Chapter 1
Role of IoT and IIoT in Energy System Automation

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ABSTRACT

The development of energy systems into automated systems has been heavily driven by the rise of the Internet of Things (IoT) and Industrial Internet of Things (IIoT). Such technologies ensure real-time monitoring, predictive maintenance, and integrated use of distributed energy resources. It focuses on the significant role played by IoT and IIoT in home automation energy systems and reflects on productivity, reliability, and sustainability. The chapter presents an in-depth examination of the ways in which these technologies facilitate the evolution of traditional energy grids into smart, adaptive, self-regulating systems through case studies and analysis.

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INTRODUCTION

Background and Motivation

Accelerating worldwide energy consumption, spurred by industrialization, urbanization, and the ubiquitous spread of digital technologies, has elevated the demand for enhanced, reliable, and sustainable energy systems. The rise of renewables further aggravates this for conventional energy networks designed primarily for a passive distribution of energy from centralized generation. Renewable energy integration, variable consumption patterns, and environmental regulations are all putting pressure on legacy systems. This highlights the urgent need to move towards smarter and automatic energy systems.

The Internet of Things (IoT) and Industrial Internet of Things (IIoT) have become transformative technologies that can provide solutions to these challenges (Munirathinam, 2020; Qiu et al., 2025). IoT and IIoT facilitate real-time data collection, advanced analytics, and automated control systems by embedding sensors, communication devices, and actuators across energy system components (Balamurugan et al., 2023; Gupta, 2019). Such capabilities are crucial for maximizing energy production, boosting the stability of the grid, and increasing user engagement.

In particular, the combination of the Internet of Things (IoT) and the Industrial Internet of Things (IIoT) with energy system automation promises not just to increase operational efficiencies but also to improve resiliency and adaptability (Boyes et al., 2018; Sisinni et al., 2018). Such a digitalization process enables predictive maintenance, smart fault detection, demand response mechanisms, and smooth trades and exchanges between energy markets and services of prosumers, producers, distributors, and consumers. Such technologies facilitate a shift from reactive to proactive energy management.

Objectives and Scope

The research chapter discusses the involvement of IoT and IIoT in the energy ecosystem's automation, along with technical, operational, and strategic contributions. The key aims of the study would be:

- To discuss the fundamental technologies that support the IoT and the IIoT and consider how the two are interlinked with energy system automation.
- To study the structural and functional evolution from traditional energy systems to automated, smart energy networks.
- To investigate case studies in energy monitoring, smart metering, demand response, and residential automation.