Causal Run

AI Based Game Design and Analysis of Brain Signals

Student: Kelvin Pang Jun Wei   **Supervisor:** Dr. Smitha Kavallur Pisharath Gopi

Objectives

This project aims to develop a simply Unity3D game and integrate an Electroencephalography (EEG) device to evaluate players' emotional states while playing the built game. This includes the development of a simple infinite runner-style game. It also aimed to investigate the feasibility of using EEG signals to assess players' emotions and the potential of EEG-based games in the field of Brain Computer Interface gaming. This will involve the usage of Signal Processing Tools such as the Infinite Impulse Response High Pass Filter and algorithms like Independent Component Analysis, and Automatic and Tunable Artifact Removal (ATAR) algorithm on the recorded raw EEG signals to investigate if the readily available Emotiv's Performance Metrics (PM) Suite differs from players' emotion responses during gameplay. This also aimed to identify the limitations and challenges using EEG devices in gaming and to suggest future research directions for game design and EEG signal analysis.

Signal Processing

The EPOC+ headset contains 14 channels and records raw EEG signals. These are preliminary filtered to remove unwanted DC components and eliminates irrelevant delta signals. They are processed with the ATAR to investigate the significance of artifacts (if present), then compute the Power Spectral Density using Welch's Method to determine its usability and suitability. From there, they are mapped to the human's brain activity to illustrate the region of high activities.
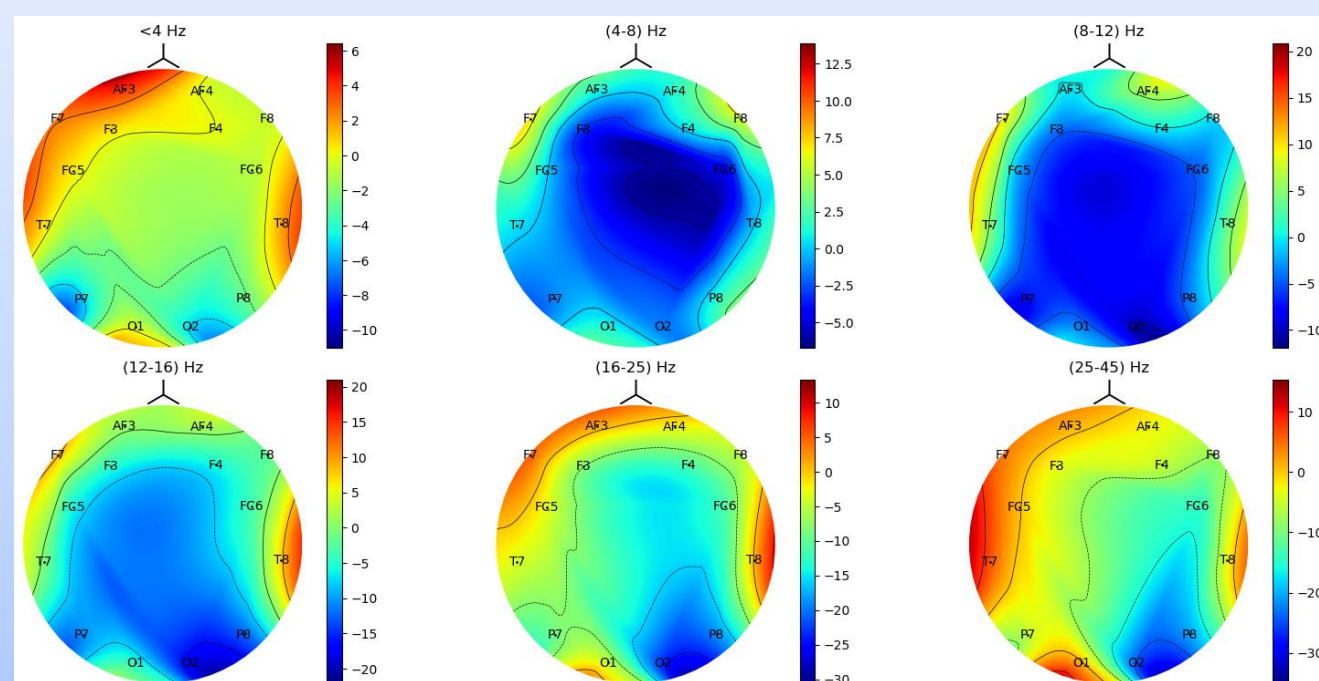
Evaluation

Survey results showed that the EPOC+ did not possess great comfort due to the pressing of scalp to accurately pick up signals. Statistical results showed that the PM differed from a developed Player's Rating (PR) survey which captured their emotion states after playing with only a third of the emotions aligned with the existing theory that *Stress* and *Relaxation* are reciprocal. It also illustrates that the headset may not be able to capture subtle variations. As such, caution must be taken when interpreting the PM score due to its inaccuracy of the evoked emotions. Furthermore, the strength of this finding was limited severely due to small sample size.