Chapter 17
A Study on an Internet of Things (IoT)–Enabled Smart Solar Grid System

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ABSTRACT

Automation in the power consumption system could be applied to conserve a large amount of power. This chapter discusses the applications for the generation, transmission, distribution, and use of electricity that are IoT-enabled. It covers the physical layer implementation, used models, operating systems, standards, protocols, and architecture of the IoT-enabled SSG system. The configuration, design, solar power system, IoT device, and backend systems, workflow and procedures, implementation, test findings, and performance are discussed. The smart solar grid system's real-time implementation is described, along with experimental findings and implementation challenges.

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INTRODUCTION

Green energy is energy that may be obtained from nature and is renewable, such as sunlight, tides, rain, and wind, and is utilised by people to produce electricity. People have mostly relied on fossil fuels and non-renewable energy sources in recent years, so investments in green energy are rising. According to a poll, half of the world's population has invested in renewable energy, but there won't be enough of it in the future. The main renewable energy source is solar energy, although its accessibility is dependent on climatic factors. It is transformed into electrical energy by photovoltaic (PV) cells and employed in a variety of industries, including home automation, manufacturing, the medical industry, transportation, and power generation. As the world population is expected to reach its maximum, people and companies need to use and manage green energy as effectively as possible to satisfy their electrical needs. This necessitates the development of an innovative solution like the Smart Grid (SG). An electrical grid-based system called a "smart grid" includes energy management components, including smart metres, smart appliances, renewable energy sources, and energy-saving resources. The suggested effort is to design a solar self-power management system that is combined with a useful controlling, monitoring, and maintenance system utilizing the Internet of Things (IoT). The challenges with solar power systems will be addressed by this technology, known as the Smart Solar Grid (SSG) technology (Al-Turjman and Abujubbeh, 2019). The application of IoT integrated SG and the scope of the research are covered in this chapter.

IoT is the integration of physical things into the Internet of Things (IoT) network using established communication protocols. It is used in many different industries, including agriculture, transportation, medicine, power grids, and so on. In order to do digital computing, smart devices need sensors, actuators, connected or wireless modules, and microcontrollers or microprocessors. IoT devices are made to carry out the principles of monitoring, tracking, controlling, and location identification. Sensors, actuators, cameras, GPS, and near field communication are all used in object-dependent notions. Concepts that depend on the Internet or networks use wireless communication technology (Minh et al., 2022; Harikaran et al., 2023; Janardhana et al., 2023; Reddy et al., 2023; Selvakumar et al., 2023). Concepts that depend on logic or functionality and focus on the range of IoT-enabled applications are called IoT devices. IoT devices are common objects connected via a microcontroller, communication modules, and a stack of protocols to allow intelligent systems. The Internet of Things (IoT) will change how organisations, governments, and consumers interact with the physical world, producing a significant quantity of data that may be applied to creative endeavours. The Internet of Things (IoT) is a network of physically linked things that can sense, find, think, and perform tasks thanks to the internet. By regulating the necessary technologies, such as calculating, communicating, embedded devices, network sensors, Internet infrastructures, and protocols, it recreates existing items from the ancient to the intelligent. IoT may be modified at any moment and is used to evaluate both the state of the global economy and the quality of life (Mehmood et al., 2021). Smart solar grid systems regulate power distribution, monitoring, smart metres, transmission lines, and renewable energy sources. This chapter presents a literature review and analyses IoT architecture, standards, and existing protocols, as well as how they are implemented at the architectural layer and on operating systems (Boopathi et al., 2023d; Jeevanantham et al., 2023; Senthil et al., 2023). The Grid is a system of power plants, transformers, substations, and transmission lines that transports energy. The "smart grid" is the name given to the digital technology that permits two-way communication between consumers and their utility while sensing along the transmission lines. Real-time measurement, monitoring, and control of power flows made possible by SG solutions increase electrical