MetroXRaine competition - Emotion dataset

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1 Experimental Paradigm

The dataset contains the EEG data of 26 subjects. One session was recorded for each subject. An ad-hoc experimental protocol was implemented to induce in the participants different emotional states. The *circumplex model of affect* [1] was the reference theory adopted. Specifically, positive/negative valence and high/low arousal were elicited by projecting a random sequence of IAPS [2] images. Subjects had to passively watch at the pictures and they were not instructed to get into the desired mood. Before the start of the experiment, the subjects were informed about the purpose and the methods. They were also instructed to limit their movements during the tasks. The entire EEG acquisition lasted about 27 min.

The overall experimental protocol is resumed in Fig. 1.

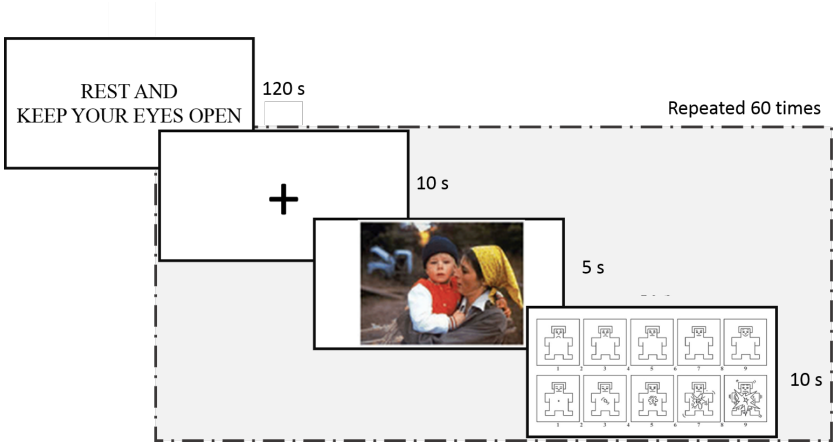


Fig. 1: Experimental protocol

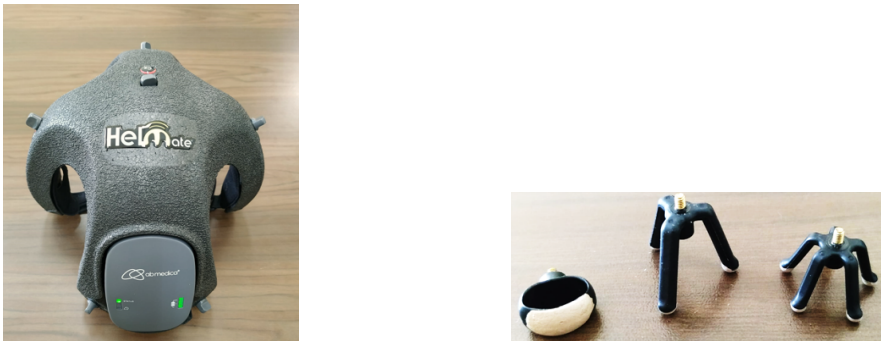
60 images polarized along the valence and arousal dimensions were selected. Specifically, the scores for the valence dimensions were: (i) (mean 7.02 $\pm$ 0.55)

for positive valence, and (ii) (mean 2.93 ± 0.78) for negative valence. The scores for the arousal dimensions were: (i) (mean 6.45 ± 0.34) for high arousal, and (ii) (mean 3.67 ± 0.41) for low arousal. The use of a polarized subset of stimuli contributed to maximize the effectiveness of the emotion induction. 30 images for each emotional state were chosen. The images were chosen including all types of content to be as varied as possible. The experiment started with 120 s rest with open eyes. The projection phase followed. 10 s fixation cross were showed to the participant before the image projection in order to separate emotional states mutually and to draw the subject's attention to the center of the screen. Each eliciting image was projected for 5 s and was followed by 10 s of self report through the Self-Assessment Manikin (SAM) questionnaire. The subject had to evaluate the valence and the arousal levels of the image on a scale from 1 to 9. Through a special interface, he could directly press the button corresponding to the desired value with the mouse. The proposed applications was developed using Unity (version 2019.4.4f1, Personal 64 bit for Microsoft Windows) as game engine.

The EEG signal was acquired, transmitted and stored using Simulink (Matlab v. R2021b). Simulink and Unity communicated via UDP protocol: Unity sent Simulink start and end messages for each task. Row EEG data and the information related to the start and end time of the task were stored for post acquisition processing.

