

Chapter 9

Edge Computing for Energy–Efficient Internet of Things: Concepts, Technologies, and Applications

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ABSTRACT

In today's world, the utilization ratio of IoT devices has been increased in the production of massive data, and these gigantic problems were posed in energy consumption and environmental conservation. To address with these problems, there is an innovative concept known as the edge computing that means computation is carried closer to the place where the data is collected. This is done in view of the above stated challenges and difficulties. Building the concept of 'Efficient Edge For Sustainable IoT' As a response to the presented research questions, this chapter employs the energy-efficient edge computing architecture concept to explore the Efficient Edge as a sustainability strategy for the IoT. It elaborates crucial questions related to edge computing and reveals the position of this concept for minimizing the energy consumption, enhancing resource efficiency, as well as the rational data

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processing on the end side of the network. Some of the diverse technologies and strategies expounded in this chapter to achieve energy efficiency in edge computing include energy-aware task offloading, load balancing as well as the integration of renewable energy. Besides this, it looks at the joy of optimization and solutions on battery-powered Internet of Things devices and issues on scalability for edge computing. In this chapter, the focus is made on how the Efficient Edge allows IoT ecosystems to be sustainable, scalable, and resilient, while the use of real-world case studies and the analysis of the future looks like.

1.1 INTRODUCTION

Recently, IoT has introduced change in the way how people communicate with environment. This has created a huge array of networked devices that can in any given moment collect, exchange, and analyse data. However, this exponential increase in the use of Internet of Things has created massive problems especially in handling data, connection as well as power consumption. Regarding the data storage and processing what catches the researchers' attention is that the traditional IoT architectures often employ cloud servers. This type of architecture can lead to latency issues, bandwidth constraints and raised power consumption related with the exchange of data through networks. The essence of edge computing has emerged as the revolutionary way of managing decentralized data processing and computation to address the problems that have been enumerated (Premalatha & Prakasam, 2023). Edge computing is therefore a subcategory of computing that entails the processing of computations and data at the network edge where data is commonly produced. This can therefore cut down on the delays, increase the speed of service delivery and there by efficiency is enhanced. Currently, it is conceivable for Internet of Things (IoT) systems to achieve significant enhancements in the areas of scalability, dependability, and power proficiency through edge computing. It will, therefore, create grounds for making the Internet of Things environment more sustainable and reliable.

In this chapter, a comprehensive analysis of how edge computing and IoT are related is described. The main emphasis of this research is placed on such framework as key concepts, structures, techniques, and solutions stimulating this shift. In this article, we induce the main causes that have made the use of edge computing in the Internet of Things adoption. These considerations include processing needs to be done concurrently, higher number of devices requiring connection and notification, and a higher need for application that has less delay and needs high bandwidth (Liu et al., 2024).

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