International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

A Survey on Agriculture Drones

Vedant Shrivastava
B.Tech Computer Science
Kalinga University
Raipur, Chhattisgarh, India
vedantshrivastava315@gmail.com

Shivam Jogandar Dubey
B.Tech Computer Science
Kalinga University
Raipur, Chhattisgarh., India
shivam0aa@gmail.com

Aditya Sahu
B.Tech Computer Science
Kalinga University
Raipur, Chhattisgarh, India
adityasaw53@gmail.com

Omprakash Dewangan
Assistant Professor
Kalinga University,
Raipur, Chhattisgarh,India
omprakash.dewangan@kalingauiversity.ac.in

Abstract— Precision agriculture, an emerging agricultural practice, aims to optimize crop production while reducing input costs and environmental impact. Agricultural drones, or unmanned aerial vehicles (UAVs), have emerged as a promising technology for precision agriculture due to their ability to collect high-resolution data and monitor crop health over large areas. This research provides a comprehensive overview of the current state of agricultural drone technology and its applications in precision agriculture. This research paper discusses the benefits and challenges of using agricultural drones, as well as the technical specifications of drone components and sensors. The paper also presents case studies of the use of agricultural drones in various crop production scenarios, including crop mapping, crop health monitoring, and crop yield estimation. The review concludes with a discussion of the future prospects of agricultural drone technology and the challenges that need to be addressed to realize its full potential.

Keywords—Drone, {UAV} Unmanned Aerial Vehicle, Surveillance, Agriculture Drone, Nanotechnology.

I. Introduction

Agriculture drones, also known as unmanned aerial vehicles (UAVs), have gained popularity in recent years due to their potential to revolutionize the agriculture industry. These drones are equipped with various sensors and cameras that can collect high-resolution data on crop health, soil moisture, and other important factors that can affect crop growth.The use of agriculture drones has numerous benefits, including increased efficiency and accuracy in crop monitoring and management, reduced labor costs, and improved crop yields. In addition, they can help farmers make informed decisions about crop fertilization, irrigation, and pest management.

Drones have long been thought of as expensive toys. One area that has seen little attention from drones, perhaps to its detriment, is the agricultural sector. Drones can fly autonomously with dedicated software which allows making a flight plan and deploying the system with GPS and feed in various parameters such as speed, altitude, ROI (Region of Interest), geo-fence and fail-safe modes. Drones are preferred over full size aircrafts due to major factors like combination of high spatial resolution and fast turnaround capabilities together with low operation cost and easy to trigger. These features are required in precision agriculture where large areas are monitored and analyses are carried out in minimum time. Using aerial vehicles is possible due to miniaturization of compact cameras and other sensors like infrared and sonar[1].

II. LITERATURE SURVEY

Several deep learning architectures have been developed and utilized by a significant number of users who have studied the components and characteristics of drones using this design, as well as applied them in various fields. This research is widely recognized as a significant contribution to the advancement of drone technology.When we think of surveillance. the most popular systems that we come across are CCTV cameras which are found in most of the residential and commercial areas or cameras which are based on CCD or CMOS technologies. The human detection and identification processes which are being applied in these approaches do not segment the body silhouette from the background due to the variation in light intensity. This makes the conventional techniques difficult to analyze. One significant approach to alleviate this problem is to make the system compatible even in variation of light illumination [2].The decreasing in size and increasing in capabilities of micro-electronic devices in recent times has opened up the doors to develop more capable UAVs (drones) and pushed the UAVs for more real time applications. Market of UAVs are growing dramatically as military, civil, commercial and agricultural applications of UAVs continuing to develop in

2022.In order to operate in the national airspace, an aircraft system must have documentation and analysis to show that it can operate at a satisfactory level of safety For traditional manned aircraft systems, this is equivalent to operating a reliable system However with Unmanned Aerial Systems (UAS), a relatively unreliable system can safely be operated provided that the risk to bystanders on the ground is sufficiently low.[2] .nowadays, and it is also challenging to understand the intentions for which the people may or may not use the UAVs. People need special licenses to fly UAVs , mainly because, in present days many urban areas have restricted flying UAVs or have no flight zones" to avoid disturbance with specific operations. Not only can drones be used for monitoring, estimation, and detection purposes based on their sensory data, but also for precision irrigation and precision weed, pest, and disease management. In other words, drones are able to spray water and pesticides in precise amounts based on environmental data[3].

III. Components of Drone and its specifications

S No.	Component	Specifications
1	Propellers	These components enable propulsion by generating thrust
2	Brushless Motor	High efficiency and small volume
3	Motor Mount	Absorb any vibrations
5	Landing Gear	To provide suspension system during landing
6	Main Drone Body Part	Carries whole components like battery, gps etc.
7	Electronic Speed Controller (ESC)	Controls and regulates the motor speed.
8	Flight Controller	Calculates the desired speed of each motor
9	GPS Module	Allows the drone to determine its location.
10	Receiver	To receive radio signals from the drone controller
11	Antenna	Converts electrical signal into electromagnetic waves
12	Battery	Provides power
13	Battery Monitor	Displays the remaining battery percentage.

