Sleep Stage Classification Using Non-Invasive Bed Sensing and Deep Learning

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Abstract:

Sleep stage classification can be used to monitor sleep quality and diagnose sleep disorders. Sleep disorders can be correlated to health conditions such as Alzheimer's and Parkinson's disease. This project uses a hydraulic bed sensor positioned under the mattress, as well as a deep learning approach, for sleep stage classification. Our motivation is to provide an automatic, non-invasive and more accessible method of classifying sleep stages by using deep learning to analyze data gathered from the hydraulic bed sensor. The test subjects for this project were elderly patients with sleep disorders. Polysomnography (PSG) data, the current gold standard, was also collected in a Sleep Lab to serve as the ground truth for the bed sensor data. In this study, sleep stages are categorized into 3 categories: Wake, Rapid Eye Movement (REM), and Non-Rapid Eye Movement (NREM). This paper uses a Convolutional Neural Network (CNN)- Long-Short Term Memory (LSTM) hybrid model with 2 CNNs of different filter sizes for feature extraction. These features are then fed into the LSTM for classification. Our results show an accuracy of 72% for Wake, 91% for REM and 67% for NREM, with an average accuracy of 77% for the model. These results are promising and show that the hydraulic bed sensor combined with a deep learning approach is capable of providing an automatic and non-invasive method of classifying sleep stages.