Mobile EEG signal Analysis using SSVEP paradigm

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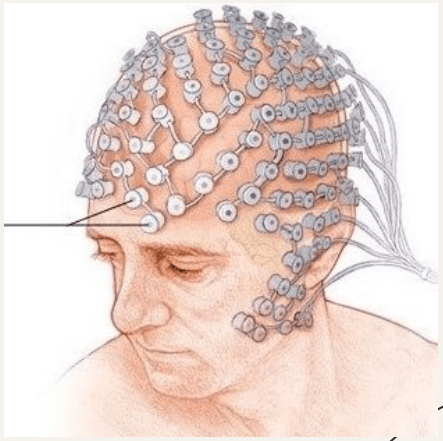
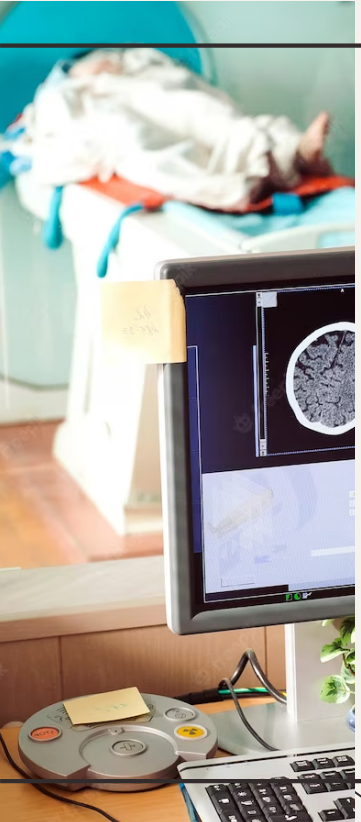
***Electroencephalogram(EEG)*:** Various types of EEG signals have been used in BCI studies to serve as BCI control signals.

Some of the techniques to obtain signals are: P300 evoked potentials, steady-state visual evoked potentials (SSVEP) and motor imagery (MI) are the most popular signals. In this paper MI was studied.

In this paper we have a mobile dataset of participants carrying out ERP task and SSVEP task of which we are focusing on SSVEP. The speeds used to create the mobile environment given are: 0, 0.8, 1.6 and 2 ms-1.





How does SSVEP work?

1) Visual Stimulation

2) Electrophysiological Measurement(EEG)

3) Preprocessing and classificaton

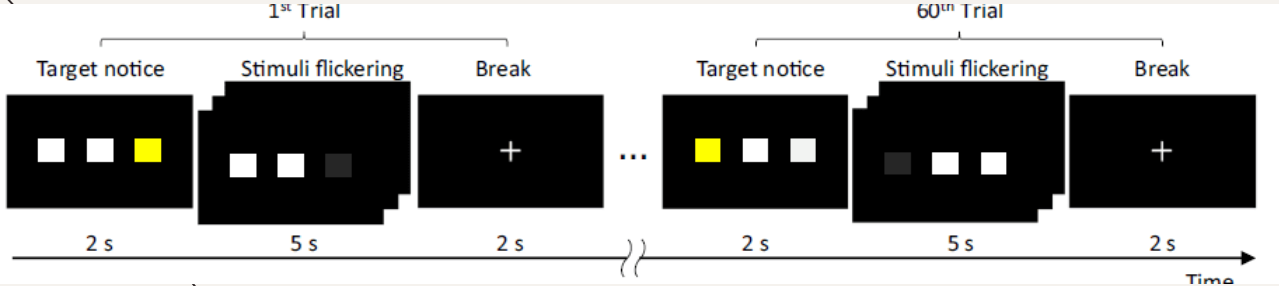
4) Finally this can be used for communication and control.

Users can focus their attention on different flickering stimuli corresponding to different commands, and the system can decode their intended actions based on the detected SSVEP frequencies.

Procedure In the given paper:

In this paper three visual stimuli were there at the left, center and right. The frequencies ta which they flickered were at 60/11, 60/7 and 60/5 Hz. The need is to classify these signals from the obtained EEG signals which was done using canonical correlation with original sinusoidal signals of the corresponding frequency,

The experiment was repeated for each speed and continued for 60 trials in the process shown below.



Results for SSVEP paradigm:

For Ear EEG:

Measure	Accuracy (%)				SNR			
Speed	0 m/s	0.8 m/s	1.6 m/s	2.0 m/s	0 m/s	0.8 m/s	1.6 m/s	2.0 m/s
AVG	53.19	44.78*	39.57*	33.30*	1.21	1.09*	1.03*	1.27

For Scalp EEG:

Measure	Accuracy (%)				SNR			
Speed	0 m/s	0.8 m/s	1.6 m/s	2.0 m/s	0 m/s	0.8 m/s	1.6 m/s	2.0 m/s
AVG	88.70	83.12*	80.65*	54.76*	2.64	2.14*	1.92*	1.94*

The accuracy is found to be very low for ear EEG in stationary and mobile dataset due to the location of its channels being far from the occipital cortex.

However it has higher usage due to its higher stability, portability and robustness.

Preprocessing steps already taken:

- High Pass fifth order Butterworth Filter set above 0.5 Hz
- EOG removal using flt_eog function
- Line Noise Removal using flt_clean_channel
- Interpolation
- Down-sampling to 100 Hz
- Segmentation from 0-5 s after start of the trial

Potential preprocessing steps to be taken:

- Indpendent Component Analysis
- Applying spatial filters as CSP or Laplacian filters

Thanks!