Subconscious Image Tagging using Human Computation and Brain-Computer Interfaces

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SUMMARY

An experiment was ran with human subjects to determine whether image tagging with an Emotiv EPOC headset (a consumer-grade brain-computer interface device, shown in **Fig. 1**) is feasible by detecting changes in the subject's electroencephalogram (EEG) signals when shown two classes of stimuli: soccer and rugby.

Fig. 1: Emotiv EPOC EEG

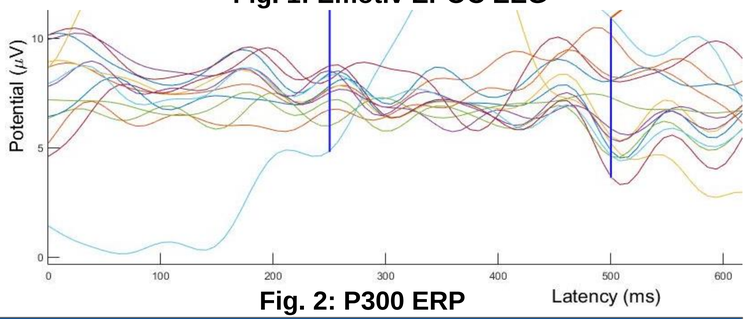

Fig. 2: P300 ERP

ANALYSIS

In the experiment, we look for signs of various event-related potentials (ERPs) that occur at various time intervals after a participant is presented with a stimulus (an image from one of the two classes, in this case).

- N170 (130 – 200 ms)
- N200 (200 – 350 ms)
- N400F (300 – 500 ms)
- P300/N400 (250-500 ms)**(Fig. 2)**
- P600F (500-75 0ms)
- Visually Evoked Potentials (50–90, 190-600 ms)

- A MATLAB script prepares data for filtering with EEGLAB, a MATLAB toolbox for filtering noise from EEG data.
- After filtering, the script utilizes support vector machines (SVMs) to determine whether the participant elicited the correct response to an image of a particular class.

BACKGROUND

- Millions of images are uploaded to the Internet every day, but there are no guidelines to provide appropriate descriptions for future image retrieval.
- Image labelling is difficult for computers utilizing complex algorithms.
- Humans, on the other hand are extremely good at this. We can make a split second determination of the content of an image.
- We propose that we exploit this advantage by utilizing electroencephalography (EEG) data captured by a consumer-grade brain-computer interface (BCI) while its user thinks of a word that describes images that flash on a screen and in theory, engages in tagging an image.

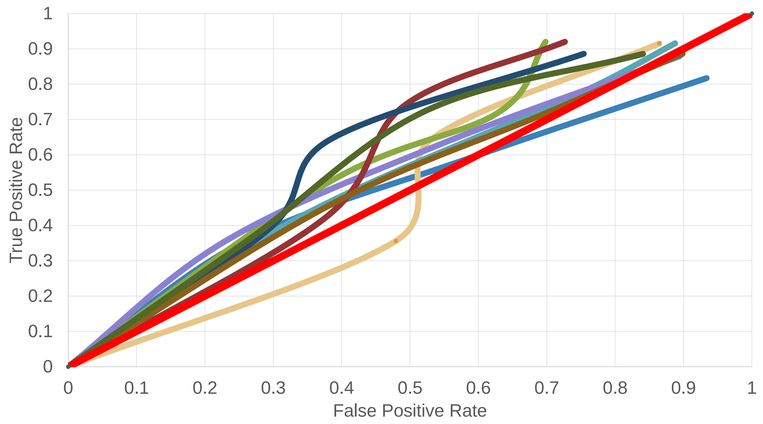

Fig. 3: ROC curve

PROJECTED RESULTS

- We will try to associate the timing of an ERP spike and the timing of the various stimuli that were shown to differentiate between the brain responses from a participant when shown images from two classes to tag images that were shown on the screen.
- We expect to find a sufficient change in EEG signals to tag (with a good degree of accuracy) two different images from different classes and hopefully outperform current computer vision image tagging techniques. **(Fig. 3)**

EXPERIMENT SETUP

- A participant is given a task while wearing an Emotiv EPOC headset. **(Fig. 1)**
- The participant followed instructions that were displayed through a web interface.
- They were asked to think of a word that best described an image that was shown on a screen.
- Each image was shown for 1 second.
- 210 images were shown in total. **(Fig. 2)**
- The photos contain an even number of photos from two classes, soccer and rugby. **(Fig. 4)**

Fig. 4: Images used for the experiment

FINAL REMARKS

We hope the result of this research will make a significant contribution to the field of image tagging. The proposed classification technique could be useful in a variety of practical and research applications, such as improvements to marketing, computer vision, content filtering, and improving the accessibility of web pages for those who are visually impaired. The results of the implicit experiment will be conclusive once they have been conducted in the near future.

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