MONITORING AGRICULTURAL CROPS THROUGH DRONE TECHNOLOGY

Rana Hani A.Rahman Azzam
Aerospace Engineering Khalifa University of Science and Technology, UAE
rana.azzam@ku.ac.ae
Jaloliddin Yigitaliev
Department of Mechatronics and robotics and Tashkent State Technical University named after Islam Karimov , Uzbekistan yigitaliyevjaloliddin1997@gmail.com

https://doi.org/10.5281/zenodo.7927709

Abstract: Monitoring agricultural crops through drone technology has become increasingly popular in recent years. Drones, also known as unmanned aerial vehicles (UAVs), can capture high-resolution images and videos of crops, allowing farmers to gather important data about plant health, growth patterns, and potential problems.This technology can help farmers identify areas of their fields that require special attention, such as areas that need additional irrigation, fertilizer, or pest control. Drones can also detect early signs of crop diseases, which can be critical in preventing the spread of disease to other areas of the field. Furthermore, drones can also help farmers improve crop yields by providing data on crop health and growth, which can inform decisions regarding crop management practices. This can include adjusting planting densities, irrigation schedules, and fertilizer application rates. Monitoring agricultural crops through drone technology has the potential to revolutionize the way farmers manage their fields. By providing real-time data and analysis, drones can help farmers make more informed decisions that ultimately lead to higher yields and more efficient use of resources.

Keywords: Agricultural, UAV (Unmanned Aerial Vehicles), security, automation, monitoring

МОНИТОРИНГ УРОЖАЯ С ПОМОЩЬЮ ТЕХНОЛОГИИ ДРОНОВ

Аннотация: Мониторинг сельскохозяйственных культур с помощью беспилотных летательных аппаратов становится все более популярным в последние годы. Дроны, также известные как беспилотные летательные аппараты (БПЛА), могут снимать изображения и видео с высоким разрешением, позволяя фермерам собирать важные данные о здоровье растений, характере роста и потенциальных проблемах. Эта технология может помочь фермерам определить площади своих полей. которые требуют особого внимания, например области, требующие дополнительного орошения, удобрений или борьбы с вредителями. Дроны также могут обнаруживать ранние признаки болезней сельскохозяйственных культур, что может иметь решающее значение для предотвращения распространения болезни на другие участки поля. Кроме того, дроны также могут помочь фермерам повысить урожайность, предоставляя данные о состоянии и росте сельскохозяйственных культур, которые могут использоваться для принятия решений в отношении методов управления культурами. Это может включать корректировку плотности посадки, графиков орошения и нормы внесения удобрений. Мониторинг сельскохозяйственных культур с помощью беспилотных технологий может революционизировать то, как фермеры управляют своими полями. Предоставляя данные и анализ в режиме реального времени, дроны могут помочь фермерам принимать более обоснованные решения, которые в конечном итоге приведут к повышению урожайности и более эффективному использованию ресурсов.

Ключевые слова: Сельское хозяйство, Беспилотные летательные аппараты, безопасность, автоматизация, мониторинг.

INTRODUCTION

Everything is network connected these days or at least uses radio frequencies for communication with other devices. Given the affordable price of electronic components nowadays, most of these connected devices are still consumer's phones, computers, TVs and even Internet of Thing (IoT) devices, but more and more of them are getting so reliable that could be used for professional or even commercial purposes. Such devices could be relay switches, access control systems (smart bells, locks, etc.), motion sensors, surveillance cameras and even drones. Due to the constant demand of technology advancements, most of the manufacturers that offer consumer electronics are already focusing on the production of specialized technology for key sectors. By using drone technology, farmers can quickly and efficiently survey their crops, identify potential problems, and make informed decisions about irrigation, fertilizer application, and pest control. The ability to collect data in real-time allows farmers to respond to changing conditions quickly, potentially increasing crop yields and reducing the risk of crop loss. Drone technology also offers several other benefits, including reducing labor costs and minimizing the environmental impact of farming. With drones, farmers can cover large areas of land more quickly and easily than traditional methods, reducing the need for manual labor and expensive equipment. Drone technology is revolutionizing the way farmers approach agriculture, enabling them to make more informed decisions and improve crop yields in a more sustainable manner. Drones can be equipped with various sensors, including thermal cameras, multispectral sensors, and LiDAR sensors. These sensors capture data on plant health, soil moisture, temperature, and other environmental factors. The data collected by the sensors is then processed and analyzed using software that creates maps and reports for farmers to use in making decisions about their crops.

