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Design and Evaluation of AI-Driven Embedded Systems for High-Performance, Low-Power Applications

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Abstract: *Artificial Intelligence (AI) is transforming the landscape of embedded systems by significantly enhancing performance, power efficiency, and real-time decision-making capabilities. Traditional embedded systems, often constrained by limited computational resources and high CPU power consumption, are increasingly being replaced by AI-enabled systems capable of intelligent automation, self-learning, and adaptive processing. This research investigates how AI techniques—such as edge computing, neuromorphic architectures, and reinforcement learning—can optimize embedded system design. A comprehensive experimental evaluation compares traditional approaches with AI-enhanced alternatives, focusing on improvements in processing speed, energy efficiency, and latency reduction. The results demonstrate that AI-powered embedded systems achieve substantial gains in responsiveness and power optimization while maintaining cost-effectiveness. These advancements have wide-ranging applications across domains such as automotive systems, healthcare diagnostics, and the Internet of Things (IoT). The paper concludes by highlighting future directions in AI-driven embedded architectures, emphasizing energy-efficient designs, security enhancements, and ethical considerations in real-time AI deployments.*

Keywords: AI-embedded systems, performance optimization, power efficiency, real-time decision-making, edge computing, neuromorphic chips, reinforcement learning, AI hardware accelerators, adaptive automation, low-latency processing.

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