

# An Evaluation of Flying Robotic Systems Using Software-Controlled Flight Plans in Its Embedded Systems

**Sravan Kumar Kota<sup>1\*</sup>, Shailesh Singh Thakur<sup>2</sup>**

<sup>1</sup> Department of Aerospace, Mechanical and Industrial Engineering, Canada.

<sup>2</sup> Kalinga University, India.

\*Corresponding Author Email: <sup>1</sup> sravankumarrkota88@gmail.com

## Abstract

The unmanned aerial system (UAS) is explored in this research which are elevating this article. The evolution can be seen in the segment of flying robotic systems and it is essential for ensuring an embedded system. The growth in the flying robotic system or generally known as drones is completely changing the entire world with the help of different innovations and progress which are leading towards a better way for the future. Modern research on drones is helping to solve different issues that are developed in the past and is able to provide a secure future for the entire world. The growth and betterment can be done with highly manoeuvrable drones which are used in different fields such as agriculture, monitoring, military combat, aerial mapping, and much more. The drones ensured a real-time response which is beneficial for completing these works within a specified time. The drone devices are restricted in high-security areas and are also recommended for use only in normal conditions. The drones are not able to perform in hazardous situations.

## Keywords

Drone, flying robotic systems, Surveillance, UAVs.

## INTRODUCTION

The flying robotic system usually known as a drone is remotely controlled or can be a software-controlled flight system. This is worked on the basis of the global positioning system (GPS). The aerial robots perform system operations without direct human control to complete specific tasks. A particular job can be completed remotely with the help of specially designed software. Pre-programmed flight paths are developed with the help of artificial intelligence (AI) with the help of different cameras and sensors. These drones are useful for monitoring or able to do mapping any wildlife or any hazardous places. Other uses of aerial robots are helping in any disaster situations by providing food and other essential ingredients. Image acquisition and surveillance are completed with the help of aerial robots or drones. Aerial mobile robots are also used on the basis of unmanned aerial vehicles (UAVs). These drone systems can be used for different military operations, complete any emergency operations by saving lives, and also can be used for personal purposes for recording videos or capturing pictures. Flying robotic systems are used for different industrial and medical uses which are beneficial for increasing the production speed and others which are able to produce a better way to provide different services in the required industries. Quadrotors, Quadcopters, and Quadcopers are the main robotic systems that can fly. These flying robotic systems are used for different operations in space and also in other places beyond the reach of humans and created a better way for humans.

In this study, the evolution is ensured in the flying robotic systems which are enabled with a software-controlled system. This is beneficial for developing various works to

secure a better future for humanity. The drone systems are going to be much bigger and wider in the future. Various present and future uses of drone systems are also discussed in this study.

## LITERATURE REVIEW

### Evaluation of drone systems

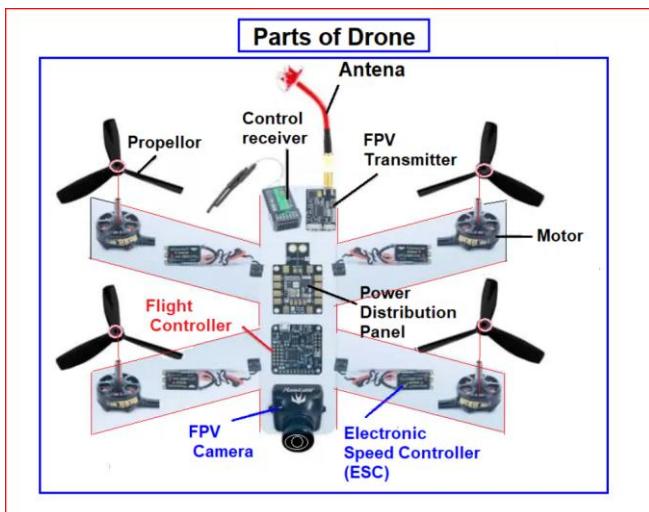
### Drone system and work functions

Drones are controlled by remote ground control systems (GSC) and are also referred to as ground cockpits. The drone systems are fully developed with two parts which are the drone and control system [6]. Different systems and navigational sensors are presented in the drones which are beneficial for gaining better knowledge of the subject. Modern drones are able to create 3D maps, rescue and research operations, and surveys which are completed with the help of radar-positing and return homing systems which are beneficial for flying in both Global Navigational Satellite Systems (GNSS) and non-satellite modes. The safety feature of return home can be useful for getting out of any unwanted situations such as battery issues and low connectivity. Multi-rotor drones, single-rotor drones, fixed-wing drones, and fixed-wing hybrid VTOLs (vertical take-off and landing) are the five types of drones that are used on various occasions.