As already mentions, the drones or as they are also known as Unmanned Aerial Vehicles (UAV) or Unmanned Aircraft System (UAS) are already available, not only as militarygrade class technology, but also as consumer-grade. The UAV could be classified like every other aircraft, based on their weight (Fig. 1), operational role, range (Fig. 2), and not only. Due to various country regulations (not only in EU and US, but all over the world), most of the consumer-grade drones are manufactured with weight below 2 kilograms, so they could be purchased and flown by wider range of pilots with significantly lower set of rules and limitations, and without requiring specific licenses or permits.

Fig. 1. UAV classification by Weight

Fig. 2. UAV Classification by range

Of course, every country has its own rules and regulations, so the minimum and maximum allowed weight may vary. For instance, the Federal Aviation Administration (FAA) in US requires all drones under 25 kilograms (except those that weigh less than 250 grams) that are flown exclusively under the Exception for Recreational Flyers to be registered. [2] Another classification that could be used to identify a UAV, as shown on Fig.2, is the range or the maximum flight altitude where the device is still capable to operate. Combining both the classifications can provide a decent framework that could be followed by both governances and manufacturers. At the same time, reviewing the values of these classifications, it's obvious there is some space for nterpretations. To confirm that and clarify how the so-called framework is practically applied by the manufacturers, we've compared most of the existing drone models of a single manufacturer, separating them not only by the given weight, flight range and altitude (Fig. 3), but also by the classification type and purpose assigned by the manufacturer, as shown in Tab. 1.

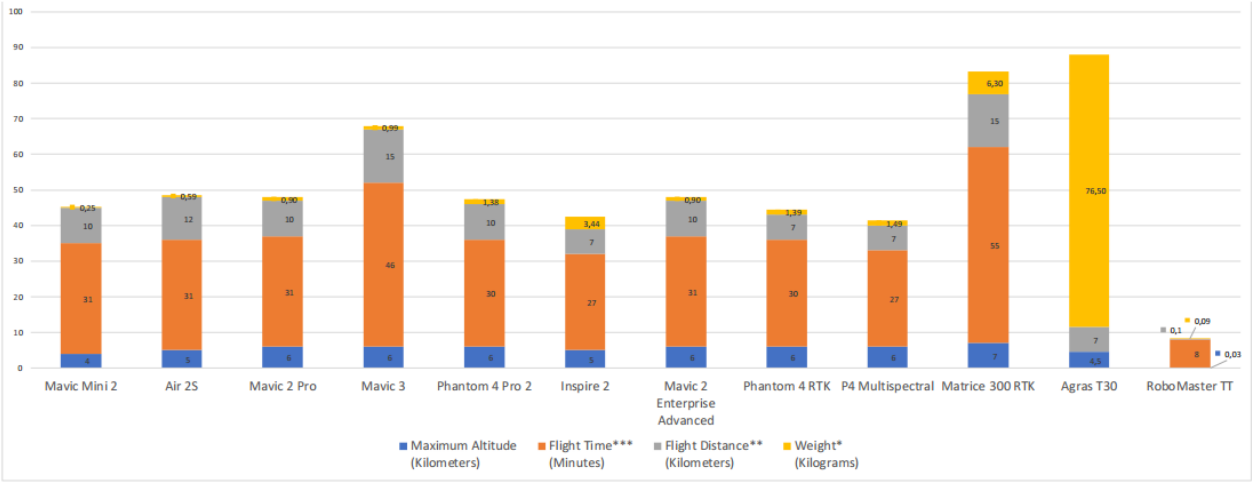

Fig. 3. DJI drones comparison by weight, flight range and time and maximum altitude

Drones	Type	Purpose
Mavic Mini 2	Consumer	Recreational
Air 2S	Consumer	Recreational
Mavic 2 Pro	Consumer	Recreational
Mavic 3	Consumer	Recreational
Phantom 4 Pro 2	Consumer	Recreational
Inspire 2	Consumer	Recreational
Mavic 2 Enterprise Advanced	Enterprise	Firefighting / Wildlife protection Law Enforcement
Phantom 4 RTK	Enterprise	2D and 3D Photogrammetry Waypoint Flight / Terrain Awareness. Block Segmentation
P4 Multispectral	Enterprise	Agriculture Environmental Monitoring
Matrice 300 RTK	Enterprise	Firefighting / Rescue missions Law Enforcement
Agras T30	Enterprise	Agriculture
RoboMaster TT	Education	Drone and AI development and education

