Data Article

Dataset for EEG signals used to detect the effect of coffee consumption on the activation of SSVEP signal

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ABSTRACT

A set of electroencephalogram (EEG) data was obtained in the National Institute of Technology, Rourkela, India, from six individuals in the presence of seven photic stimuli of different frequencies (range: 3 Hz–30 Hz). The EEG data were recorded prior to, and post-consumption of caffeinated coffee for detecting the influence of coffee consumption on the initiation of steady-state visual evoked potential (SSVEP) signals in different regions of the brain. The data supports the article: “Data mining-based approach to study the effect of consumption of caffeinated coffee on the generation of steady-state visual evoked potential signals” [1]. The obtained dataset can also be used to have more insight into the brain response during the post-consumption of coffee using different feature extraction, classification, and SSVEP signal detection techniques.

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1. Data

The steady-state visual evoked potential (SSVEP) is generated in the parieto-occipital regions of the brain whenever a source of light of constant stimuli frequency, is focused on the retinal cells [2,3]. Caffeine, an essential constituent of coffee, is believed to have a partial impact on different brain regions such as parietal and occipital cortex areas [4,5]. The current data set can be used to evaluate the post-consumption effect of coffee on the SSVEP activity in the brain regions. The EEG signals were recorded using a clinical EEG acquisition machine (RMS Maximus 32 CH). The equipment has 22 EEG channel electrodes, 2 mastoid electrodes, 1 ground electrode and two limb electrodes for ECG recording. The EEG electrodes were placed on the brain following the 10:20 standard positioning (Fig. 1). The sampling frequency of the recording was maintained at 256 Hz.

The recorded EEG data from a single volunteer contains the embedded signal of 7 different photic stimulus frequencies of 20s duration and the resting period of 10-sec in between two stimuli frequency. The useful 20s duration data can be divided into different trials of varying length to increase the sample size as per user requirement. The EEG data of each volunteer was stored in a.mat file, represented in the format of "Vn_B" and "Vn_A", where n represents the serial number of volunteers, and B and A represent before coffee and after coffee consumption condition, respectively. Information regarding the data collected is presented in Table 1. Each.mat file contains a 7X2 cell array. The first column of the cell array contains the EEG signal in a 5120X23 matrix format, and the 2nd column contains the corresponding photic stimulus frequency. The number of rows in each data matrix is equal to the number of data points (256X20 = 5120) and the first 22 columns contains the corresponding amplitude value of each EEG channel (FP1, FP2, PG1, PG2, F7, F3, FZ, F4, F8, C3, CZ, C4, P3, P4, PZ, T3, T4, T5, T6, O1, O2, and OZ) at that data point. The last column contains the amplitudes of a single lead ECG signal (Fig. 2) during the recording.
2. Experimental design, materials, and method

This experiment is based on a within-group analysis that consists of two stages. In stage 1, EEG signals were acquired in the presence of seven photic stimuli frequency (3 Hz, 5 Hz, 10 Hz, 15 Hz, 20 Hz, 25 Hz, and 30 Hz). In stage 2, EEG signals were recorded 5 min after consumption of caffeinated coffee following the same protocol as in stage 1. Two types of stimuli were used in this experiment. A primary, photic stimulus of a certain frequency (to generate the SSVEP response) and a secondary stimulus, caffeinated coffee (to find the effect of coffee consumption on SSVEP). The stimuli frequency values used in this experiment were chosen in such a way that it will cover all the EEG bands (Table 2) [6].

Six healthy male volunteers, who are living a sedentary life and frequent coffee drinkers, were included in this experiment. Prior to recording, permission from the Institute ethical committee

Table 1
The data of recorded EEG signals.

| Volunteer ID | Age (in years) | Sex | Stimulus condition (Caffeinated Coffee) | .mat file |
|--------------|----------------|-----|---------------------------------------|-----------|
| 001          | 23             | Male| Before                                | V1_B      |
|              |                |     | After                                 | V1_A      |
| 002          | 29             | Male| Before                                | V2_B      |
|              |                |     | After                                 | V2_A      |
| 003          | 21             | Male| Before                                | V3_B      |
|              |                |     | After                                 | V3_A      |
| 004          | 25             | Male| Before                                | V4_B      |
|              |                |     | After                                 | V4_A      |
| 005          | 24             | Male| Before                                | V5_B      |
|              |                |     | After                                 | V5_A      |
| 006          | 26             | Male| Before                                | V6_B      |
|              |                |     | After                                 | V6_A      |
(NIT Rourkela) was taken for the recording of the EEG signals vide office order #NITRKL/IEC/FORM/2/35/4/11/001, Dated 13/12/2013. The participants were explained the detailed procedure and purpose of the experiment. Further, they were urged to sign a consent form as a record of agreement of their voluntary participation in the experiment. The consent form was prepared following the guidelines of WHO’s (World Health Organisation) informed consent for clinical study as a reference [7] and is divided into three parts. Part-I contains the information related to the research, part-II contains the Information related to the volunteers and part-III contain the declaration made by the participant. A sample consent form has also been attached as a supplementary file. Fig. 3 shows the different sections of the consent form, used in this experiment. The volunteers were also assured that they can leave the experimental procedure at any time if they feel uncomfortable or change their minds.

The EEG signals were recorded using a 32-channel EEG machine, capable of recording 22 EEG signals from different brain regions. The electrodes were placed on the scalp using an electrode cap. The electrodes on the cap were arranged following the 10–20 international standard configurations. After mounting the electrode cap, the contact impedances of the electrodes were adjusted to <20 KΩ. This was achieved by applying a conducting gel on the electrode scalp interface. The sampling frequency of the recording was maintained at 256 Hz. The volunteers were instructed to abstain from food and beverages before 2 h of recording. During recording, they were asked to sit on a chair inside a dim-lit room in a relaxed position. A set of LED was placed in front of their eyes at a distance of 60 cm. The LEDs were made to flicker at seven different frequencies (3 Hz, 5 Hz, 10 Hz, 15 Hz, 20 Hz, 25 Hz, and 30 Hz). The volunteers were requested to stare at the flickering light source during the process of EEG recording. The LED flickered at each stimulus frequency for a period of 20s with a 10s gap between two

| Frequency Band | Range of Frequency (in Hz) | Frequency considered in this study (in Hz) |
|----------------|---------------------------|------------------------------------------|
| Delta          | 0–4                       | 3                                        |
| Theta          | 4–8                       | 5                                        |
| Alpha          | 8–13                      | 10                                       |
| Low-beta       | 12.5–16                   | 15                                       |
| Beta           | 16.5–20                   | 20                                       |
| High-beta      | 20.5–28                   | 25                                       |
| Low-gamma      | 30–100                    | 30                                       |
consecutive frequency stimulation. In the first phase, the EEG signals were recorded without any stimulus (pre-consumption of coffee). In the next phase, the volunteers were served a hot cup of coffee (120 ml containing 1.5 mg of coffee powder). After 5 min of consumption, the EEG signals were re-recorded following the same protocol.

**Conflict of Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Appendix A. Supplementary data**

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105174.

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