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Editorial

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# IoT-Based Energy Monitoring with Edge Computing

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## Introduction

The rapid growth of the Internet of Things (IoT) has transformed how energy consumption is measured, analyzed, and managed across residential, commercial, and industrial sectors. Traditional energy monitoring systems often rely on centralized data collection and cloud-based processing, which can introduce latency, bandwidth overhead, and privacy concerns. To address these challenges, IoT-based energy monitoring systems increasingly integrate edge computing. By processing data closer to the source, edge computing enables faster decision-making, improved reliability, and more efficient energy management. This combination plays a crucial role in supporting smart grids, sustainable energy practices, and real-time operational control [1,2].

## Discussion

IoT-based energy monitoring systems consist of smart sensors, meters, and connected devices that continuously collect data such as voltage, current, power consumption, and environmental parameters. These devices generate large volumes of data at high frequency. When all data is transmitted to the cloud, it can strain network resources and delay critical responses. Edge computing mitigates this issue by performing data processing, filtering, and analytics at or near the data source [3,4].

With edge computing, raw sensor data can be locally analyzed to detect anomalies, peak loads, or equipment inefficiencies in real time. For example, edge nodes can identify abnormal energy usage patterns and trigger immediate alerts or automated control actions without waiting for cloud-based analysis. This is especially valuable in industrial environments where rapid responses can prevent equipment damage and reduce energy waste.

Another significant advantage is improved data privacy and security. Sensitive energy usage data can be processed locally, and only summarized or relevant information is transmitted to the cloud. This reduces exposure to cyber threats and helps organizations comply with data protection regulations. Additionally, edge computing enhances system resilience by allowing continued operation even during network disruptions [5].

However, challenges remain in implementing edge-enabled IoT energy monitoring systems. These include limited computational resources at edge devices, system interoperability, and increased complexity in system design and maintenance. Efficient resource management and standardized communication protocols are essential to fully realize the benefits of this approach.

## Conclusion

The integration of edge computing with IoT-based energy monitoring represents a significant advancement in smart energy management. By enabling real-time data processing, reducing latency, enhancing privacy, and improving system reliability, edge computing addresses many limitations of cloud-centric architectures. Although challenges related to scalability, standardization, and device management persist, ongoing technological advancements are steadily overcoming these barriers. As energy efficiency and sustainability become increasingly critical, IoT-based energy monitoring supported by edge computing will play a vital role in optimizing energy usage and supporting intelligent, resilient energy systems.

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