**Figure 1:** Basic Drone model  
 (Source: 6)

A sufficient amount of upward force is required to lift the vehicle against gravity which is used in drones. A force created to move the vehicle or body in motion is called thrust. These principles are used for drones for completing the flow pattern. A drone system is completed with the help of propellers, antennas, motors for controlling the propellers, a First Person View (FPV) transmitter, an FPV camera, an electronic speed controller, and a power distribution panel [7]. Thermal Sensors, Optical Cameras. Lidar (Light Detection and Ranging) Sensor. Ground Penetrating Radar (GPR) Sensor and Antenna Configuration, Lightweight Portable Radiometer (LPR) these systems are usually used in drones as sensors.

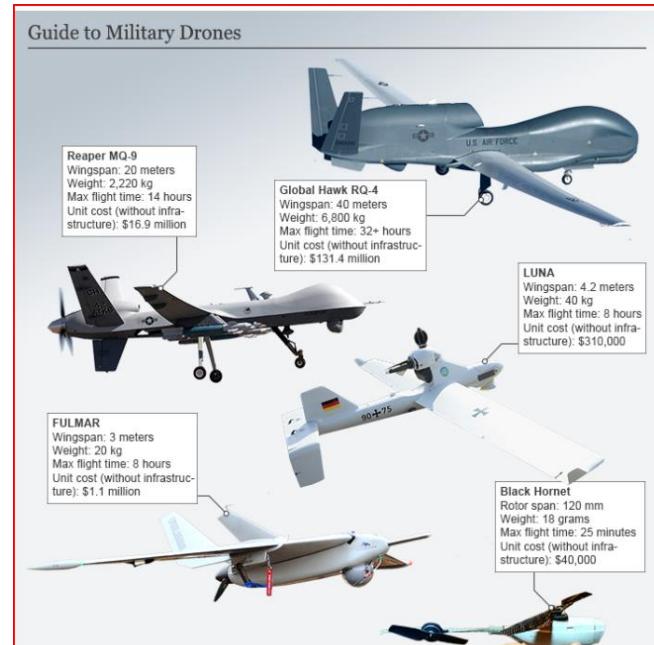


**Figure 2:** Different parts of drone systems  
 (Source: 7)

#### Military operations

In the modern era of technologies, drones are widely used in different military operations. These drones are completely different in every term from other drones, the build quality and the purpose of these drones are also different. On the basis of operations, the size of drones is also changed for geographical surveying or to combat wildlife poaching. Predators drones are used which are able to cover a large

section of land. This is also required a short runway and fixed wings. For other covert military operations or other surveillance operations in different areas drones are used which are smaller in size but faster and also can be entirely soundless. Military drones are also can be developed in a camouflage design, shape, or colours which are beneficial for merging in different situations [8].



**Figure 3:** Different military drones  
 (Source: 8)

Military drones are also used for direct attacks in enemy camps and other areas which are beneficial in getting a better position in a war situation. Military autonomous drones (UAVs) are able to fly in a specific location, pick their own targets, and can kill without the assistance of any remote human operators. Military drones are hard to detect as the drones are incredibly fast and also have infrared sensors for night operations. Military drone attacks can be conducted by different commercial UCAVs for firing a missile, dropping bombs, and eliminating targets.

#### Agriculture

Drones are beneficial for providing real-time data for farmers so that they can work accordingly. A visible revolution can be developed with drone systems can be done in a cheap, most reliable, and fast possible way. With the help of agricultural drones, a visible revolution can be seen in the field of modern agricultural development. Unmanned aerial vehicles (UAVs) represent the technological advancement that is used for precision farming [9]. Farm management decision-making can be possible with the help of these drone systems which are providing a high-resolution image of crops that are beneficial for understanding the issues of crops and can be taken different solutions accordingly. Agricultural drones are also used for spraying different pesticides in agricultural fields.



**Figure 4:** The use of agricultural drones  
 (Source: 9)

Major cost savings, more profitability, and enhanced efficiency can be gained by the farmers with the help of a drone system which is why it is referred to as the future of agriculture. The surveillance of the crops, understanding the health of crops, monitoring livestock and irrigation systems, mapping the agricultural field, and improving the spraying accuracy of water and pesticides can be easily done with the help of agricultural drones [10]. Farmers now use different automatic harvesters, autonomous tractors, drones, seeding, and weeding to transform the cultivation of crops.

