Paper 200

Energy Efficiency Management in Smart Homes: The Integration of IoT and Machine Learning

The rapid advancement of smart home technology has revolutionized residential energy management, enabling homeowners to monitor and optimize their energy consumption in real-time. The integration of the Internet of Things (IoT) and machine learning (ML) has significantly enhanced the efficiency and intelligence of smart home energy management systems. By leveraging IoT-enabled smart devices, sensors, and cloud computing, households can collect real-time energy consumption data, while ML algorithms analyze this data to optimize energy use, predict consumption patterns, and suggest energy-saving strategies.

Traditional energy management systems often rely on fixed schedules and predefined rules, which may not effectively adapt to dynamic user behaviors and changing environmental conditions. However, ML-powered energy management systems can learn from user habits, adapt to real-time electricity demand, and autonomously adjust appliance operations to minimize energy waste. Moreover, predictive analytics allows homeowners to anticipate energy demand fluctuations and take proactive measures, such as load shifting and demand-side response, to reduce costs and carbon footprints.

This paper explores the integration of IoT and ML in smart home energy management, highlighting the role of real-time data collection, predictive modeling, and intelligent automation. By examining recent advancements in smart home energy efficiency, this study aims to provide insights into how emerging technologies can enhance sustainability, reduce energy bills, and improve overall residential comfort. The findings contribute to the development of smarter, more adaptive, and energy-efficient homes for the future.