Enhancing Sleep Apnea Prediction Using Advanced Numerical Dataset Analysis

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Abstract:
Sleep apnea significantly impact human health, necessitating accurate and early detection systems. This study presents a mixed-model deep learning system that analyzes polysomnographic data from the Sleep-EDF dataset, using Convolutional Neural Networks (CNNs) and Bi-directional Long Short Term Memory(BiLSTM) networks. The presented method effectively captures spatial and temporal interconnections in Electroencephalogram (EEG), Electrooculogram(EOG), and Electromyogram(EMG) recordings and achieves reliable performance measures. The system outperformed conventional models and previous frameworks by scoring an impressive 98.7% accuracy, 98.4% precision, and 98.6% F1-score. In particular, robust classification capabilities of the system were demonstrated through Area Under Curve-Receiver Operating Curve(AUC-ROC) values above 99% in the wake, Non-Rapid Eye Movement (NREM), and Rapid Eye Movement (REM) phases. Statistical significance was verified using paired t-tests. The proposed method is scalable and applies both to academic and clinical contexts as it manages the limitations of automated predictions of sleep apnea. Within the framework of healthcare, an area for improvement in the future is implementation of real-time processing in healthcare systems.

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