#### **Delivery and Transport**

A safe environmental impact can be possible with drone delivery systems. The deliveries are faster compared with land-based delivery services. Reducing the energy consumption of small package deliveries is helping to lower CO<sub>2</sub> emissions which are beneficial for reducing climate change. Different unmanned aerial vehicles (UAVs) are used for transporting packages for use cases that include fresh food, medical supplies, or other goods for delivery [13]. The drones are mostly electric and can carry different lightweight delivery packages as a part of the last-mile delivery process.

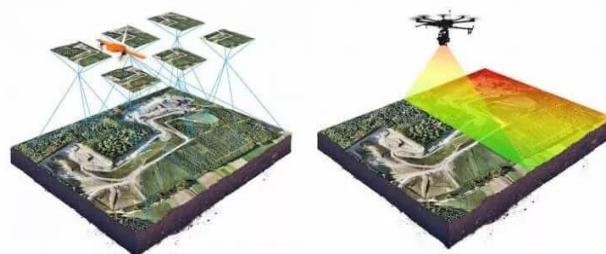


**Figure 5:** Drones used for delivery services  
 (Source: 13)

As per the data of 2022, an estimated that more than 2,000 drone deliveries are completed every day worldwide. E-commerce companies are moving towards drone deliveries in the future due to reliability, cost efficiency, and efficiency. Controlling operational costs is helping with drones are the future of delivery systems. Tackling the inefficiencies in last-mile logistics is solved with the help of a drone delivery system. Easy access to remote areas can be possible with the help of drones.

#### **Mapping and traffic surveillance**

Drones are taking pictures of a particular place from the air and provide a 3D map with the help of different software systems. This aerial survey is useful for getting an overview of a particular area within a short period of time [14]. Aerial mapping with drone systems is accurate, cost-effective, and time-effective. Easy access to different areas can be reached with the help of drone systems that benefit drone mapping. Traffic monitoring can also be done with the help of drone systems that are useful for increasing endurance and providing a mechanical safety.



**Figure 6:** Mapping and surveillance systems used with drones  
 (Source: 14)

Multiple vantage points are beneficial for mapping and inspections which are able to measure the accurate distance, also surfaces, and volumes of different physical objects. UAVs are providing pictures that are unable to detect by the human eye which is able to provide a major development in the areas of surveillance. Drones are sometimes used in traffic monitoring for managing heavy traffic situations also accidents and are able to monitor the flow of vehicles for various research purposes. Drones are also used for security reasons in various gatherings; the arterial view of the area is easily able to find out any issues quickly and efficiently. General References are usually called planimetric maps, Topographic Maps. Thematic and Navigation Charts are the different types of mapping that can be developed with the help of drones.

#### **Other uses of drones**

In the areas of construction and mining flying robotic systems are also used which are beneficial for gaining better development from these. The drones are used for spraying colours, painting, and understanding everything from First Person View (FPV) [11]. This is helpful to understand any

mistakes in the construction. In serious accidental conditions, drones are helpful for locating trapped people and can rescue them easily. Weather monitoring can be done with temperature, humidity, or air pressure sensors which are attached directly to the drone.



**Figure 7:** Drones used in construction  
 (Source: 11)

This is beneficial for providing real-time data about the weather and can predict different issues in the weather. Drones are useful for different scientific research which are based on various advanced technologies and provide accurate data collection from different hazardous conditions beyond the reach of humans. Monitoring endangered species and exploring marine biology can also be done with the help of scientific research drones [12]. Ecosystems and atmospheric conditions of the earth are easily understood with drones which are also beneficial for the studies of environments. Firefighting is a serious issue that can be solved with the help of drones. By spreading water from drones a huge fire can be easily controlled which is beneficial for overcoming different difficult situations. The drones are also used for showing paths for aeroplanes in difficult situations such as fog which are beneficial for avoiding accidental situations. Drones can also be used for personal purposes taking various photographs and videography which are helping to take a bird's eye view of a place and creating some memorable memories for a person. Aerial imagery, mapping, and inspections are completed with the help of different drone devices which are used for space explorations. NASA and various other space research agencies are using different modified drones to gain high-quality images and live-stream videos easily beyond the reach of humans.

#### **Difficulties of using flying robotic systems**

Drones can be used in various ways which are beneficial for creating better growth for humans and the world. But drones also have some disadvantages which are not useful for humans for getting better help from the system. Drones can damage properties or can harm people. These are the most dangerous disadvantages of these systems as these systems can be less regulated compared with manned aircraft systems.

