IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Ai Powered Drone Applications

Pragathi [1], Preeti .V. Uttur [2], Rashmitha N [3], Rupali kumari [4], Prateek Rathod [5], Shobha T [6]

[1,2,3,4,5,6] Department of Information Science and Engineering,
B.M.S College of Engineering, Bengaluru, India

Abstract: This literature review explores the applications of artificial intelligence (AI) in drone technology, highlighting significant advancements and emerging trends across various sectors. Analyzing a broad spectrum of studies, this review categorizes AI applications into key areas: autonomous navigation, real-time data processing, and machine learning-driven analytics. In military operations, AI enhances surveillance capabilities and target recognition, while in agriculture, drones equipped with AI optimize crop monitoring and pest management. Environmental monitoring applications demonstrate AI's role in habitat conservation and disaster response. The review also addresses challenges such as data privacy, regulatory compliance, and the ethical implications of autonomous decision- making. By synthesizing current research, this study aims to inform future developments and applications of AI in drone technology, emphasizing the need for interdisciplinary approaches to overcome existing barriers and maximize potential benefits.

***Keywords* - Artificial Intelligence (AI), Drone Technology, Autonomous Navigation, Machine Learning, Environmental Monitoring**

I. Introduction

The integration of artificial intelligence (AI) with drone innovation marks a transformative period, on a very basic level improving the capabilities, independence, and effectiveness of drones over assorted businesses. This advancement has moved drones from funda- mental remote-controlled gadgets to progressive independent frameworks which is able of complex decision-making and assignment execution in genuine time. AI-driven drones presently play a significant part in segments such as farming, foundation assessment, natural checking, and coordination's, where they offer phenomenal preferences in execution and versatility. By leveraging AI for independent route, direction optimization, and pre- scient upkeep, drones can execute assignments with a tall degree of flexibility, reacting powerfully to their situations and performing basic capacities such as question discovery, information examination, and cargo transportation. This versatility is to assist improved by profound learning (DL) calculations and modern information preparing methods that empower drones to make complex choices independently.

AI has an undeniable influence when it comes to improvement in the operational effectiveness and security of drones. In coordination, AI streamlines the courses and load arrangement permitting for real time following and enthusiastic course alterations. These advances add to achievable co-ordinations in and as well to minimizing surges and shut- ting on asset utilization. In addition, AI plans drones with high level acknowledgment abilities to distinguish and track objects; they can likewise identify plans and react with- out limits as the circumstances change in reconnaissance and discernment missions. In Cultivation, AI- organized excursions can autonomously draw out limitless territory, keep an eye on yield prosperity and control assets all the more capably lessening human labor and modernizing efficiency. But with greater autonomy of drones using AI comes ethical and regulatory challenges, particularly over whether machines should ever be al- lowed to operate completely independent of human oversight. The figure of autonomous decision-making raises new and complicated ethical challenges, which require a extremely cautious method to coverage and law to make sure that AI-enabled unmanned aerial vehicles deployed for public security are each moral and protected.

The diversity of types now available in drones can be credited to the miniaturization of various parts such as sensors, microprocessors, batteries, and navigation systems. These range from very large fixed-wing UAVs to extremely small devices, like ”smart dust” consisting of MEMS embedded with sensors or miniature robots. This miniaturization is possible when devices are in a good communication environment with their control systems.

The applications of drones are such diverse fields, mainly focusing on surveying and mapping, project progress tracking, safety monitoring, and asset maintenance. In the construction industry, for instance, drones offer multiple benefits, including improved safety measure and reduced inspection costs, heavy load-carrying capability, and interproject communication stakeholder improvement.In spite of various thinks about centering on particular applications and calculations for AI- driven drones, a comprehensive audit of the worldwide applications and centre AI calculations remains meager. Existing writing regularly investigates confined viewpoints such as co-ordinations, question discovery, and direction optimization without displaying an coordinates outline of the field. This paper looks for to fill this crevice by giving a wide examination of AI applications in drone innovation, from real-time protest acknowledgment and way optimization to prescient support and independent flight capabilities. The paper investigates state-of-the-art AI calculations, looking at their commitments to different drone functionalities, and examining their effect on the current and future scene of unmanned ethereal frameworks. Through this review, we seek to highlight the transformative potential of AI in drones, offering a comprehensive perspective on current advancements, emerging trends, and the challenges and opportunities that lie ahead.

