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(57) Abstract :
The rapid growth in global energy demand necessitates efficient energy management solutions that optimize consumption, reduce waste, and promote sustainability. This paper presents an IoT-driven Smart Meter Data Analysis System that integrates Machine Learning (ML) and Internet of Things (IoT) technologies to enable real-time energy monitoring, predictive consumption analysis, and intelligent optimization. The proposed system employs IoT-enabled smart meters to collect real-time energy usage data from residential, commercial, and industrial settings. This data is transmitted securely to a cloud-based platform, where advanced ML models (such as Long Short-Term Memory (LSTM), Random Forest, and Gradient Boosting) analyze consumption patterns and forecast future energy demand. AI-powered anomaly detection identifies irregular energy usage, such as faulty appliances, unexpected power spikes, and unauthorized consumption, and alerts users via a mobile dashboard. To enhance energy efficiency, the system provides personalized recommendations, including load shifting, automated scheduling, and integration with renewable energy sources (such as solar and wind). Additionally, the system seamlessly integrates with IoT-enabled smart home devices, allowing users to automate energy consumption for optimal efficiency. The architecture is scalable and cloud-based, ensuring adaptability across various energy sectors. This intelligent, predictive, and automated energy management system offers significant benefits, including cost reduction, energy conservation, and a lower carbon footprint. By leveraging AI-driven insights, real-time monitoring, and IoT connectivity, the system transforms conventional energy management into an intelligent, adaptive, and highly efficient solution.