Small and lightweight designs of drones are easily manipulated by heavy winds or any others which are creating different difficulties in flying robotic systems [3]. The battery issues for drone systems are creating a negative impact as battery backup is very average which established drone systems are not useful in the long run. Specific training for properly flying a drone is required otherwise it can be difficult for flying the drone. Different governments have not applied any specific regulations for drones used for personal use. So normal people are flying drones in the no-fly zones in the country which is creating some serious situations in surveillance and flights. In some cases, governments have completely restricted the flying of drones in the country which are created problems for the general population. Although after taking permission drones can be filed in the country. Governments are imposing a high tax on drones which is making these devices too expensive for the use of common people [19]. The fixing charges of drones are also higher. Moral and social decisions cannot be made by drones which are creating different chances of accidents and other issues. The drone systems can be easily hackable and the navigation system can be tempered which are creating difficulties in using a flying robotic system [4]. Due to the security risks, people are not wanting to use flying robotic systems which are making the market more compressed and prices of the drones are becoming more expensive rapidly. The drones are not always capable of multi-tasking which is creating a barrier for the system. The delivery systems with drones can create a major issue for job security and can be replaced by various job opportunities. An invisible drone is a drone that uses a 360° camera to capture footage in all directions which can provide the invisibility of drones.

#### **METHODOLOGY**

The methodology is an essential part of a research study which is providing better growth in the research. For this research secondary qualitative methodology is used which is beneficial for completing the entire research work and gaining a visible value to the research. Secondary qualitative research is cost-effective and less time-consuming as the entire research is completed based on different journals, articles, and another research which are available on the internet [1]. This article is completed with the help of the positivism philosophy which is beneficial for helping to achieve the research aim and objective of the work. An inductive approach to the research helps to make an impact on the provided study with a specific and appropriate conclusion. For completing the secondary research, the articles are collected after the year 2018 which is beneficial for providing the latest knowledge about this research and gaining benefits. Google scholar, google is a reliable search engine that is used to complete the entire research work. Using the secondary qualitative method researchers are able to understand the issues and valuable research which were done previously in the field of flying robotic systems. These are beneficial for providing a better way of developing

software-controlled flight plans. With the help of a vast amount of study materials, the researchers are able to understand the overall growth in the area of flight plans and robotic flying systems. The effort of the researchers is saved by using secondary qualitative research which is gaining a positive development in the research work [2]. Software-controlled flight plans are useful for understanding better ways in the navigation system, surveillance, disaster management, and others. These systems are helpful for knowing the issues of flying robotic systems and easily upgrade the issues and build a better way in the research. The entire secondary qualitative research is economical. The researchers are able to develop further research work more easily and precisely, which can help to ensure great value for the research. The data collection by using this method is easy and can be used by anyone with a wide knowledge of flying robotic systems. Based on different case studies, and published journals the entire research can be swiftly done and ensure a better value in society or for future researchers. Only basic knowledge is enough for collecting data for the research in the secondary qualitative method. The secondary qualitative methods are helping the researchers to easily understand what are the major and minor issues that are seen in the flying robotic systems. With the help of these understandings, they can easily overcome the issues or develop their research in such a way that is useful for finding a solution to previous obstacles.

The flying robotic system is gaining evaluation which is able to ensure better growth in society in every aspect. The qualitative analysis of flying robotic systems is also showing the opportunities that can be done with the help of flying robotic systems in the future [5]. The only issue with using secondary qualitative research is it is not based on real-time data which can create some issues. But with the help of the latest knowledge about the field of research, these issues can be easily solved. Another issue that is also developed with secondary qualitative research is the lack of quality data, a massive quantity of data can be gathered with the help of secondary qualitative research but not possibly gained a high quality of data all the time. This issue can be easily solved with the help of a proper understanding of the research topic and gathering data accordingly. It can be said that this research system can be justified by using the secondary qualitative method which is essential for the compilation of research work in flying robotic systems by using a software-controlled flight plan. The maximum value of the research can be easily reached with the help of this research methodology.

