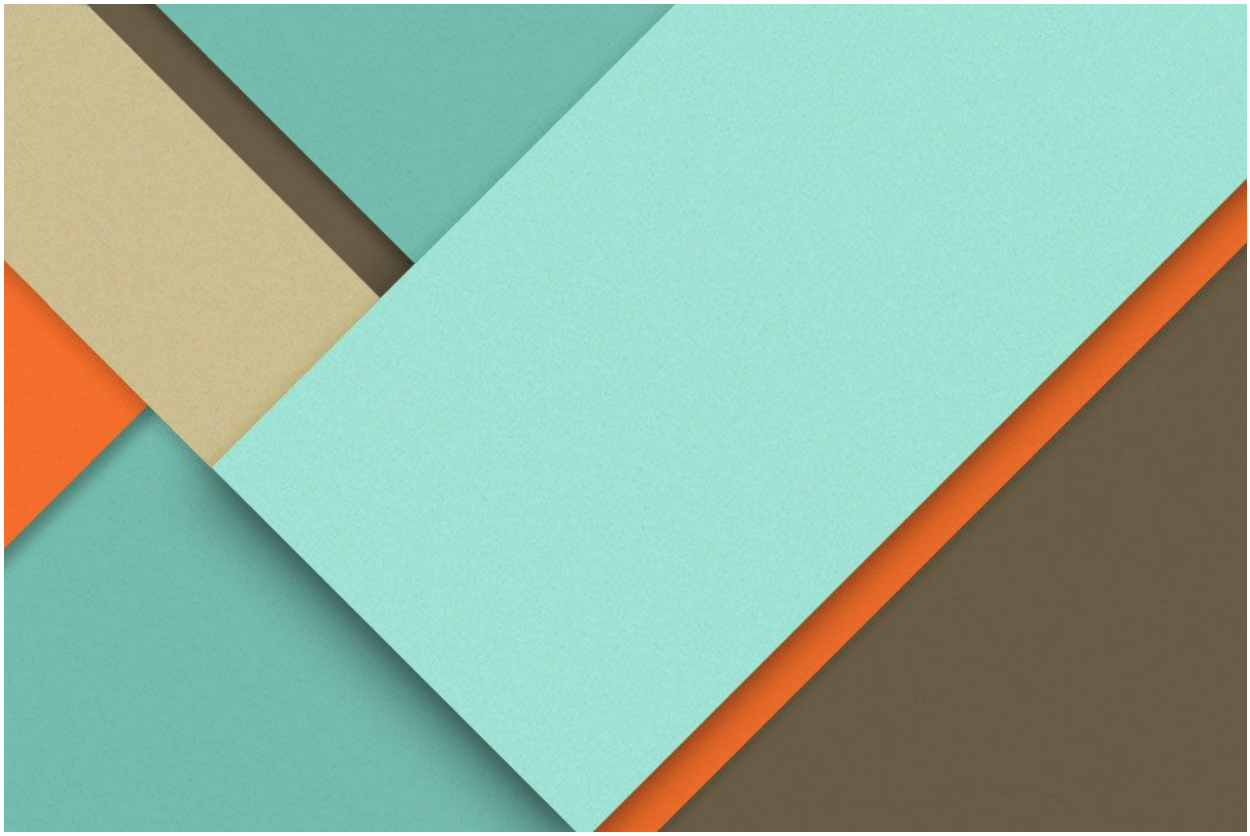

Project Proposal

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Name: Zhixiang Wang
Email: zhixiang.wang@vanderbilt.edu

Overview

The goal of the project is to build a proof-of-concept visualization for an autonomous system that monitors the movements of patients who have epilepsy and use machine learning algorithms to predict the onset of a potential episode.

We speculate that there are certain movement patterns that are likely to be indicators of a potential epilepsy episode and we should be able to train a neural network to recognize these movement patterns.

For a proof of concept, we will visualize the movement trace using the keypoint position data generated by OpenPose using D3.js and Python. We want the visualization to help us gain a better understanding of the following questions:

1. Are the data generated by OpenPose accurate enough for us to reconstruct the movement trace?
2. If so, is a sudden lack of movement usually correlated with an epilepsy episode?
3. Are there any other movement patterns noticeable enough for human eyes to recognize?