TABLE I. DJIDRONES COMPARISON BY TYPE AND PURPOSE

DRONE APPLICATIONS IN MODERN AGRICULTURE

Drones equipped with specialized sensors and cameras can provide high-resolution images of crops. These images can be analyzed to detect diseases, pests, and nutrient deficiencies. The data collected by drones can be used to create maps of crop health, which can help farmers identify and treat problems before they cause significant losses. Crop monitoring can also help farmers optimize their use of pesticides and fertilizers, reducing waste and improving crop health. Drones can generate detailed images of fields, which can be used to create accurate maps of crop health, yield potential, and soil variability. This data can help farmers make better decisions about planting, fertilization, and irrigation. Crop mapping can also help farmers identify areas of their fields that are performing poorly, allowing them to take corrective actions before it's too late. Drones apply pesticides and fertilizers with high accuracy. This reduces waste and minimizes the environmental impact of farming. Drones can also be used to plant crops with high accuracy, reducing labor costs and increasing efficiency. They are monitor livestock, especially in large farms where it may be difficult to keep track of animals. They can provide real-time information about the location, health, and behavior of animals. This can help farmers identify sick or injured animals early on and take corrective actions to prevent losses. Drones in modern agriculture are vast, and the technology is constantly evolving. However, there are still challenges that need to be addressed, such as regulatory hurdles, limited flight time, and high costs. As these challenges are overcome, drones are expected to become an increasingly important tool in the modern agricultural industry.

CONCLUSION

Looking at the current state of consumer-grade UAV technology, its capabilities, and the community's involvement in developing high-end products that allow consumers to accelerate the use of their aircraft has shown us that even budget drone solutions can provide high value. agriculture and not only. The example of use that we have considered in this article can be used with the same efficiency in urbanized areas or even in closed areas, only by adjusting the height of the aircraft and taking into account the line of sight during flight. An evaluation of the application areas, the benefits of having "eyes in the sky" and the potential savings that can be achieved with a drone solution have shown us that the benefits of using drones probably outweigh the potential drawbacks and complications. the result of their use.

REFRENCES

1. C. Atzberger, “Advances in Remote Sensing of Agriculture: Context Description, Existing Operational Monitoring Systems and Major Information Needs,” Remote Sensing, vol. 5, no. 2, pp. 949–981, Feb.2013, doi: 10.3390/rs5020949.
2. R. Tanwar, “BIS Research: UAV Delivery Systems and UAV Application of Formulation & Adjuvant Technologies”(AgroPages), May. 20, 2019
3. W. Shuan, A. Haizhou and H. Kezhong, "Difference image based on multiple moving targets detection and tracking", Journal of Image and Graphics, vol. 4, no. 6, pp. 470-474, 1999.
4. L. Hongwen, Y. Zuoliang, T. Dan and L. Guohui, "Prospects and Current Studies on Background Subtraction Techniques for Moving Objects Detection from Surveillance Video", National University of Defense Technology, vol. 25, no. 3, pp. 66-69, 2003.
5. A. C. Shastry and R. A. Schowengerdt, "Airborne video registration and traffic-flow parameter estimation," in IEEE Transactions on Intelligent Transportation Systems, vol. 6, no. 4, pp. 391-405, Dec. 2005, doi: 10.1109/TITS.2005.858621..
6. C. Constantinides and P. Parkinson, "Security challenges in UAV development," 2008 IEEE/AIAA 27th Digital Avionics Systems Conference, 2008, pp. 1.C.1-1-1.C.1-8, doi: 10.1109/DASC.2008.4702757.
7. V. Dey, V. Pudi, A. Chattopadhyay and Y. Elovici, "Security Vulnerabilities of Unmanned Aerial Vehicles and Countermeasures: An Experimental Study," 2018 31st International Conference on VLSI Design and 2018 17th International Conference on Embedded Systems (VLSID), 2018, pp. 398-403, doi: 10.1109/VLSID.2018.97..
8. S. Liao, Dji drones can get past no-fly zones thanks to this Russian software company [online], 2017, https://www.theverge.com/ 2017/6/21/15848344/drones-russian-software-hack-dji-jailbreak.