## DISCUSSION

Without any human pilot, a drone device is developed which is why it is named unmanned aerial vehicle (UAVs). Drones are used for various purposes and provide a visible difference in the daily activities of life. Different areas of our daily life can be easily enriched with the help of drones such as surveillance and mapping, agricultural research and crop

management, delivery of essential items in remote areas, or providing easy delivery in high-traffic areas, military operations, and much more. UAV systems are capable of detecting coronavirus automatically with thermal imaging quickly and developed fewer human interactions by using IoT-based drone technology [15]. This system is beneficial during the time of pandemic and is able to control the situation in an effective manner. Drones are useful devices for maintaining communication in various situations like rescue operations, military operations, and different other developments which are creating advantages. On the other hand, the commercial drone manufacturers are developing different drones for personal use as well which is helping to promote positive growth in the drone industry. The real-time data are easily accessible with the help of drones and are able to use these in various new activities which are making the lifestyle of humans easier and the hassle becomes a lowering little bit. With the help of real-time data which are developed by drones are able to make different decisions in various areas where the drones are used. Mobile phones are also used as a controller for controlling and looking at the first-person view of a drone easily [16]. In different disasters, situations drones are beneficial for completing rescue operations easily. Micro controllers are used in drones and are able to provide UAV monitoring systems which are developed as nano-size hardware and software for achieving object-tracking capabilities. UAVs are able to plan different swarms of drones for completing rescue or search operations [17]. Flight control can also be developed with the help of different drones to guide flights safely for landing on some difficult occasions such as fog and others. In modern times drones are becoming easier to develop, and the price of drones is distributed on the basis of work [18]. In short, drones are used for various new things. The market of drones is becoming wider and different new opportunities are developed by using drone devices. Different flying robots are developed which are like an insect or flies by using wings, propellers, motors, and gears. Drones are also criticized for being vastly used in wars as a weapon but this can be changed with the help of a sensible thinking on usability. Different little flying drones are created nowadays and used for various surveillance and other purposes. Batteries for flying cars need to be of very high-energy density lifting the cars in the air for a good amount of time. The drones are used in different sports and other events to record the situations which are done with the help of event cameras [20]. Different futuristic drones are continuously developed which are solving different issues for humans and society. In health care drones are used for supplying medical equipment, medicine, and other essential things which are beneficial for providing visible growth in the industry. Wildlife and historical conservation and outer space studies are also developed with the help of different drones which are beneficial for the compilation of research. Efficient surveillance is provided by drones which are able to ensure safety and security for the mass. The drones can be used as a workforce multiplier as it is able to solve various

challenges with the help of improved data accuracy and can overcome the limitations of humans easily and efficiently. Aerial data are useful for different industries which are able to produce various ways for solving different challenges of businesses with the help of real-time data from drones. In restricted airspace, drone flying is completely banned due to several security reasons. Drones are not recommended for flying in rainy situations, high humidity, mist, or over water bodies in strong winds. The anti-drone jamming devices are developed which are beneficial for stopping the signals by stopping radio frequencies.

## CONCLUSION

From the above study, it can be concluded that drones are used for various things in modern days. This is used for different occasions and successfully completed surveillance, traffic control, military operations, and things. Rescue operations are easily completed with the help of drones which are beneficial for developing occasions. RTOS systems are used for understanding real-time response which is beneficial for developing drone systems. Secondary qualitative research is used for the study which is providing maximum growth to complete the research. With the help of different data collected from different articles on the internet are able to successfully achieve the research goal easily. The understanding of various use of flying robotic systems and different new opportunities of drones are developed in this research. The issues of flying robotic systems are also understood from this research which are creating a negative impact on humanity. The risk of crashing drones is creating difficulties in using a drone that can be used with proper training and understanding the restrictions of flying the drones. In the future drones are used for various ways of transporting several essential goods, medical supplies, vaccines in different remote areas, and other dangerous places for humans. In contagious diseases like COVID situations drones are used as essential mediums which are beneficial in controlling the effect of the virus. Some risks are there of using a drone system are can be easily overcome with the help of the sensible use of drones and the awareness of the consequences that are developed in flying robotic systems. Hacking is a serious issue of using droning devices which are the major security issues for using these technologies. Drone systems are evolving at a high speed which able to be used in various new industries such as mining, construction, environmental monitoring, and others.

