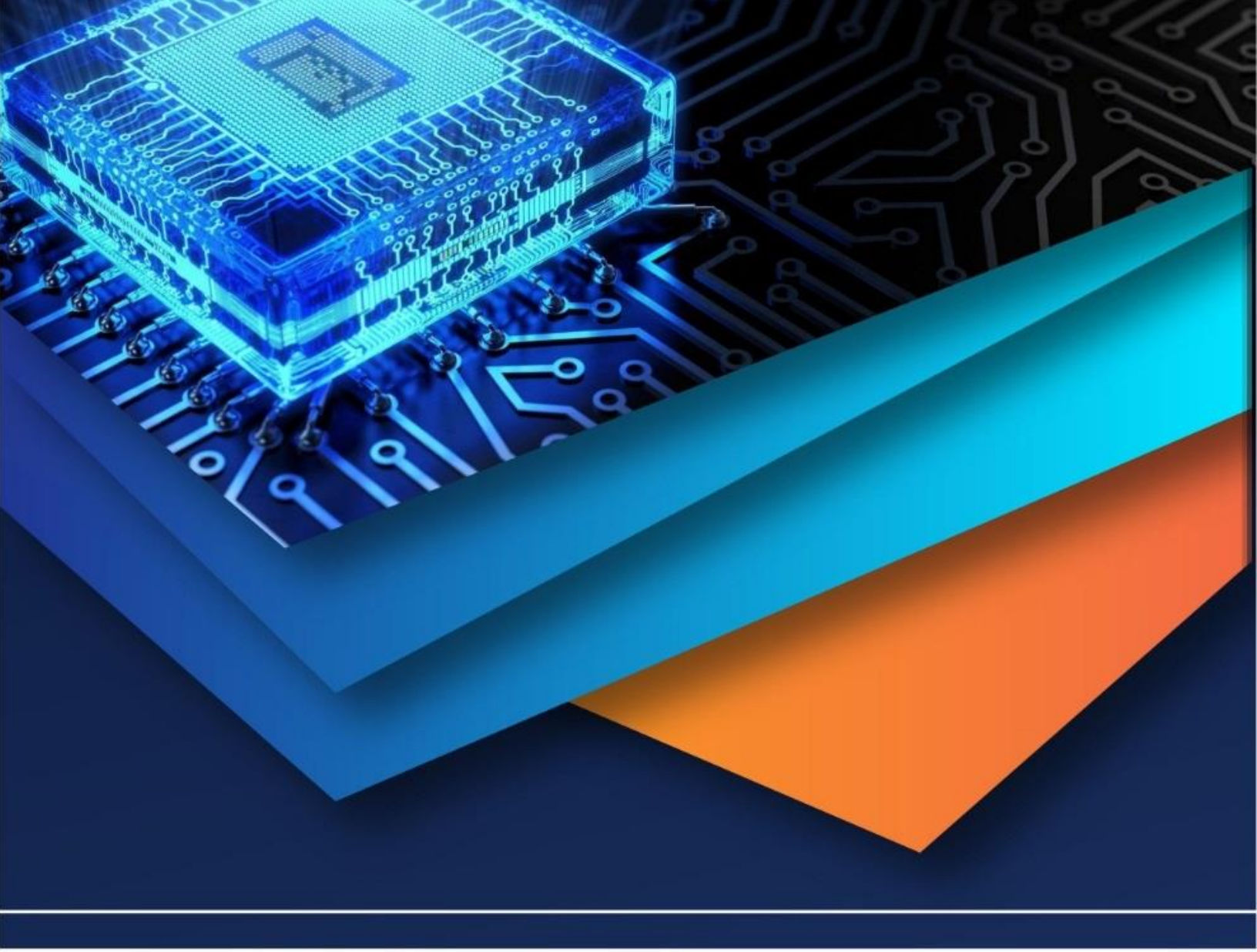

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