Chapter 6
Enhancing Healthcare Quality through AI-Driven Wireless Sensor Networks for Real-Time Monitoring

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ABSTRACT

The trend of WSNs is increasingly becoming integral to all fields, particularly in healthcare, wherein the real-time reliable transmission of data is highly critical. In healthcare, while communicating sensitive health data, Quality of Service for WSNs requires strict QoS to enable prompt, secure, and accurate communication. This paper investigates the development of a robust approach that may improve the quality of service in healthcare applications powered by WSNs. The methodologies applied here are state-of-the-art techniques using AI and optimizing networks, thus ensuring an optimal quality of data from health care information communication even in resource-constrained settings. This study details the major improvements in the key parameters such as latency, bandwidth, and data quality through intensive analysis and simulation based on real cases that have been tested on healthcare

DOI: 10.4018/979-8-3373-6796-5.ch006

scenarios. This research emphasizes WSNs in healthcare, promoting the development of reliable, efficient, and AI-enhanced solutions for the real-time monitoring of healthcare.

INTRODUCTION

WSN has become a storming phenomenon in this new age of healthcare, giving an impression of a paradigm shift and, effectively, transforming the approach taken towards medical care as it exists today. The networks have become essential facilitators of remote monitoring, diagnosis, and treatment of patients, literally breaking the geographical barriers and revolutionizing healthcare delivery. WSNs enable healthcare professionals to observe patients in real-time from any corner of the world with information that is timely and also accurate about the state of the patient. Such an ability is very critical for patients suffering from chronic diseases, the elderly, or people living in remote areas where they may not access healthcare facilities all the time. WSNs will allow smooth communication of this critical health information gathered from the monitoring devices to the patient's healthcare providers. This, in turn, is going to help healthcare professionals react just in time and respond wisely with intelligent medical intervention. Embedded sensors in a wearable device may include heart rate monitors, blood glucose sensors, temperature sensors, etc. Constantly, the data flows from these monitoring devices to the health systems to analyze whether there is some anomaly or trend in the health parameters. It gives a quick response to clinicians by adjusting their medications and proposing adjustments in lifestyle or triggering the implementation of emergency procedures. In fact, such an approach not only benefits the patients but also helps save health resources as the number of interventions during emergencies and hospitalizations reduces (Srilakshmi et al., 2024).

However, such promise of a technological revolution does contain a big challenge: it is to provide QoS at the time of healthcare data transmission through WSNs. QoS is now more of an important concern because this information is sensitive and crucial to proper treatment procedures. Even minute delays or mistakes in information may have dire consequences for healthcare applications, threatening patient safety. For example, additional amounts of latency or unreliable communication may cause a missed or delayed medical intervention, which may lead to adverse health effects. Of most concern, however, is the confidentiality and integrity of health data since access without permission or alteration would violate patient trust and breach legal and ethical codes of conduct (Soltanian et al., 2010). Issues such as these have seen a vast improvement in AI-based solutions optimizing WSNs for healthcare applications. Machine learning and deep learning algorithms will predict congestion within the