Tania Soutonglang, Saurabh Rajput

CS 584-02

Spring 2023

Project Proposal - Aberrant epileptic seizure identification: A computer vision perspective

Epilepsy is a neurological disorder that affects many people worldwide, and accurately identifying the underlying causes is crucial for effective treatment. However, existing clinical methods rely heavily on experience and training, leading to misdiagnosis and ineffective treatment. This project aims to develop a computer vision-based approach to identify aberrant epileptic seizures, which are challenging to classify using current clinical methods.

The Problem

Body movement may lead to discovering underlying causes of epilepsy, however, modern clinical methods rely heavily on experience and training. Previous approaches include a facial semiology analysis approach for identifying patients with mesial temporal lobe epilepsy (MTLE), and a hierarchical multi-model system quantifying and classifying MTLE and extra-temporal lobe epilepsy (ETLE). However, these methods rely heavily on supervised learning, so when a new patient is added and is not part of a training category, the model is not useful anymore. These models have low performances and classification accuracy when classifying patients with potentially aberrant seizures and do not strongly correlate with the training and validation data.

What Has Been Done So Far

The research team grouped patients into a best-fit model by using a template from a pre-learned database of known semiology in the form of libraries. These libraries would help identify if the semiology of a new patient fits into the learned information of epilepsy or with aberrant semiology. Typical MTLE and ETLE behaviors are recorded and split into short video sequences to create two motion capture (MoCap) libraries, which are then preprocessed to detect the patient and resize the images. A CNN-LSTM structure is trained to model the relationship between known semiologies and different epilepsy types. MoCap libraries for each type of epilepsy are then generated by extracting spatiotemporal representations from the LSTM layer. When a new seizure is observed, the recorded seizure is split into smaller sequences and matched to a library. A cosine similarity metric is used to compute the similarity of each sequence from the test patient, so the acceptance threshold is based on the total number of sequences that are similar to the MoCap library. The study included 62 seizures from 14 patients with MTLE and 57 seizures from 14 patients with ETLE, a total of 119 seizures, to create the MoCap libraries.

The data is validated with k-fold cross validation, with sequences of all patients of the same class are split into 70% for training, 15% for validation, 15% for testing, and *k* is set to 10.

According to the paper, the CNN–LSTM model achieved an average accuracy of 0.9703 for the k-fold cross-validation scheme (Ahmedt-Aristizabal et al.).

Our Plan

We can try to replicate the experiment to the best of our abilities.

In conclusion, developing a computer vision-based approach to identify aberrant epileptic seizures is a promising avenue for improving epileptic seizure diagnosis and treatment. By using computer vision and machine learning techniques, we can complement existing clinical methods and gain a more comprehensive understanding of the relationship between body movement and epilepsy.

Reference

Ahmedt-Aristizabal, David, et al. "Aberrant Epileptic Seizure Identification: A Computer Vision Perspective." *Seizure*, Elsevier BV, Feb. 2019, pp. 65–71. *Crossref*, doi:10.1016/j.seizure.2018.12.017.