Chapter 8
Sustainable Sensor Networks and Their Applications in Green Networking and Eco-Friendly Wireless Solutions

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ABSTRACT

Technological innovation has entered a transformative phase because sustainable and eco-concerned practices merge with wireless sensor networks (WSNs). Sustainable sensor network deployments function as a strong tool to tackle ecological issues and construct smart infrastructure. The system applications extend from environmental observation to medical usage through agricultural management and industrial process automation and adopt environmentally friendly design principles. WSNs

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driven by traditional battery power generate environmental and sustainability issues because of their energy requirements. Autonomy for nodes has been enhanced by solar power along with wind power and thermal power and piezoelectric power technologies to decrease battery requirements and infrastructure maintenance expenses. Sustainable WSNs depend heavily on eco-friendly material as one of their fundamental elements. The chapter analyzes real-life examples while demonstrating the influence of sustainable WSNs on existing situations.

INTRODUCTION

The continuous evolution of digital transformation depends on wireless sensor networks (WSN) that serve as a basis for hundreds of modern applications. Smart sensors exist in all distributed spaces to monitor physical or environmental changes, including temperature, humidity, air quality, vibration and movement before sharing the data collected at a door or central location through the network. WSN are recognized as a vital element in domains that vary from health monitoring and urban infrastructure management to industrial automation and intelligent agriculture due to their real -time monitoring capacity and data -based designs.

However, dependence on data -based systems increases, a world sustainability demand is also taking shape. Governments, industries and companies have been forced to reconsider the environmental effects of modern technologies due to the growing fears of climatic changes, the exhaustion of resources and the use of unsustainable energy.

We have extended our analysis to include WSN, which, despite its advantages, if they are not designed with sustainability in mind, then it could damage the environment. In general, widely dispersed sensors and battery operated can produce a significant amount of electronic waste. Therefore, it requires regular maintenance or replacement predominantly in hard or remote environments.

Sustainable sensor networks aim to reduce the ecological impact in each phase of their life cycle from design and deployment to operation and dismantling. The development of robust or self -control network topologies, the incorporation of renewable energy sources such as wind or solar energy and the use of biodegradable or recyclable materials are considered as an example. The key objectives are to reduce the dependence of non -renewable energy sources, increase the useful life of the sensor and produce less environmental problems. In the broader context of ecological networks, these networks are an important step in which communication technologies support environmental conservation instead of damage.

In order to design a sustainable WSNS, a compound approach is needed that reaches a commitment between performance, ecological and reliability. As energy

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