

# A Novel Approach Utilizing Electroencephalography (EEG) devices for Detection and Classifications of Thoughts

## **Research Summary**

Electroencephalography (EEG) headsets, being highly portable, present a convenient, noninvasive method of recording the brain's electrical activity. We seek to develop a method for the classification of thoughts, memories, and stimuli from EEG data, for potential use in brain-computer interface (BCI), and the treatment of Aphasia and disabilities that affect verbal communication. The Emotiv EEG headset contains 14 electrodes, manifesting data as 14-D time series. For analysis of multidimensional data, We adopted support vector machine (SVM) and K-Nearest Neighbor learning algorithms to train models in the classification of event-related potentials corresponding to predetermined thoughts. Simple, tangible things that provoke distinct sensations, like pizza toppings, are more universal and easily conceived, making them suitable classifications for our study. SVMs are fed EEG recordings of subjects imagining a topping, forming a classifier model based on the data's spatial and temporal configurations. This model is then able to classify events given new EEG data, and stochastic neighbor embedding allows visualization of the 14-dimensional data in 2-D. We aim to reduce noise while preserving electrical behavior by expanding analysis to interval centroids of the time series. Technology enabling nonverbal communication is exciting not only for its futurist appeal, but its potential to help millions suffering from Aphasia and other speech impairments. While methods such as MRI capture data with extreme resolution, EEG headsets would provide a non-invasive, inexpensive and accessible means of translating brain activity. We therefore hope our research will contribute to the future development of an EEG based BCI for therapeutic and rehabilitative purposes.

## **Procedure**

Utilizing the Emotiv and OpenBCI headset, I collected data of a few subjects thinking about things such as dogs, trees, and pizza toppings, as well as listening to different musical pieces. There are virtually no safety risks as the headsets are highly non-invasive and are worn over the head.

## **Human Participants**

Three Participants:

- Participant 1
  - Caucasian Male, 21
- Participant 2
  - Caucasian Male between, 19
- Participant 3
  - Indian Male between 17

The participants all were interested in contributing in the project. As such, they knew about the purpose of the project and willingly participated. Due to the nature of the data collection schema, confidentiality is ensured as the data was collected as a time series and is impossible to be pinpointed to a particular individual. The data was handled by me, where I have no intention of publishing it without the consent of the human participants.

The human participants have given written consent allowing the data to be published.

## **References**

- [1] MATLAB  
Machine Learning with MATLAB. (n.d.). Retrieved August 30, 2017, from <https://www.mathworks.com/solutions/machine-learning.html>
- [2] OpenBCI. (n.d.). Retrieved March 21, 2018, from <https://github.com/OpenBCI>