2 Data recording

The EEG signals were recorded through the *ab medica Helmate*. The device is class IIA certified according to the EU regulation 2017/745. The headset



(a) EEG cap (b) Dry electrodes

Fig. 2: EEG acquisition system.

is equipped with 10 dry electrodes made of conductive-rubber and coated with Ag/AgCl. Channel placement follows the 10/20 International Positioning System

and the provided positions are: Fp1, Fp2, Fz, Cz, C3, C4, O1, and O2. AFz is the reference electrode while Fpz is the ground. The electrode placement is shown in Fig. 3. Electrodes have different shapes to reach the skin passing through the hair. The EEG acquisition system and the dry electrodes are shown in Fig.2a and Fig.2b, respectively. The Helmate integrates the ADS1298 analog front-

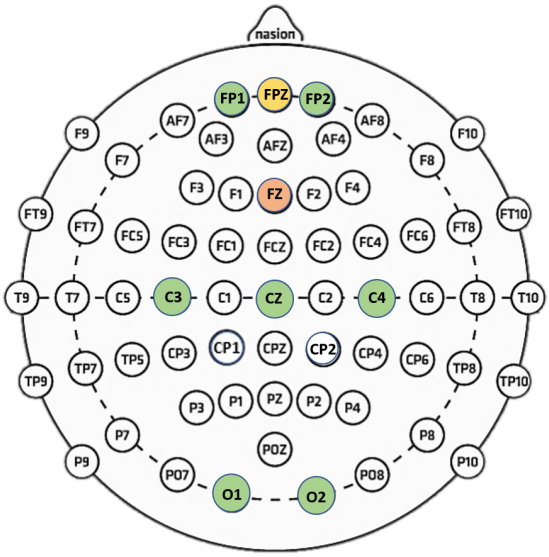


Fig. 3: Electrodes placement

end from Texas Instruments, with a multi-channel simultaneous sampling, and a 24-bit $\Delta\Sigma$ analog-to-digital converter (ADC). Analog signals are analog filtered and amplified with a nominal pass-band from 0.2 Hz to 70 Hz with the 50 Hz notch filter enabled. The EEG signals are acquired at a sampling frequency of 512 Sa/s. The device has a rechargeable battery and a Bluetooth connection for data transmission. The Helm8 software manager allows to check the contact impedance between the electrodes and the scalp and the real-time visualization of the EEG data. It also allows a simple pre-processing of the EEG signals.

3 Data file description

All data sets are stored in the *.mat* extension, one file for each subject. Each *.mat* file contains two structures, namely *Data* and *Notes*. The first one provides the operational data, the second one provides general information. The structure of stored data is shown in Fig. 4.

In turn, data contains nine fields:

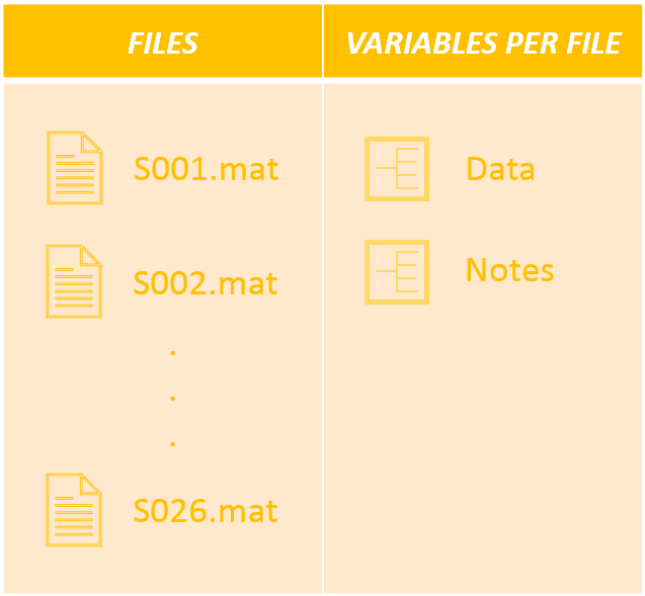


Fig. 4: Structure of stored data.

- X is a NxM matrix, where N is the channels number and M is the samples.
- *Trial* is a vector of length 60 containing the trial start samples.
- *Fs* is the sampling frequency;
- y is a vector of length 60 containing the labels. *y_IAPS_valence* and *y_IAPS_arousal* are the labels obtained from the valence and arousal scores provided by the IAPS dataset for each image. *y_SAM_valence* and *y_SAM_arousal* are the labels obtained from the ratings provided by the participants for each image. *Classes* is a 1x2 cell containing the task associated to the labels, both for valence (*Classes_valence*) and arousal (*Classes_arousal*);

Notes contains general information such as the age, gender and ID of the subject, the date on which the signals were acquired, the reference and ground electrode positions, and a 1x8 cell containing the name of the channels (sorted as the rows of the matrix X).

The EEG data of three participants will be made available after the deadline of the competition in order to test the classifier and evaluate the performance.

References

1. J. A. Russell, "A circumplex model of affect." *Journal of personality and social psychology*, vol. 39, no. 6, p. 1161, 1980.
2. P. J. Lang, "International affective picture system (iaps): Affective ratings of pictures and instruction manual," *Technical report*, 2005.