March, 2024, Vol.1: 14-15

Revolutionizing Agriculture: The Transformative Applications of Drones

Venkata Naresh Boddepalli

Department of Agronomy, Iowa State University, USA

naresh89@iastate.edu

Technological advancements have been pivotal in reshaping various industries in recent years, and agriculture is no exception. One such groundbreaking technology making waves in the agricultural sector is drones. Unmanned Aerial Vehicles (UAVs), commonly known as drones, have emerged as powerful tools that offer innovative solutions to longstanding challenges in agriculture. Advancements in technology are revolutionizing agriculture by aiding in faster decision-making, reducing costs, and increasing yields. Drones transform farmers' management of crops and maximize yields through crop monitoring and precision farming (Tsouros et al., 2019; Delavarpour et al., 2021).

Critical Applications of Drones in Agriculture

i. Crop Monitoring and Assessment

Drones, equipped with advanced cameras and sensors, have emerged as essential assets in modern agriculture, revolutionizing the way farmers monitor and manage their crops. These unmanned aerial vehicles soar over fields, capturing high-resolution images and valuable data that offer real-time insights into the overall health and conditions of crops. The detailed images obtained by these drones provide farmers with a comprehensive view of their fields, allowing them to assess plant health, detect nutrient deficiencies, and identify potential pest infestations. The ability to obtain such precise and timely information is crucial for making informed decisions that can significantly impact crop yields and farm productivity.

DJI INSPIRE DRONE

One of the critical advantages of drone technology in agriculture is the early detection of issues. By identifying problems early, farmers can implement prompt corrective measures, preventing the escalation of crop diseases or pest outbreaks (He et al., 2021). This proactive approach minimizes crop losses and reduces reliance on pesticides and fertilizers, contributing to more sustainable and environmentally friendly farming practices.

Additionally, the real-time data drones provide enables farmers to optimize their resource allocation. Farmers can tailor their irrigation, fertilization, and pest control strategies by understanding the specific needs of different areas within a field, resulting in more efficient resource utilization and cost savings.

ii. Precision Agriculture

Precision agriculture involves optimizing inputs such as water, fertilizers, and pesticides to maximize output while minimizing waste (Tsouros et al., 2019). Drones play a crucial role in precision agriculture by offering accurate and timely data for decision-making. Farmers can create precise maps of their fields by analyzing data collected from drone surveys, enabling targeted application of resources. This not only increases efficiency but also reduces environmental impact.

iii. Crop Spraying

In the past, crop spraying was a task that required much manual effort and the use of tractors. However, with the introduction of drones equipped with specialized spraying systems, this process has been transformed. These drones can navigate through fields with great precision and deliver pesticides (Latif et al., 2020) or fertilizers to targeted areas with accuracy. This not only helps reduce the amount of chemicals used but also minimizes human exposure to harmful substances.

iv. Irrigation Management

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have been identified as a cost-effective solution for real-time monitoring of irrigation requirements. This technique has been proven to improve water use efficiency and crop productivity, as noted by Mokari et al. in 2022. By employing drones equipped with thermal imaging sensors, farmers can assess soil moisture levels in agricultural fields, which enables them to optimize their irrigation strategies. This ensures crops receive the appropriate amount of water at the right time, leading to healthier plant growth. Efficient irrigation management not only conserves water but also promotes sustainable agriculture.

v. Livestock Monitoring

Drones can help manage crops and monitor livestock. They can assist farmers in identifying and evaluating the health of animals in large grazing areas with the help of thermal cameras. This technology can be used to detect diseases at an early

WEATHER AND SOIL DATA CAPTURING BY THE DRONES IN A FIELD
SOURCE: WWW.RAWPIXEL.COM

stage, keep track of animal movement, and manage the entire herd effectively (Li and Xing, 2019).

Vi. Mapping and Surveying

Drones are handy tools for creating precise maps and surveys of agricult
-ural landscapes. These maps can provide valuable insights into the terrain, soil composition, and topography, which can be extremely helpful for farmers when making informed decisions about land use and choosing the best crops to grow (Wang et al., 2020). This data is especially beneficial for large-scale farms where having a clear understanding of the entire landscape is crucial.

DRONES SPRAYING CHEMICALS IN MAIZE FIELD
SOURCE: WWW.IOWAFARMSINC.COM

Challenges in Agricultural Drone Deployment

Drones are increasingly used in agriculture for crop monitoring, but they face several challenges that limit their efficiency. The limited flight time of drones (15-30 minutes) and their range (2-3 kilometres) pose difficulties for extensive coverage in large-scale farming operations. Moreover, weather conditions such as wind, rain, and fog can impede drone operation and the quality of data collected during crop monitoring. The restricted payload capacity of drones also limits the sensors and cameras they can carry, leading to a lack of essential data such as thermal imaging or hyperspectral data. Additionally, the use of drones in agriculture is subject to legal and regulatory challenges, including airspace regulations and privacy concerns, which can hinder their widespread adoption and integration into farm operations. While using drones in agriculture can be cost-effective in the long term, the initial investment can be a significant barrier for many farmers. Commercial drones for agricultural use can cost between $1,000 to $10,000, impacting adoption, especially for smaller-scale or resource-constrained farmers.

Conclusion

The use of drones in agriculture is becoming increasingly diverse as technology advances. Drones play a significant role in increasing productivity and sustainability in the agricultural sector. They are used for various purposes, including crop monitoring, resource management, and optimization. As farmers integrate these innovative technologies, the future of agriculture looks promising. The potential benefits include higher yields, lower environmental impact, and improved overall efficiency.

References

- Delavarpour, N.; Koparan, C.; Nowatzki, J.; Bajwa, S.; Sun, X. A (2021). Technical Study on UAV Characteristics for Precision Agriculture Applications and Associated Practical Challenges. Remote Sens. 13, 1204. https://doi.org/10.3390/rs13061204
- He, C., Li, X., Liu, Y., Yang, B., Wu, Z., Tan, S., and Weng, H. (2022). Combining multicolor fluorescence imaging with multispectral reflectance imaging for rapid citrus Huanglongbing detection based on the lightweight convolutional neural network using a handheld device. Computers and Electronics in Agriculture, 194, 106808.
- Latif, G., Alghazo, J., Maheswar, R., Vijayakumar, V. and Butt, M. (2020). Deep learning based intelligence cognitive vision drone for automatic plant diseases identification and spraying. Journal of Intelligent & Fuzzy Systems, 39(6): 8103-8114
- Li, Xiaohui, and Li Xing (2019). “Use of Unmanned Aerial Vehicles for Livestock Monitoring Based on Streaming K-Means Clustering.” IFAC-PapersOnLine, vol. 52, no. 30, 2019, pp. 324–29. DOI.org: https://doi.org/10.1016/j.ifacol.2019.12.560.
- Mokari, Esmaiil, et al.(2022). “Development of a New UAV-Thermal Imaging Based Model for Estimating Pecan Evapotranspiration.” Computers and Electronics in Agriculture, vol. 194, Mar. p. 106752. https://doi.org/10.1016/j.compag.2022.106752.
- Tsouros, D.C.; Bibi, S.; Sarigiannidis, P.G. (2019). A Review on UAV-Based Applications for Precision Agriculture. Information, 10, 349. https://doi.org/10.3390/info10110349.