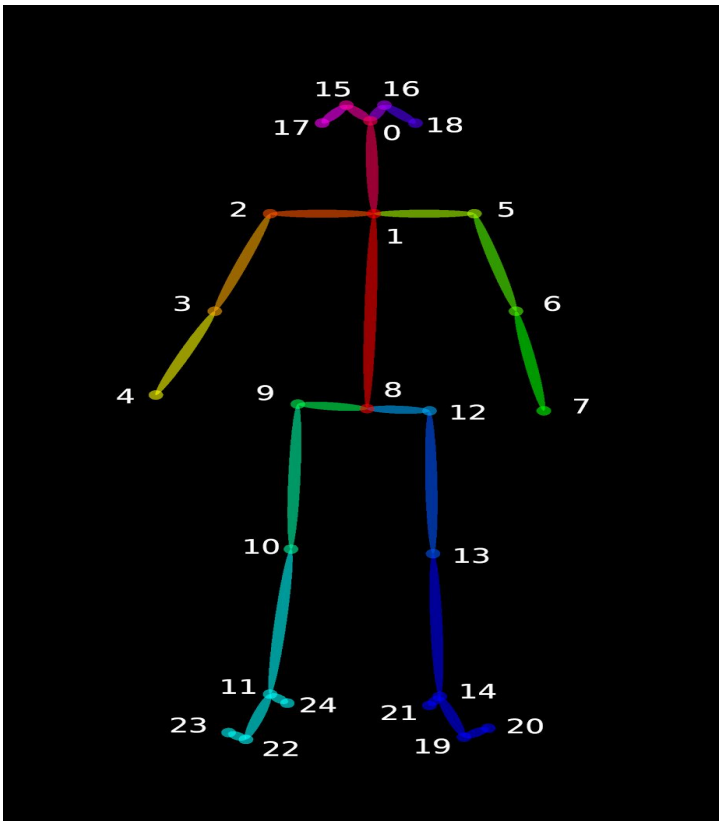
Data

1. Collection

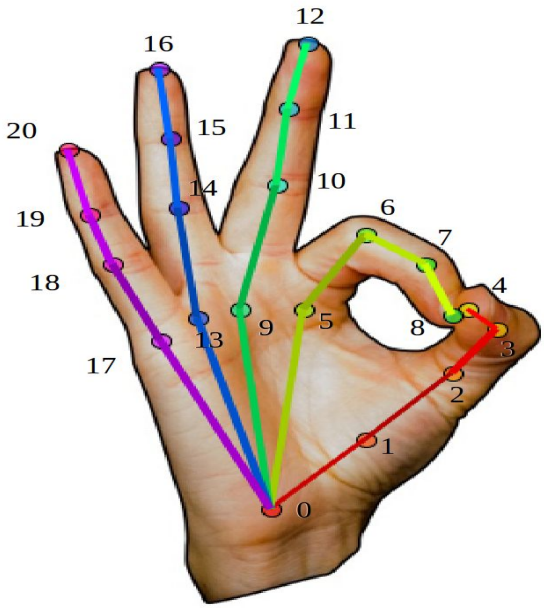
   OpenPose, which is a real-time multi-person keypoint detection software, is used to analyse the videos collected from the Vanderbilt Epilepsy Monitoring Unit. It generates the keypoint positions on each frame of the video and saves the result into a single json file. Each JSON file has a people array of objects, where each object has:

   - An array pose_keypoints_2d containing the body part locations and detection confidence formatted as x1,y1,c1,x2,y2,c2, (x, y) being the pixel coordinate of the keypoint in the video and c being the confidence score in the range [0,1].
   - The arrays face_keypoints_2d, hand_left_keypoints_2d, and hand_right_keypoints_2d, analogous to pose_keypoints_2d.
   - The analogous 3-D arrays body_keypoints_3d, face_keypoints_3d, hand_left_keypoints_2d, and hand_right_keypoints_2d (if --3d is enabled, otherwise they will be empty). Instead of x1,y1,c1,x2,y2,c2,..., their format is x1,y1,z1,c1,x2,y2,z2,c2,..., where c is simply 1 or 0 depending on whether the 3-D reconstruction was successful or not.
   - The ordering of the keypoints follows as shown below:

- Pose Output Format (BODY_25)



- Hand Output Format



2. Pre-processing

   We wrote a python module to calculate the Euclidean distance of the same keypoint position between every two consecutive frames for each object in the original JSON file and combine the results into one single JSON file. Given the timeline and data validity (OpenPose did not recognize the patient's face for the most frames because of the quality of the video), we will only be using the data from pose_keypoints_2d, hand_left_keypoints_2d, and hand_right_keypoints_2d.

   There will be three JSON files for the visualization: pose_data.json, hand_left_data.json, and hand_right_data.json. Pose_data.json is an array of array, where the indices outer array corresponds to the frame numbers and the inner array is the distances for each keypoint. It is formatted as [d1, c1_1, c2_1, d2, c1_2, c2_2, d3, c1_3, c2_3, ...], d being the distance, and c1 being the confidence level of the point in the first frame and c2 being the confidence level of the point in the second frame.

Visualization Design

We want the visualization to be three line charts with coordinated views. The y-axis of each line chart corresponds to the distance and the x-axis corresponds to the frame number. The user should be able to zoom in and out around a certain frame and select a group of keypoints to highlight.

Features

As stated in the overview, we want the visualization to help us gain a better understanding of the following questions:

1. Are the data generated by OpenPose accurate enough for us to reconstruct the movement trace?
2. If so, is a sudden lack of movement usually correlated with an epilepsy episode?
3. Are there any other movement patterns noticeable enough for human eyes to recognize?