II. Artificial intelligence applications of drones

2.1 Drones in military applications

In addition to drastically enhancing military capacities globally, drones will continue to change the character of combat in a variety of ways that impact ground forces and there are significant justifiable worries that command and control drones provide fundamental information on enemy development areas and major targets. Despite drone technologies commanders are able to make better decisions and operate more effectively in the field because of these insights. while military defence temporary workers are combining drones with state-of-the-art computer vision and picture recognition relative youth military engineers have quickly started combining drones with artificial intelligence to create frameworks that occasionally match human observation groups to illuminate military challenges and advancements.

A great case is the MQ-9 Reaper-a military drone presently in use-that can achieve a run of around 1852 km. Its length is around 36 feet and an elevation up to 50,000 feet. It can do perseverance and tall elevation, giving observation and an airstrike. The drones offer assistance the military powers by making insights gathering and strategic activity attain- able. drones in such models are illustrations of the state-of-the-art innovation that makes for a great insurgency in cutting edge fighting, subsequently making them unmatched resources in modern military methodology.

As demonstrated by businesses such as shield artificial intelligence AeroVironment and Lockheed martin for example it has been described that shield ai drones can traverse uncharted territory without the need of GPS enabling military personnel to gather in- formation that promotes rapid growth and has an impact with the use of drones they are able to discern whether they are being pursued during mapping operations strategic observation and combat assessments administrators can make decisions without worrying about being trapped behind machine vision navigational aids and mechanical components are all combined to make counterfeit insights in rambles the ai needs to go through an administered learning handle which will be more curiously in my supposition[5].

2.2 Drones in Obstacle detection and avoidance

One of the most transformative applications of AI in drone innovation lies obstacle detection and avoidance. Not at all like conventional drones, which depend on manual direction to control clear of deterrents, AI-powered drones are outlined to work freely, indeed in complex and erratic situations. Prepared with modern sensors and computer vision frame- works, these progressed drones can recognize impediments in their prompt environment, such as buildings, trees, or other airborne object and independently explore around them. AI calculations play a basic part by analysing sensor information in genuine time, empowering drones to identify potential risks and produce elective flight ways that maintain a strategic distance from collisions whereas remaining adjusted with mission goals.

This independent route capability is important in high-stakes scenarios such as look and protect missions, where drones must move through complex urban scenes or thick characteristic situations to find and help people in require. In such cases, AI-driven impediment evasion upgrades both the security and productivity of operations, permitting rambles to get too hard- to-reach region quickly and safely without requiring consistent human intervention. By joining AI-powered impediment location and path-planning capabilities, drones can perform complex assignments with increased unwavering quality, making them a fundamental instrument for mission-critical applications over different businesses. This advancement not as it were extending the operational scope of drones but moreover under- scores the urgent part AI plays in opening unused conceivable outcomes for independent framework.

2.3 Drones in agriculture

The integration of AI in drones has transformed agriculture dramatically to an extent: improving efficiency, sustainability, and precision in farming operations. Using advanced sensors and AI technologies, drones render an overall view of agricultural fields; this way, farmers are able to track the crops in real-time and generate data-driven decisions for better productivity [4].

One directly associates such an application with crop health monitoring, where drones fitted with multispectral and hyperspectral cameras take high-resolution crop images from which AI algorithms later analyse the images to detect signs of stress, including diseases, pests, and nutrient deficiencies, thus enabling farmers in good time to intervene in such problems. Drones can revolutionize each dimension of agriculture-from checking climate patterns and humidity levels to timing when it is time for crops to grow. Drones can also analyse the soil conditions, taking an amount of fertilizer needed and so on. One can even detect unhealthy plants and- in theory- plant trees by dropping seed pods of the species into the ground at regular intervals in 2021 from US dollar 2.8 billion in 2018 as they became less costly and more versatile. Likewise, the construction industry was projected to be the second-largest economic market for drones in 2020 after the agriculture sector.

