Executive Summary

EEG Decoding Group 39

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ECE Senior Capstone 2020-2021

1. Project Summary

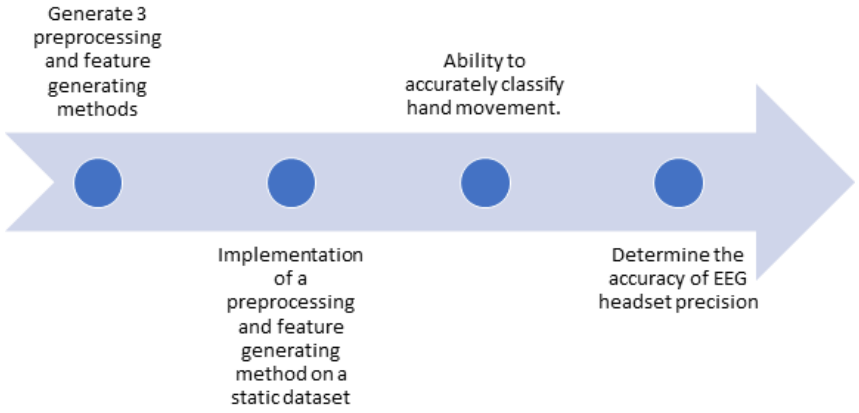
The goal of this ECE Senior Design Capstone project is to implement a system that reads brain signals from an electroencephalogram (EEG) and outputs a visualization of the user's hand movement that was recorded. The final visualization will be a prediction of the user's movement that is derived from a series of signal processing techniques and feature selection methods. A machine learning model will be trained in real time to make these movement predictions, and the output will be able to be directly compared to the motion recorded by a glove circuit to determine accuracy.

In the years of research that have been done surrounding EEG signals, researchers have realized that they can be helpful in diagnosing brain tumors, brain damage from head injury, brain dysfunction (encephalopathy), inflammation of the brain (encephalitis), strokes, and sleep disorders. Most research has been done on expensive equipment, but the project we present will open the world of EEG signal research to lower-cost development and more readily accessible information.

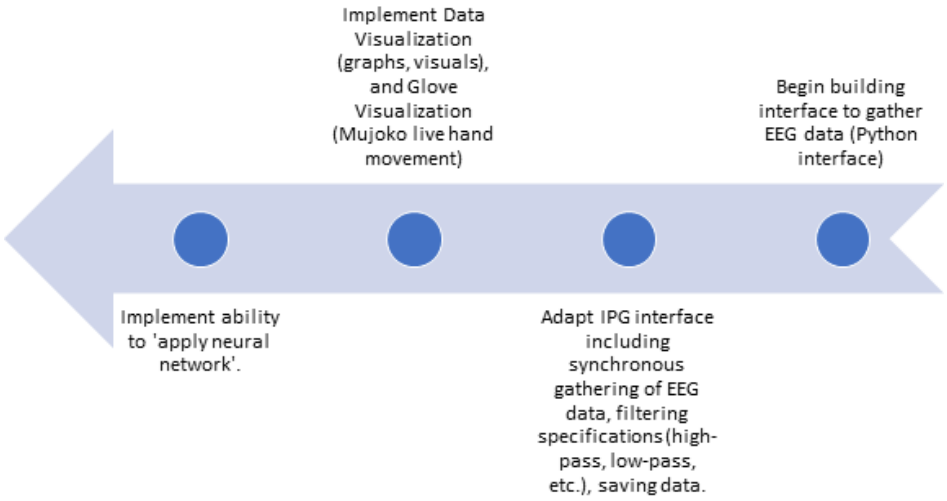
2. Project Organization

The project has been organized into six main categories of tasks that require applications of signal processing and machine learning. Throughout the course of the school year, various tasks will be organized into a timeline and delegated to team members. In summary, team members will have established a data collection system to store data simultaneously, designed pre-processing systems and feature selection methods that will remove artifacts and identify hand motion, developed an interactive data visualization tool for the user, trained a machine learning model with customizable hyperparameters, and displayed the live prediction of hand movement from the system virtually for the user to view.

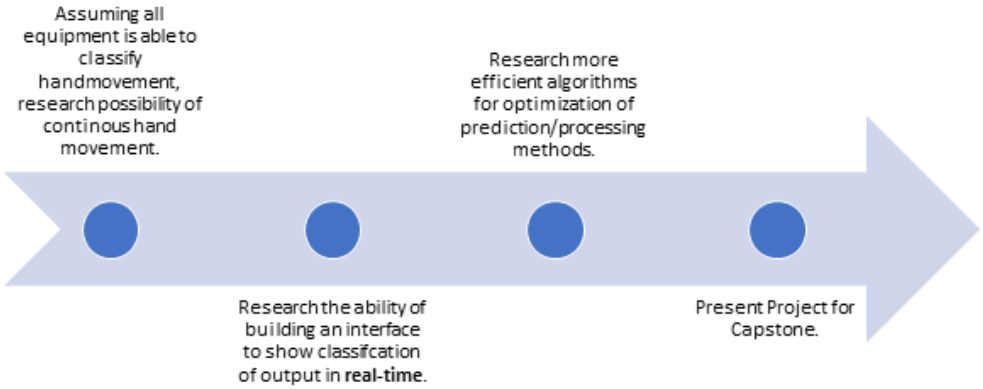
Fall 2020



Winter 2020



Spring 2020



3. **Reflection**

Looking back on our experiences during this project, our team was able to grow both our technical skills and our project management skills greatly. We adapted to a virtual work environment and established communication rhythms that allowed us to stay productive individually while still making cohesive progress as a team. In parallel with this, we each had the opportunity to research and implement signal processing algorithms that were well documented in EEG decoding literature. In doing this research we were able to develop our abilities to analyze, summarize, and reproduce complex research documents in a way that made the material attainable to those who are not specializing in it. A key barrier that we faced was trying to quantify this research work in a way that was equitable to non-research projects, but we learned that metrics should be looked at differently for different types of projects. Assessing our work in terms of enclosure quality and cost is not an adequate nor an appropriate representation of the level of work. In all, we gained experience working as a team in a challenging environment and gained both technical and project management skills that will benefit us in future projects.