BrainLab

Towards Mobile Brain Research

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Electroencephalography (EEG) is a non-invasive method for measuring electrical activity in the brain and crucial for the detection and evaluation of neurological and psychological disorders. However, it traditionally requires complex hardware and computing set-ups restricting its application to clinical environments. Therefore, the use of classical EEG systems provides low accessibility which is particularly disadvantageous for health care in regions with limited infrastructure. Furthermore, traditional EEG restricts subjects in terms of their movement limiting research.

We present BrainLab, a mobile system for brain research consisting of a mobile Android application combined with a wireless consumer EEG device. Since the chosen EEG device is primarily a headset, it is placed easily while data acquisition is enabled via Radio/Bluetooth. At the same time, visual and auditory experiments can be conducted on the mobile device measuring the reaction of the brain to predefined events. Implementation of experiments is possible without previous programming knowledge using a simple structured text file. The recorded data containing brain reactions and occurrences of the stimuli can be exported using the common EDF format or, in the future, be analyzed directly on the mobile device without an Internet connection. For this purpose, we embedded a visual programming interface into BrainLab allowing loading and plotting of records as well as basic processing. Further functions are in development. To evaluate BrainLab, several experiments regarding usability and functionality were conducted until now, including the replication of a scientific EEG experiment.

In the course of the evaluation, brain activity recorded with BrainLab was confirmed to appear valid by an expert while known brain reaction to specific stimuli was detectable in the data. Furthermore, the average cross-correlation between the signals at the electrodes and the recorded signals was calculated to be 0.9875. This shows that no significant distortion is induced through the recording process. Usability of BrainLab was evaluated in a pilot study using the questionnaire ISONORM 9241/10. Here, we achieved good mean scores in the fields “suitability for the task” (2.3 points on a -3 to 3 scale), “conformity with expectations” (2 points) and “suitability for learning” (1.8 points). However, improvements are possible regarding “suitability for individualization” (0.8 points), “error tolerance” (0.4 points), “controllability” (0.5 points) and “self-descriptiveness” (0.4 points).

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The evaluation results show that our system already allows for fully mobile and feasible EEG based experiments in an arbitrary environment while being well suited for use by inexperienced users.

To conclude, BrainLab is a promising starting point for mobile brain research. It allows for the creation and conduction of custom experiments while recording brain reactions to specific stimuli. Enabling analysis and interpretation of the resulting data on the mobile device without additional infrastructure is currently in progress. Even though quality of the measurements is limited in comparison to clinical EEG systems, our research shows that BrainLab may have the potential to be a feasible approach for screening for the presence of neurological disorders. Thus, BrainLab holds the potential to improve accessibility to neurological examination.