2.4 Wildfire Monitoring and Risk Prediction

On the other hand, drones are very significant machinery not just to conserve wildlife and historical sites but also to keep track of vulnerable ecosystems in economic and efficient means as well as heritage. Drones in wildlife conservation allow quicker aerial observations and the ability of scientists to assess the health status of species and their habitats. With its frequent observation of migration routes and animal population, drones are supporting the research on behavioural patterns and prevent illegal poaching by offering real-time surveillance of remote areas [20].

The importance of drones also lies in wildlife monitoring, and it has been in endeavours to reforest areas where forest floors have been ravaged by fires. There, drones are used, laden with seed containers containing seeds, fertilizers, and other crucial nutrients to be dispersed into areas to enable the growth of trees for the rapid revamping of forests and aiding in the recovery of an ecosystem. Drones present a powerful ally in the struggle for the preservation of natural habitats and biodiversity as they efficiently traverse large distances and explore inaccessible places .

There are now significant ethical concerns with the usage of drones due to their quick development and growing popularity. The military's goal for further drone autonomy to lower operational costs raises questions about who is responsible for the drone's conduct. There are many different opinions on how to guarantee that drones behave morally, from scepticism to support for complete autonomy. Human emotions often impair judgment, leading to unethical decisions, which is a major contributing factor to human unethical behaviour in war. Robots are more efficient and morally superior to humans in warfare because they are immune to human emotions like rage and the need for vengeance, and they have sophisticated sensors and data processing capabilities. However, drones are not yet able to assess situations and make moral decisions more quickly or effectively than humans due to the limitations of present robot technologies. It is extremely challenging to model and program human behaviour and decision-making into a drone. Therefore, it makes more sense to create a human-machine partnership at this time, in which people collaborate with robots to maximize efficiency by leveraging each other's abilities. The drone will execute commands and make non-essential judgments without the need for a human operator, as they already do. However, humans make important decisions, particularly when it comes to using deadly force. The person can decide whether or not to engage the targets by using the drone's sophisticated sensors to collect data about the mission circumstances. Humans and robots will need to cooperate until artificial intelligence technology advances to the point where completely autonomous drones are possible. However, drones should become completely autonomous in order to significantly reduce the number of human casualties in conflict.

Drones can differentiate between hostile and civilian targets; therefore, they can't commit war crimes out of rage but will act more morally than people. Even though artificial intelligence (AI) hasn't made a significant appearance in conflict yet, scientists are fore- casting how AI might affect warfare in the future. The pace of commercial investment, the need to compete with global rivals, the ability of the research community to improve the state of AI capability, the general attitude of the military toward AI applications, and the creation of AI-specific warfighting concepts are just a few of the variables that will determine this influence[3,13].

2.5 Drones in autonomous navigation

AI-driven autonomous navigation in drones presents a huge leap in technological advancement of drones, greatly adaptable and flexible for various uses. Unlike the traditional pre- programmed fixed flight drones, AI-driven drones could autonomously plan and amend routes according to real-time situations to adapt to dynamic environments. Such ability to make real-time decisions is enabled through advanced algorithms within AI that analyse data coming from onboard sensors in the drone, allowing it to refine flight paths based on weather conditions, obstacles, or a change in mission parameters. Drones integrating AI can automatically navigate across agricultural fields continuously optimizing their flight path considering wind, crop lay, and terrain in real-time for example. This will enable them to carry out operations like crop inspection, land survey, or spraying of fertilizers and pesticides with minimum human intervention. In search and rescue operations, AI-fitted drones will be able to fly through complicated and alienated areas, changing the trajectory accordingly to steer clear of obstacles and increase the chances of finding missing people.
Safety also gets an added input because through AI, drones can sense and steer clear of any obstacles coming in the way without collision, especially in flight. Using autonomous navigation, such machines can be used for inspection of infrastructural things, etc., or delivery without much human intervention in complex environments. This is because environmental data is continuously being processed and flight paths adjusted to suit the environment with the result that tasks may be executed relatively more efficiently and precisely.

