Chapter 9
Real-Time Threat Detection and Anomaly Monitoring Using AI-Enhanced IoT Drones on Blockchain Networks

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ABSTRACT

The convergence of Artificial Intelligence (AI), IoT-enabled drones, and blockchain offers a powerful framework for real-time threat detection in high-risk environments. This chapter presents a decentralized surveillance system that integrates AI-based edge computing for autonomous anomaly detection, blockchain for immutable data storage, and smart contracts for automated threat response. Case studies in border control and industrial hazard zones highlight gains in detection accuracy, response time, and operational efficiency. The framework also supports multi-stakeholder collaboration via decentralized ledgers and live dashboards, promoting transparency and informed decision-making. Future directions include swarm intelligence, federated learning, and lightweight consensus mechanisms to enhance scalability and data integrity. This unified system ensures a secure, intelligent, and adaptive solution for mission-critical operations and infrastructure monitoring.

1. INTRODUCTION

Once the combination of Artificial Intelligence (AI), Internet of Things (IoT) and blockchain technologies is created, it changes the system of real-time surveillance and management of threats. In-real-time threat-detection and anomaly monitoring is essential and cannot be overstated in safety-critical environments such as at the border, disaster response, industrial surveillance, or in the case of smart cities. The

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advantage of AI-powered IoT drones is that they are dynamic and adaptable data collectors, and can be deployed to detect anomalies a very high rate and scale at very large or inaccessible locations (Altin & Sipahioglu, 2024). Such drones may be equipped with computer vision, environmental sensors, and edge AI models that would classify and detect threats, such as unauthorized individuals, fire outbursts, or any hazardous leaks or any other structural anomalies independently. The integrity, traceability, and timeliness of such data is however important, more so in mission-critical cases. The data produced by the drone can be stored in the blockchain networks in a secure and decentralized ledger that can be used in trusted decision-making and audited (Chamola et al., 2020). By integrating the improved features of AI-enhanced drones with blockchain infrastructure, the system ensures not only the authenticity and source of the data it sends, but it can be shared in a secure and real-time manner even among a large number of stakeholders. The provided paper is going to speak about the combined solution in which AI, IoT drones, and blockchain will collaborate in order to facilitate intelligent real-life applications and scalable, non-tamper able threat detection and anomaly surveillance systems.

1.1 Rationale For Technology Convergence

Artificial Intelligence (AI), Internet of Things (IoT), and blockchain added to surveillance systems are explained by the necessity to observe complex environment in the real-time, safely and independently. The traditional surveillance system has the drawbacks of latency, centralization, and manipulation vulnerability that are very critical weaknesses in the environment of mission sensitive contexts that include border security, disaster management and industrial safety. Anomaly detection AI is smart, IoT Drones can gather data on a large scale and in a dynamic fashion and blockchain can store data in a secure, transparent and tamper-proof way. When these technologies come together, they result in a powerful ecosystem that guarantees rapid and decentralized and trusted decision-making (Obiuto et al., 2024a). This reason is essential in the necessity to explore their integration to come up with effective surveillance mechanisms capable of addressing the existing security threats.

1.2 Objectives Of The Chapter

- To explore the integration of AI-enhanced IoT drones with blockchain for real-time threat detection.
- To design a secure, decentralized architecture that ensures data authenticity, traceability, and low-latency responses.
- To evaluate anomaly detection techniques on edge-enabled drones using AI models.
- To demonstrate use cases in border surveillance, smart cities, and industrial monitoring.
- To identify challenges and propose future research directions in AI-IoT-blockchain convergence.

2. BACKGROUND STUDY

New solutions have been developed by smart surveillance technologies on real-time threat detection and monitoring of anomalies. With effective data collection of remote or inaccessible locations, the mobility and coverage of the IoT-based drones has become more possible. (Gao et al., 2020). Those drones are installed with such sensors as cameras, thermal detectors, and gas analysers to collect various

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