

# Enhancing Drone Internet Performance through Artificial Intelligence Algorithms: A Comprehensive Review

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**Abstract - Internet of Drones (IoD) refers to the integration of unmanned aerial vehicles (UAVs) into the broader framework of the Internet of Things (IoT). IoD involves connecting drones to the Internet to enable them to communicate with each other, and with other devices and systems, to collect, share and process data. This connectivity enhances the capabilities of drones to work collaboratively, share information in real time, and be part of a networked ecosystem for various applications, such as surveillance, agriculture, disaster response, and industrial inspection. Through seamless connectivity and intelligent data exchange, IoD improves efficiency and opens up new possibilities for diverse industries. Integrating AI algorithms with the Internet of Drones (IoD) is a promising model for enhancing the performance and capabilities of unmanned aerial vehicles. This review paper provides a comprehensive analysis of recent developments in this field, focusing on the synergies between AI and IoD technologies and providing taxonomy of AI applications in the field of IoD. It also explores key challenges and opportunities and discusses potential future directions for research and development.**

**Keywords:** IoD, AI, IoT, Internet of Drones, Internet of Things, Unmanned aerial vehicles.

## I. INTRODUCTION

The Internet of Drones represents a transformative technology that combines unmanned aerial vehicles and interconnected systems, providing a myriad of applications in areas such as surveillance, agriculture, disaster response, and logistics. However, the complexity of managing a large fleet of drones, coupled with dynamic and unpredictable environments, necessitates the integration of intelligent algorithms to improve performance and functionality (1).

## II. CLASSIFICATION OF AI APPLICATION IN IoD

In disaster management applications drones with camera sensors can enhance situational awareness for various

emergency responses, enabling them to function from difficult-to-reach locations. They can be applied in a variety of contexts where sensitive data may be present and safe cryptographic processing is necessary. In addition, smart technologies can be included into its operations. For example, deep learning (DL) models can be used to monitor disaster areas—such as floods, fallen buildings, or fires—in order to promptly lessen the effects they have on the local community and environment. Additionally, it improves the throughput, delay, dependability, and interconnection of different types of networks. However, their deployment raises various challenges related to high degrees of mobility, battery life as well as the unpredictability of the wireless medium.

This section classifies AI applications in IoD into several main areas:

### 2.1 Energy efficiency and battery management

This study classifies machine learning in the context of IoD-UAVs based on its applications, which include resource management, mobility management, object identification, monitoring, energy control, and security management. The researcher wanted to give readers a better grasp of the fundamentals of IoD/UAV, the most recent advancements and discoveries in this field, the benefits and drawbacks of the approaches being used now, and the key areas that still require investigation and study. The findings show that the convolutional neural network (CNN) approach is the machine learning technique that is most frequently utilized in the literature. The majority of the studies, according to the research, discuss mobility and resource management. The majority of the papers concentrated on improving just one characteristic, with the accuracy parameter drawing the greatest attention. According to him, Python is the language that is employed in research in 90% of cases.

### 2.2 Mission planning and optimization

Base stations (BSs), sensor nodes (SNs), and Internet of Things (IoT) devices were designed by Haider, S.K. (et al.) to

receive signals from the BSs and use Internet connectivity in a way that benefits users and allows for the integration of drones into IoT. Drone-based cluster models are not without difficulties, though. A few of these optimization techniques are covered, such as the chicken swarm clustering algorithm (CSOCA), bee optimization algorithm, and genetic algorithm (GA). Lastly, the topic of routing protocols, schemes, and difficulties in the context of IoD is covered.

### 2.3 Fusion of sensor and perception

An AI-based secure communication and classification system for drone-enabled emergency monitoring systems (AISCC-DE2MS) has been developed by Fatima Al-Rayes and collaborators. They recommended that coding and classification models be the primary tools used by this technique in emergency catastrophe monitoring scenarios. There are two phases to this technique: picture categorization and encryption. Initially, security is achieved by utilizing the Artificial Gorilla Troop Optimizer (AGTO) algorithm in conjunction with ECC-based Al-Gamal encryption technology. Regarding emergency classification, the method uses long-term memory (LSTM)-based classification, hyperparameter tuning based on Penguin Search Optimization (PESO), and feature extraction from a densely linked network (DenseNet). The innovative nature of their work was illustrated by the development of PESO-based hyperparameter tuning and AGTO-based optimal key generation. The AIDER dataset was used to test the AISCC-DE2MS model using simulation analysis, and the findings demonstrate the model's enhanced performance across a range of criteria.

### 2.4 Communications and networks

Christos Chronis (et al.) have extensively employed traditional AI algorithms in their research to successfully fly drones across a known, stable environment and determine the shortest path in 2D or 3D environments. They started utilizing reinforcement learning to successfully navigate a drone in uncertain situations because the scenario becomes more complex when the environment changes or is unknown beforehand. In a series of validation studies in a simulated environment, they contrasted their method with conventional AI algorithms and discovered that the drone can be effectively navigated out of obstacles with just two inexpensive distance sensors.