2.6 Radar positioning and returning home

Marine radar systems, primarily using X-band (9 GHz) and optionally S-band (3 GHz) radars, play a critical role in navigation and collision avoidance, especially in low-visibility conditions. To enhance the positioning capabilities of these radars, several techniques have been developed, such as E-RACON positioning, image matching, radar conspicuity map- ping, terrain matching, and Simultaneous Location and Mapping (SLAM). E-RACON positioning uses radar beacons that respond with Morse code, allowing the vessel to determine its position by measuring range and bearing to multiple beacons, though this method requires several beacons and is limited by range. Image matching involves com- paring current radar images with reference images to calculate the vessel's position, but its accuracy deteriorates as the vessel moves further from the reference point. Radar conspicuity mapping creates a detailed map of radar targets within an area, allowing vessels to match current radar data with the map to determine their position within about 30 meters. Terrain matching, which simulates radar returns based on terrain data, offers potential but has been limited by inaccuracies in terrain data and radar configurations. SLAM, on the other hand, enables vessels to build their own radar maps as they sail, even in previously uncharted areas, by integrating radar data with traditional dead reckoning, achieving positioning accuracy within 20–25 meters. These techniques offer promising solutions, with SLAM being the most accurate, providing reliable position fixing that could eventually meet the IMO's accuracy requirements of 10 meters [4].

III Conclusion

This study has looked at how artificial intelligence (AI) is being incorporated into drone technology, demonstrating how it is revolutionizing a number of industries, including logistics, agricultural, defense, and environmental monitoring. Drones with artificial intelligence (AI) have greatly increased their autonomy, operational effectiveness, and decision- making skills, opening up new applications in fields including resource optimization, smart surveillance, precision farming, and disaster management. Even with all of the potential that AI-powered drones have, issues with data security, legal restrictions, and moral dilemmas are still very important. Policymakers, business leaders, parameters. Drones integrating AI can automatically navigate across agricultural fields continuously optimizing their flight and researchers must work together to effectively address these concerns and advance the safe and responsible application of AI in drone systems.

In conclusion, this study emphasizes the enormous potential of AI to transform drone- based applications while highlighting the significance of continued development and regulatory actions. To maximize the benefits of AI-integrated drones while lowering related hazards, future development should focus on improving AI algorithms, boosting computational efficiency, and guaranteeing ethical AI deployment.

References

[1] S. D. Panjaitan et al. "A Drone Technology Implementation Approach to Conventional Paddy Fields Application". In: *IEEE Access* 10 (2022), pp. 120650–120658. doi: 10.1109/ACCESS.2022.3221188.

[2] S. Sanz-Martos et al. "Drone Applications for Emergency and Urgent Care: A Systematic Review". In: *Prehospital and Disaster Medicine* 37.4 (2022), pp. 502–508. doi: 10.1017/S1049023X22000887.

[3] C. A. S. Lelis et al. "Drone-Based AI System for Wildfire Monitoring and Risk Prediction". In: *IEEE Access* 12 (2024), pp. 139865–139882. doi: 10.1109/ACCESS. 2024.3462436.

[4] T. Ko¸c. *Drone Technologies and Applications*. IntechOpen. 2023. doi: 10.5772/ intechopen.1001987.

[5] Aleksandar Petrovski and Marko Radovanovi´c. "Application of Drones with Artificial Intelligence for Military Purposes". In: *Journal of Advanced Military Technolo- gies* 4.3 (2022), pp. 45–56.

