Neurotechnology & BCI Lab

Project Report

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P300 Speller

- P300 is a brain machine interface that leverages visual stimulus from the occipital lobe for detecting the response of the individual for varying visual impulse of rows and columns.
- The application of this system includes assistive support for patients with motor disorders , speech impairments . Moreover, it can be used for applications gaming and prosthetic / robotic control
- We also wish to integrate ECG and EMG artifact reduction model to ensure good signal to noise ratio

Experimental Design

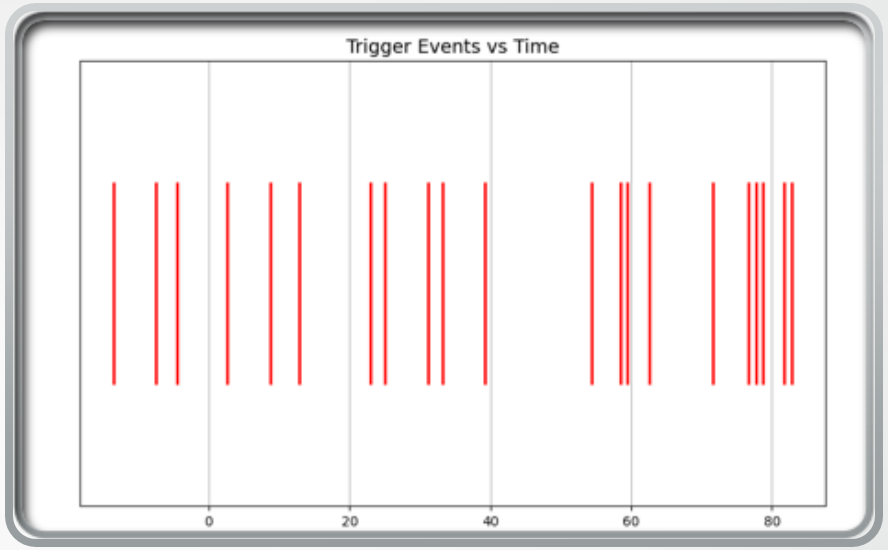
- The experiment is caried out with the following specifications.
  - The single channel electrode is placed on the Pz (Parietal middle).
  - An 8×8 image of letters is generated using PsychoPy python library .The 8 rows and columns are flashed randomly after an interstimulus interval of 100ms.
  - This done for until we receive around 20 flashes for each letter of the alphabet in the experimental duration.
  - Total expected experiment time since time here is a random variable for identification of one letter =128sec± 64sec(calculated via coupon collector problem)

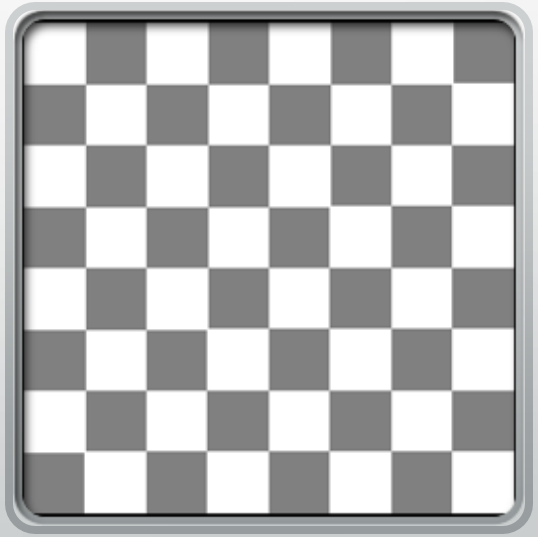
Data Processing

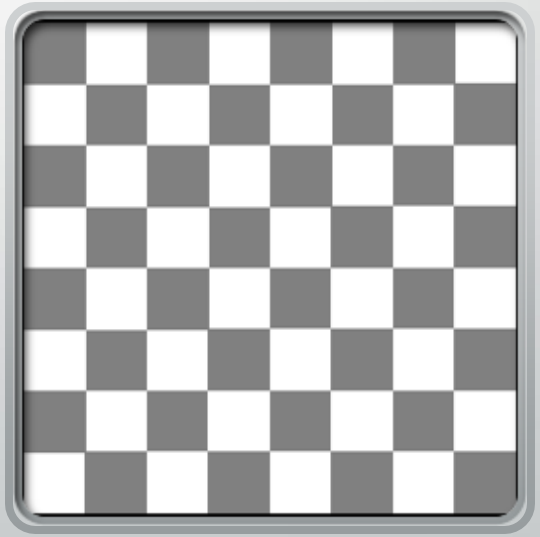
- A trigger with the map of the row and column of the flash. This is connected via a python code to the arduino signal.
- The data is cut 200*ms* before and 500*ms* after the stimulus for each letter with trigger synchronization.
- The signal is then ensemble averaged over each letter to detect the P300 peak for letter detection.
- Perform ICA for EMG and ECG artifact rejection for removal of eye blink and muscle artifacts.

Preliminary Simulations

- Implemented chess board flip with trigger.
- Ensemble averaging to detect P300 peak.







Price Sensitivity Analysis

- In this project we wish to understand the physiological response to different price using EEG,ECG and GSR sensors from a neuromarketing perspective.
- We wish to test certain hypothesis like does ₹999 differ from ₹1000 and what is the sensitivity function as the price increases and effect of different discount on different price ,where same amount of profit is made
- We also wish to develop a gambling setup where the prices of products are dynamically adjusted based on the cognitive state of the person.

Experimental Design

- The experiment is caried out with the following specifications.
  - We measure ECG (stress/excitement), EEG (cognitive load) from Pz (parietal middle), and GSR placed at palm of the hands.
  - We perform a randomized control trial one exposed to Null and Alternate Hypothesis
  - Use statistical methodologies to reject the Null Hypothesis. *Ho*:The change from $999 to $1000 does not cause a psychological threshold effect.

Data Processing

- Record EEG, ECG, GSR and extract relevant features while filter noise and normalize signals.
- Identify key metrics like heart rate variability (ECG), brainwave patterns (EEG), and skin conductance peaks (GSR).
- Align physiological responses with different price points, discounts, and dynamic pricing changes.
- Detect patterns in price sensitivity using statistical tests while Defining a metric for thresholding as a function of the input signals.
- Following this we wish to identify if certain prices are preferred over others within a small range as an optimization problem using a real time adaptive model

Thank you