Edge AI-Based Smart Patient Monitoring and Alerting System

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Abstract

The integration of Edge Artificial Intelligence (Edge AI) with the Internet of Medical Things (IoMT) has revolutionized real-time patient monitoring by enabling low-latency, localized decision-making. This paper presents an Edge AI-based Smart Patient Monitoring and Alerting System that employs a Long Short-Term Memory (LSTM) Autoencoder for health trend prediction and abnormality detection. The system comprises three layers: (1) a Data Collection Layer, where temperature, blood pressure, SPO2, and heart rate sensors acquire patient vitals to an ESP32 module and transmitted via Bluetooth Low Energy (BLE); (2) a Data Aggregation and Task Scheduling Layer, where a Raspberry Pi (RPi) serves as the edge device, hosting an MQTT broker and executing TDMA-based data aggregation and real-time AI inference; and (3) an Application Layer, where processed data is visualized with predictive insights for medical officers. The LSTM Autoencoder model was trained with a 1000 multivariate dataset, and the model achieved an accuracy of 65.45%, a sensitivity of 52.5%, and a specificity of 100%, indicating high reliability in identifying normal cases but requiring further optimization for improved sensitivity. The system also incorporates a fuzzy logic-based criticality decision-making mechanism, ensuring prioritization of high-risk patients in real time. This work introduces a novel combination of Edge AI, predictive analytics, and task scheduling to enhance patient monitoring efficiency and responsiveness. The proposed system minimizes cloud dependency, reduces latency, and enables timely alerts for medical professionals, thereby enhancing clinical decision-making in resource-constrained environments.

Keywords

Edge AI, Internet of Medical Things (IoMT), LSTM Autoencoder, Smart Patient Monitoring.