A Multimodal Approach to Real-Time Seizure Prediction Using Discreet Wearables

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Epilepsy is a neurological disorder characterized by recurrent seizures, and affects nearly 50 million people, causing ~140,000 deaths worldwide annually. Many of these deaths could be prevented through accurate prediction and detection of seizures. However, seizure monitoring currently relies on in-hospital technology, leaving a critical gap in patient safety during daily life. This project aimed to develop an accurate seizure detection and prediction algorithm for outside a hospital, using data from a discreet, simple 2-electrode, multimodal wearable. Three data types (EEG/ECG/EMG), collected from wearables in the SeizeIT2 dataset, were used. With 48 time and frequency domain features extracted, SVM, Random Forest, and XGBoost architectures were evaluated for seizure detection. XGBoost performed best and reproduced the results from the deep learning model in the SeizeIT2 paper with a recall of 73.6%. Prediction was performed in three trials, also testing the same three model architectures. A cross-patient model in Trial 1 was unusable, with only 5.68% sensitivity. Using patient-specific transfer learning boosted sensitivity to 84.1%, confirming that multimodal physiological data is deeply individual. In Trial 3, fully patient-specific models achieved exceptional results: an average sensitivity of 86.6% and a low false alarm rate of 0.22 per hour. Implementing a 3-consecutive prediction rule also significantly lowered false alarm rate, by triggering an alarm only if three consecutive epochs were classified as pre-seizure. This step allows for accurate, real-time warnings necessary to protect epilepsy patients in their daily lives.

Awards Won:

Third Award of $1,200