ElectroAssist: A Cost-Efficient, Wearable Body Sensor System for the Prediction of Cardiac and Neural Episodes Through Machine Learning Models and a Proactive Mobile Application

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Cardiovascular and neurological diseases make up the majority of the world's current health crisis, yet there is a lack of a proactive and accurate system in place to address this issue. Hence, a system of long-term, cost-effective,wearable sensors were built to continuously monitor the user's EEG and ECG signals. The PCB sensors were built by custom design through KiCad software, and both included a microcontroller, analog-to-digital converter, and a BLE Module to create a system that could process and transmit data through the Serial Peripheral Interface. In addition to the sensors, two machine learning systems were implemented in conjunction to analyze the biosignals in real-time. The first machine learning process involved the following key steps: ECG Denoising, GLCM Feature Extraction, Support Vector Machine, and Convolutional Neural Network. The Support Vector Machine was a binary classification system which determined if the beat was abnormal, and in testing, it maintained in accuracy of 93.7%. If the SVM classified a beat as abnormal, it was sent to the CNN which categorically classified the type of abnormality and tracked abnormality patterns to predict heart attacks. The CNN had an overall accuracy of 98.3% and predicted heart attacks 23 minutes before they occurred. As for the second machine learning algorithm, two different SVM models were implemented to predict epileptic seizures and look for signs of Alzheimer's Disease for early detection. The prediction model had an accuracy of 96.7% and the Alzheimer's detection system had an accuracy of 91.6%.

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