Team 3: A Microcontroller-Based System for Real Time Seizure Onset Detection

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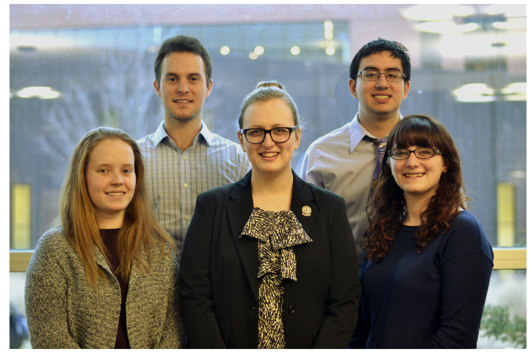

Allison Colberg, Edward Novikov, Jamie Mierzejewski, Juan Romero and Rebecca Newman (Left-to-Right)

BIOMEDICAL ENGINEERING

Epilepsy is a neurological disorder characterized by sudden, recurring seizures, which are the result of excessive and synchronous electrical discharges of a large number of neurons. Epileptic seizures occur in over 1% of the world's population, making it the second most common neurological disorder after stroke. Currently the most precise method of epileptic seizure detection involves utilizing three certified clinicians to analyze a patient's EEG signal data and establish a consensus as to where the beginning and end of each episode takes place. The purpose of this project is to design and prototype a microcontroller-based system that interfaces with iEEG data for automatic detection of an oncoming seizure. This system will raise an alarm when a seizure is detected and, by means of its graphical user interface (GUI), will plot the filtered iEEG data and show a brain map on an external monitor. The GUI will assist the clinician in better understanding the onset and spread of the imminent epileptic seizure. The real-time component of this design will be a novel contribution to existing systems and is of critical importance because added detection lag will delay clinician response time before seizure onset.

The system's first stage of processing will transmit iEEG signals from a virtual patient's intracranial electrodes within the brain to a set of microcontrollers. Second, the signals will be frequency filtered into four separate frequency sub-bands. Then, signal features will be calculated for each frequency sub-band to assist in determining seizure events. The features our system utilizes are kurtosis, power, line length, and number of maxima and minima. Once the features are extracted, the third step in processing is to use a Support Vector Machine to linearly separate the data into seizure and non-seizure classes. The classification decision will be sent from MCU 1 to MCU 2, and ultimately displayed on the GUI (see figure below). The graphical user interface will present the raw iEEG data in real-time alongside a brain map that will visually show seizure propagation on the electrode grid.