## REFERENCES

- [1] Malterud, K., Aamland, A. and Fosse, A., 2020. How can task shifting put patient safety at risk? A qualitative study of experiences among general practitioners in Norway. *Scandinavian journal of primary health care*, 38(1), pp.24-32.
- [2] Xu, A., Baysari, M.T., Stocker, S.L., Leow, L.J., Day, R.O. and Carland, J.E., 2020. Researchers' views on, and experiences with, the requirement to obtain informed consent in research involving human participants: a qualitative study. *BMC medical ethics*, 21(1), pp.1-11.
- [3] Delavarpour, N., Koparan, C., Nowatzki, J., Bajwa, S. and Sun, X., 2021. A technical study on UAV characteristics for precision agriculture applications and associated practical challenges. *Remote Sensing*, 13(6), p.1204.
- [4] Salamh, F.E., Karabiyik, U. and Rogers, M., 2021. A constructive direct security threat modeling for drone as a service. *Journal of Digital Forensics, Security and Law*, 16(1), p.2.
- [5] Delmerico, J., Mintchev, S., Giusti, A., Gromov, B., Melo, K., Horvat, T., Cadena, C., Hutter, M., Ijspeert, A., Floreano, D. and Gambardella, L.M., 2019. The current state and future outlook of rescue robotics. *Journal of Field Robotics*, 36(7), pp.1171-1191.
- [6] Fan, B., Li, Y., Zhang, R. and Fu, Q., 2020. Review on the technological development and application of UAV systems. *Chinese Journal of Electronics*, 29(2), pp.199-207.
- [7] Ayamga, M., Akaba, S. and Nyaaba, A.A., 2021. Multifaceted applicability of drones: A review. *Technological Forecasting and Social Change*, 167, p.120677.
- [8] Wu, T., Liu, H., Zhu, J. and Wang, L., 2021, June. A Review of Camouflaged Target Detection Research. In *2021 IEEE 4th Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC)* (Vol. 4, pp. 2054-2059). IEEE.
- [9] Yaqot, M. and Menezes, B.C., 2021, August. Unmanned aerial vehicle (UAV) in precision agriculture: business information technology towards farming as a service. In *2021 1st International Conference on Emerging Smart Technologies and Applications (eSmarTA)* (pp. 1-7). IEEE.
- [10] Raj, E., Appadurai, M. and Athiappan, K., 2021. Precision Farming in Modern Agriculture. In *Smart Agriculture Automation Using Advanced Technologies* (pp. 61-87). Springer, Singapore.
- [11] Khan, S., Tufail, M., Khan, M.T., Khan, Z.A., Iqbal, J. and Wasim, A., 2021. Real-time recognition of spraying area for UAV sprayers using a deep learning approach. *Plos one*, 16(4), p.e0249436.
- [12] Yang, Z., Yu, X., Dedman, S., Rosso, M., Zhu, J., Yang, J., Xia, Y., Tian, Y., Zhang, G. and Wang, J., 2022. UAV remote sensing applications in marine monitoring: Knowledge visualization and review. *Science of The Total Environment*, p.155939.
- [13] Ajmera, D., Saroliya, M. and Arora, P., 2022. Unmanned Aerial Vehicles (UAVs). *International Research Journal of Innovations in Engineering and Technology*, 6(1), p.22.
- [14] Ren, H., Zhao, Y., Xiao, W. and Hu, Z., 2019. A review of UAV monitoring in mining areas: Current status and future perspectives. *International Journal of Coal Science & Technology*, 6(3), pp.320-333.
- [15] Udgata, S.K. and Suryadevara, N.K., 2021. Advances in sensor technology and IOT framework to mitigate COVID-19 challenges. In *Internet of Things and Sensor Network for COVID-19* (pp. 55-82). Springer, Singapore.
- [16] Tezza, D. and Andujar, M., 2022. First-Person View Drones and the FPV Pilot User Experience. In *International Conference on Human-Computer Interaction* (pp. 404-417). Springer, Cham.
- [17] Ruetten, L., Regis, P.A., Feil-Seifer, D. and Sengupta, S., 2020, January. Area-optimized UAV swarm network for search and rescue operations. In *2020 10th annual computing and communication workshop and conference (CCWC)* (pp. 0613-0618). IEEE.
- [18] Syed, F., Gupta, S.K., Hamood Alsamhi, S., Rashid, M. and

- 
- Liu, X., 2021. A survey on recent optimal techniques for securing unmanned aerial vehicles applications. *Transactions on Emerging Telecommunications Technologies*, 32(7), p.e4133.
- [19] Choi, T.M., Kumar, S., Yue, X. and Chan, H.L., 2022. Disruptive technologies and operations management in the Industry 4.0 era and beyond. *Production and Operations Management*, 31(1), pp.9-31.
- [20] Pattanayak, S. and Shukla, V.K., 2020, July. Comparative Analysis of ENG, EFP and Drone camera and its Impact in Television Production. In *2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT)* (pp. 1-8). IEEE.