Smart Healthcare IoT: A Hybrid Deep Learning Approach

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1. Dataset Description

The dataset used in this project is based on real-time healthcare data collected through IoT sensors. These sensors are capable of monitoring various physiological parameters such as heart rate, body temperature, blood pressure, oxygen saturation, and patient movements. The data is gathered from wearable devices and transmitted to a central server for further processing. The richness and variety of this real-time data make it suitable for applying deep learning models for health condition prediction and anomaly detection. Such a dataset ensures that the system can be used in real-world healthcare settings for continuous monitoring.

2. Parameters Used

The parameters considered in this research are critical indicators of a person's health. These include:

- Heart Rate: Measures beats per minute, an indicator of cardiac activity.
- Blood Pressure: Monitors the pressure of circulating blood on artery walls.
- Body Temperature: Detects fever or hypothermia conditions.
- Oxygen Saturation (SpO2): Evaluates oxygen level in the blood.
- Motion Data: Tracks physical activity and falls.

These parameters help the model to accurately detect any abnormalities in the patient's health.

3. Project Overview

The project is a smart healthcare system that integrates IoT devices with a hybrid deep learning framework. IoT sensors collect vital health parameters in real-time, which are then transmitted to a central system for analysis. The core of the project is the hybrid deep learning model, combining Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks. This system can monitor patients remotely and issue alerts in case of anomalies, potentially saving lives by enabling timely medical interventions.

4. Research Gap and Improvement

In previous research, single deep learning models were used for health prediction, which had limitations in handling complex and sequential healthcare data. This project addresses that gap by introducing a hybrid CNN-LSTM architecture. CNNs are efficient in feature extraction from sensor data, while LSTMs are effective in processing time-series data. By combining these models, the system achieves higher accuracy and robustness in predicting patient conditions. This novel approach represents a significant step forward in smart healthcare technologies.

5. Results and Accuracy

The system's performance was evaluated using accuracy as the primary metric. The models used and their respective accuracies are as follows:

CNN Model Accuracy: 85.20%

LSTM Model Accuracy: 87.36%

Hybrid CNN+LSTM Model Accuracy: 90.78%

The hybrid model outperformed the standalone models, demonstrating the effectiveness of combining CNN and LSTM for healthcare data analysis.

6. Limitations and Future Scope

Despite the promising results, the project has some limitations. The dataset size is relatively small, which may affect the models generalizability. There is also a potential for data imbalance, where some health conditions are underrepresented. Moreover, in real-time deployment, challenges such as energy efficiency, network latency, and data privacy must be addressed. Future work could focus on expanding the dataset, implementing federated learning for enhanced privacy, and optimizing the system for low-power environments.