[6] Osim Kumar Pal et al. "A Comprehensive Review of AI-enabled Unmanned Aerial Vehicle: Trends, Vision, and Challenges". In: *arXiv preprint arXiv:2310.16360* (2023). url: https://arxiv.org/abs/2310.16360.

[7] Fadi AlMahamid and Katarina Grolinger. "Autonomous Unmanned Aerial Vehicle Navigation using Reinforcement Learning: A Systematic Review". In: *arXiv preprint arXiv:2208.12328* (2022). url: https://arxiv.org/abs/2208.12328.

[8] Enkhtogtokh Togootogtokh et al. "An Efficient UAV-based Artificial Intelligence Framework for Real-Time Visual Tasks". In: *arXiv preprint arXiv:2004.06154* (2020). url: https://arxiv.org/abs/2004.06154.

[9] Mohamed-Amine Lahmeri, Mustafa A. Kishk, and Mohamed-Slim Alouini. "Artificial Intelligence for UAV-enabled Wireless Networks: A Survey". In: *arXiv preprint arXiv:2009.11522* (2020). url: https://arxiv.org/abs/2009.11522.

[10] Montaser N. A. Ramadan et al. "Towards Early Forest Fire Detection and Prevention Using AI-powered Drones and the IoT". In: *Journal of IoT and AI Systems* (2024).

[11] S. D. Panjaitan et al. "A Drone Technology Implementation Approach to Conventional Paddy Fields Application". In: *IEEE Access* 10 (2022), pp. 120650–120658. doi: 10.1109/ACCESS.2022.3221188.

[12] S. Sanz-Martos et al. "Drone Applications for Emergency and Urgent Care: A Systematic Review". In: *Prehospital and Disaster Medicine* 37.4 (2022), pp. 502–508. doi: 10.1017/S1049023X22000887.

[13] C. A. S. Lelis et al. "Drone-Based AI System for Wildfire Monitoring and Risk Prediction". In: *IEEE Access* 12 (2024), pp. 139865–139882. doi: 10.1109/ACCESS. 2024.3462436.

[14] T. Ko¸c. *Drone Technologies and Applications*. IntechOpen. 2023. doi: 10.5772/ intechopen.1001987.

[15] Aleksandar Petrovski and Marko Radovanovi´c. "Application of Drones with Artificial Intelligence for Military Purposes". In: *Journal of Advanced Military Technolo- gies* 4.3 (2022), pp. 45–56.

[16] Osim Kumar Pal et al. "A Comprehensive Review of AI-enabled Unmanned Aerial Vehicle: Trends, Vision, and Challenges". In: *arXiv preprint arXiv:2310.16360* (2023). url: https://arxiv.org/abs/2310.16360.

[17] Fadi AlMahamid and Katarina Grolinger. "Autonomous Unmanned Aerial Vehicle Navigation using Reinforcement Learning: A Systematic Review". In: *arXiv preprint arXiv:2208.12328* (2022). url: https://arxiv.org/abs/2208.12328.

[18] PEnkhtogtokh Togootogtokh et al. "An Efficient UAV-based Artificial Intelligence Framework for Real-Time Visual Tasks". In: *arXiv preprint arXiv:2004.06154* (2020). url: https://arxiv.org/abs/2004.06154.

[19] Mohamed-Amine Lahmeri, Mustafa A. Kishk, and Mohamed-Slim Alouini. "Artificial Intelligence for UAV-enabled Wireless Networks: A Survey". In: *arXiv preprint arXiv:2009.11522* (2020). url: https://arxiv.org/abs/2009.11522.

[20] Montaser N. A. Ramadan et al. "Towards Early Forest Fire Detection and Prevention Using AI-powered Drones and the IoT". In: *Journal of IoT and AI Systems* (2024).

[21] Diego Dantas et al. "Testbed for Connected Artificial Intelligence using Unmanned Aerial Vehicles and Convolutional Pose Machines". In: *arXiv preprint arXiv:2001.04944* (2020). url: https://arxiv.org/abs/2001.04944.