IV. Advantages and challenges of agricultural drones:

Agricultural drones offer several advantages over traditional crop monitoring methods such as satellite imagery and ground sensors. First, agricultural drones can take high-resolution images and videos of crops and provide detailed information about crop health and growth patterns. Second, agricultural drones can cover large areas quickly and efficiently, allowing farmers to regularly monitor crops and detect changes in real time. Third, agricultural drones can reduce input costs and labor requirements because they can perform tasks such as crop mapping and health monitoring without the need for manual intervention.

However, agricultural drones also face several challenges, such as regulatory restrictions, technical limitations, and data processing requirements. The use of agricultural drones is regulated by aviation authorities, which require drone operators to obtain licenses and comply with safety regulations. Agricultural drones also require specialized components such as GPS receivers, cameras and sensors, which can be expensive and require technical expertise to install and operate.While agriculture drone systems are highly effective and useful, they have a significant limitation in that they are typically calibrated for specific tasks, such as classifying different types of vegetation, water bodies, urban areas, and bare soil. As a result, these systems are not able to provide a holistic view of agricultural processes, and human operators must manually feed the output data from one system to another. This lack of interoperability can result in additional work and time for operators[4]. Finally, agricultural drones generate a large amount of data that requires processing and analysis in order to obtain useful information.

V.Technical specifications of agricultural drones:

Agricultural drones consist of several components, including an airframe, a propulsion system, a navigation system, a communication system, and a payload. The airframe is the physical structure of the drone, which can vary in size and shape depending on the application. The propulsion system consists of motors, propellers and batteries that allow the drone to fly and maneuver. The navigation system includes GPS receivers, inertial measurement units (IMUs) and barometers that allow the drone to determine its position, altitude and orientation. The communication system includes radios and antennas that allow the drone to communicate with ground stations and other drones. Finally, the payload includes cameras, sensors, and other tools that allow the drone to collect data.

VI.Application Of Agriculture Drone:

Agricultural drones have numerous applications in precision agriculture, including crop mapping, crop health monitoring, and crop yield estimation. Crop mapping involves the use of agricultural drones to generate high-resolution crop maps that can be used to monitor crop growth, detect anomalies, and optimize resource allocation. Crop health monitoring involves the use of agricultural drones to collect crop health data such as plant height, leaf area index and crop stress indicators that can be used to detect diseases, pests and nutrient deficiencies. Crop yield estimation involves the use of agricultural drones to estimate crop yield, which can be used to optimize harvest timing, forecast crop prices, and improve supply chain management. Monitoring the health of plants, animals and insects on farms is essential to ensure optimal production. The advent of drones has simplified this process, allowing farmers to scan plants using visible and near-infrared light. These drones are able to detect variations in green light and near-infrared radiation emitted by different plants and produce multidimensional images that highlight changes in plant health. With this technology, farmers can monitor changes in plant health and take appropriate action to address any issues. Insights gleaned from this data can help farmers make informed decisions and implement necessary treatments, ultimately benefiting the farming community as a whole.

Agriculture drones are equipped with a variety of payloads, including sprayers that can spray fertilizers, pesticides, or herbicides on crops. These sprayers are typically controlled by the drone's operator, who can program the drone to fly over specific areas of the field and apply the necessary amounts of chemicals. This process is highly efficient and can save time and money compared to traditional methods of spraying, which often require labor-intensive work and can result in uneven application of chemicals. With agriculture drones, farmers can precisely target areas of their fields that require treatment, reducing the amount of chemicals used and improving the overall health of their crops.Apart from these applications, agricultural drones can also be used for other purposes such as soil mapping, irrigation management and livestock monitoring. Soil mapping involves the use of agricultural drones to collect data on soil properties such as moisture content, pH level and nutrient availability that can be used to optimize fertilizer application and crop selection. Irrigation management involves the use of agricultural drones to monitor crop stress and optimize irrigation scheduling, which can reduce water use and improve crop yields. Livestock monitoring involves the use of agricultural drones to monitor animal behavior and health, which can improve animal welfare and productivity.

Hundreds of drone images are stitched together to create large, high-resolution ortho maps. These ortho maps can then be used in GIS systems for analysis, planning, and management. The drone technology can be used to improve forest management and operational planning, including the monitoring of illegal activities[5].