### 2.5 Artificial intelligence-based navigation systems for drones

The applications of machine learning in the IoD-UAV domain, such as resource management, monitoring, object identification and control, energy management, mobility management, and security management, are categorized by

him and his colleagues. The researcher's aimed were to give readers a better grasp of the fundamentals of IoD/UAV, the most recent advancements and discoveries in this field, the benefits and drawbacks of the approaches being used today, and the key areas that still require investigation and study. According to their findings, the most popular study methodology is the machine learning approach (CNN). The majority of the publications, according to the research, dealt with mobility and resource management. With the accuracy parameter garnering the greatest attention, the majority of researchers concentrated on enhancing just one metric. According to him, Python is the language that is employed in research in 90% of cases.

## III. CHALLENGES AND OPPORTUNITIES

Addressing the challenges in integrating AI with IoD, such as real-time processing, scalability, and regulatory compliance, is critical to unlocking the full potential of this technology. Opportunities lie in the development of adaptive and flexible AI systems capable of learning from diverse and dynamic environments

In order to get around obstacles and raise the caliber of SAR service, Tri Nguyen et al. (7) investigated the viability of an Internet of Drone (IoD) system employing blockchain technology and artificial intelligence at the edge. A proposal for an IoD has been made before their system architecture from end-user terminals and back-end systems to drones. Additionally, they have integrated cutting-edge technologies and AI at the cutting edge to find missing people automatically. Furthermore, empty the account Methods are offered to lower system latency and increase UAV energy efficiency. Additionally, they looked into and examined public and private blockchains, such as Hyperledger Fabric and Ethereum, in order to create a safe and decentralized healthcare platform that would allow healthcare organizations to communicate with one another in real time and enhance services. Their findings indicate that the suggested system assisted in overcoming the obstacles and raising the standard of SAR service. Additionally, their suggested system satisfies all security criteria, including availability, automaticity, tolerance, privacy, trust, privacy, confidentiality, and integrity, as well as access control, authorization, and authentication.

In order to identify and categorize intrusions in an IoD environment, researchers José Escorcia-Gutierrez et al. (8) created the sea turtle search algorithm with a hybrid deep learning-based intrusion detection system (STFA-HDLID). To standardize the input data using minimum and maximum normalization, data pretreatment was required. Additionally, STFA served as the foundation for the feature selection procedure. For classification, a deep belief network (DBN)

using the Sparrow Search Optimization (SSO) algorithm was employed. To illustrate the effectiveness of STFA-HDLID, a thorough experimental analysis was conducted on a benchmark dataset. The results showed that STFA-HDLID outperformed alternative methods, achieving 99.51% and 98.85% accuracy on the TON\_IoT and UNSW-NB15 datasets, respectively.

Nan Cheng et al. (9), To overcome the present limitations of MPTCP models, a novel data-driven stochastic framework was built. Additionally, an intelligent multipath scheduling infrastructure was designed (at the transport layer) taking lower layer (hybrid) packet shaping into consideration. Our multi-layer architecture is centered around an intelligent actuation and interaction learning agent that leverages the successful aspects of multi-armed banditry and federated learning to learn from experience with optimal packet cloning, scheduling, aggregation, and packet formation. They demonstrate that the suggested framework is more useful for creating reliable and reliable next-generation MPTCP models and that it can jointly estimate and optimize (exploration and exploitation).

The researcher Siva Sai et. Al. (1) presented comprehensively survey AI-based autonomous drone networks. A review of more than 100 articles on UAVs was conducted with an emphasis on the following topics: power control, energy efficiency of UAV networks, multiple access and routing protocols, autonomous feature categorization, and network resource management and planning. The researchers discovered through evaluation and analysis that AI-based drones are a model that may be used to achieve cost-effectiveness in the design and deployment of such autonomous networks in an economically and technologically feasible manner. In the rapidly developing field of drone networks, the researchers have highlighted open research problems.

#### Future trends:

Discuss potential research directions, including exploring edge computing, federated learning, and ethical considerations in AI-based IoD applications. Emphasizing the necessity of cooperation between disciplines to confront emerging challenges.

#### IV. CONCLUSION

This review paper provides a comprehensive overview of the state-of-the-art in enhancing IoD performance through AI algorithms. As AI continues to evolve, its integration with IoD is poised to revolutionize industries, bringing unprecedented efficiency and capabilities to unmanned aerial vehicles in diverse applications. Researchers and practitioners alike are

encouraged to contribute to this evolving field, drive innovation and address remaining challenges for a seamless integration of AI and IoT technologies.

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