

Secure and Sustainable AIoT Architectures: Integrating Edge Intelligence, Blockchain, and Green Computing for Smart Cities

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Abstract: *The rapid urbanization and proliferation of Internet of Things (IoT) devices in smart cities generate massive data volumes, raising critical challenges in real-time processing, security, privacy, trust, and energy consumption. This work proposes a secure and sustainable AIoT (Artificial Intelligence of Things) architecture that synergistically integrates edge intelligence, blockchain, and green computing principles to address these issues holistically. Edge intelligence enables low-latency, distributed AI inference at the network periphery, reducing cloud dependency, bandwidth usage, and response times for latency-sensitive applications such as traffic management, environmental monitoring, and emergency response. Blockchain provides decentralized trust, immutability, and tamper-resistant data sharing through smart contracts, ensuring secure authentication, access control, and transparent transactions among heterogeneous IoT devices while mitigating single-point-of-failure risks. To promote sustainability, green computing strategies—including energy-efficient edge node design, renewable-powered hardware, dynamic resource allocation, and low-power protocols—are embedded to minimize carbon footprint and operational energy demands in resource-constrained environments. The proposed layered architecture (perception, edge AI processing, blockchain-secured middleware, and application layers) is evaluated through simulation and prototype implementation, demonstrating up to 40–60% reduction in latency and energy consumption compared to traditional cloud-centric models, alongside enhanced security against common threats (e.g., DDoS, data tampering). Results highlight improved scalability, resilience, and environmental efficiency, making this framework suitable for next-generation sustainable smart cities. This integrated approach paves the way for trustworthy, eco-friendly urban ecosystems, aligning with global sustainability goals (e.g., UN SDGs 9, 11, 13) and offering practical insights for deployment in real-world smart city initiatives.*

Keywords: AIoT, Edge Intelligence, Blockchain, Green Computing, Smart Cities, Sustainability, Security, Decentralized Architectures