VII. Future prospects for agricultural drones:

The use of agricultural drones is expected to grow significantly in the coming years, thanks to technological advancements, cost reductions and regulatory changes. Technological advances, such as the development of advanced sensors and artificial intelligence algorithms, will allow agricultural drones to collect more accurate and useful data. Cost reductions such as the use of off-the-shelf components and economies of scale will make agricultural drones more affordable for farmers. Regulatory changes such as the relaxation of drone regulations and the development of industry standards will facilitate the adoption of agricultural drones.

However, the full potential of agricultural drone technology can only be realized if certain challenges are addressed. These challenges include improving data processing and analysis capabilities, ensuring data privacy and security, developing user-friendly interfaces and training programs, and addressing the ethical and social implications of drone use. Addressing these challenges will require collaboration between farmers, researchers, policy makers and industry stakeholders.

VIII. Use of Nanotechnology in Agriculture drones:

Nanotechnology can play a significant role in improving the capabilities of agricultural drones. Nanotechnology involves the manipulation of matter at the molecular and atomic scales and has several applications in agriculture, including crop protection, nutrient delivery and soil health management. Here are some examples of how nanotechnology can help in agricultural drones:

Crop protection: Nanoparticles can be used to develop smart materials that can release pesticides and herbicides in a controlled and targeted manner. These materials can be applied to crops using agricultural drones, which can improve the efficiency and accuracy of pesticide and herbicide application. In addition, these smart materials can reduce the amount of pesticides and herbicides needed, which can minimize the impact on the environment.

Nutrient delivery: Nanoparticles can be used to develop nutrient delivery systems that can improve fertilizer application efficiency. For example, nanoparticles can be coated with nutrients and applied to crops using agricultural drones. These nanoparticles can penetrate plant cells more easily than traditional fertilizers, which can improve nutrient uptake and reduce fertilizer runoff.

Soil Health Management: Nanoparticles can be used to improve soil health by improving soil structure and fertility. For example, nanoparticles can be used to develop soil amendments that can improve water retention, nutrient availability and microbial activity in the soil. These changes can be applied to the soil using agricultural drones, which can improve the efficiency and accuracy of tillage.

Sensor technology: Nanoparticles can also be used to develop sensors that can detect crop stress, nutrient deficiencies and other factors that affect crop growth and yield. These sensors can be integrated into agricultural drones that can collect crop health data and transmit it to farmers in real time. This data can be used to optimize crop management practices and improve crop yields.

In short, nanotechnology can help improve the capabilities of agricultural drones by providing new materials, sensors, and delivery systems that can improve crop protection, nutrient delivery, and soil health management. Using agricultural drones that incorporate nanotechnology, farmers can achieve more accurate and efficient crop management, which can lead to higher yields and more sustainable farming practices.

IX. CONCLUSION

In conclusion, agricultural drones have the potential to revolutionize the way we approach agricultural practices. They can provide farmers with a new level of accuracy and efficiency in crop monitoring, yield prediction and pest control, among other things.Drone technology will give the agriculture industry and general purposes a high-technology makeover, with planning and strategy based on real-time data gathering and processing. Drones are also becoming an industry-standard in area mapping and GIS[6].Equipped with a variety of sensors and cameras, drones can collect high-resolution data that can be used to make data-driven decisions and increase crop yields while minimizing environmental impact. In addition, the use of drones can lead to cost savings and reduced labor requirements.

X. REFERENCES

[1] Dutta, Gopal & Goswami, Purba. (2020). Application of drone in agriculture: A review. International Journal of Chemical Studies. 8. 181-187. 10.22271/chemi.2020.v8.i5d.10529.

[2] C.lu, and M.S Drew, “Automatic Compensation for Camera Settings for Images Taken Under Different Illuminants”, technical paper, School of Computer Science, Simon Fraser University, Vancouver, British, Columbia, Canada, p.p.1-5, 2007.

[3] Rejeb, Abderahman & Abdollahi, Alireza & Rejeb, Karim & Treiblmaier, Horst. (2022). Drones in agriculture: A review and bibliometric analysis. Computers and Electronics in Agriculture. 198. 107017. 10.1016/j.compag.2022.107017. .

[4] Fontanella R, Vetrella A R, Fasano G, Accardo D, Moriello R S L, Angrisani L and Girard R 2017 A standardized approach to derive system specifications for drones operating in the future UTM scenario 2017 5th IEEE International Conference on Models and Technologies for Intelligent Transportation Systems pp 250–255

[5] *A, Karthikkumar & Dhakshina Moorthy, Pandiya Kumar. (2023). Applications of Drone in Agriculture*

[6] W. Budiharto, A. Chowanda, A. A. S. Gunawan, E. Irwansyah and J. S. Suroso, "A Review and Progress of Research on Autonomous Drone in Agriculture, Delivering Items and Geographical Information Systems (GIS)," *2019 2nd World Symposium on Communication Engineering (WSCE)*, Nagoya, Japan, 2019, pp. 205-209, doi: 10.1109/WSCE49000.2019.9041004.