[Poster] An Affective Evaluation Tool Using Brain Signals

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ABSTRACT

We propose a new interface evaluation tool that incorporates affective metrics wich are provided from the ElectroEncephaloGraphy (EEG) signals of the Emotiv EPOC neuro-headset device. The evaluation tool captures and analyzes information in real time from a multitude of sources such as EEG, facial expressions, and affective metrics such as frustration, engagement and excitement. The proposed tool has been used to gain detailed affective information of users interacting with a mobile multimodal (touch and speech) iPhone application, for which we investigated the effect of speech recognition errors and modality usage patterns.

Author Keywords

Usability research; Affective evaluation; Evaluation tool; Brain signals; EEG; iPhone

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: Miscellaneous

INTRODUCTION

Traditional evaluation metrics may offer detailed usage of an interface but only offer a limited view of user interaction experience and the percieved quality of the interface. For example, multimodal spoken dialogue systems are traditionally evaluated with objective metrics such as interaction efficiency (turn duration, task completion, time to completion), error rate, modality selection and multimodal synergy [2]. Incorporation of affective information [3] can potentially provide a better understanding of the interaction process from the user perspective. In this work, we investigate the use of EEG elicited affective metrics for the evaluation of interactive systems with the development of a dedicated tool described in the following section. We argue that incorporation of physiological channels and their elaborated interpretation is a challenging but also a potentially rewarding direction towards emotional and cognitive assessment of interaction design.

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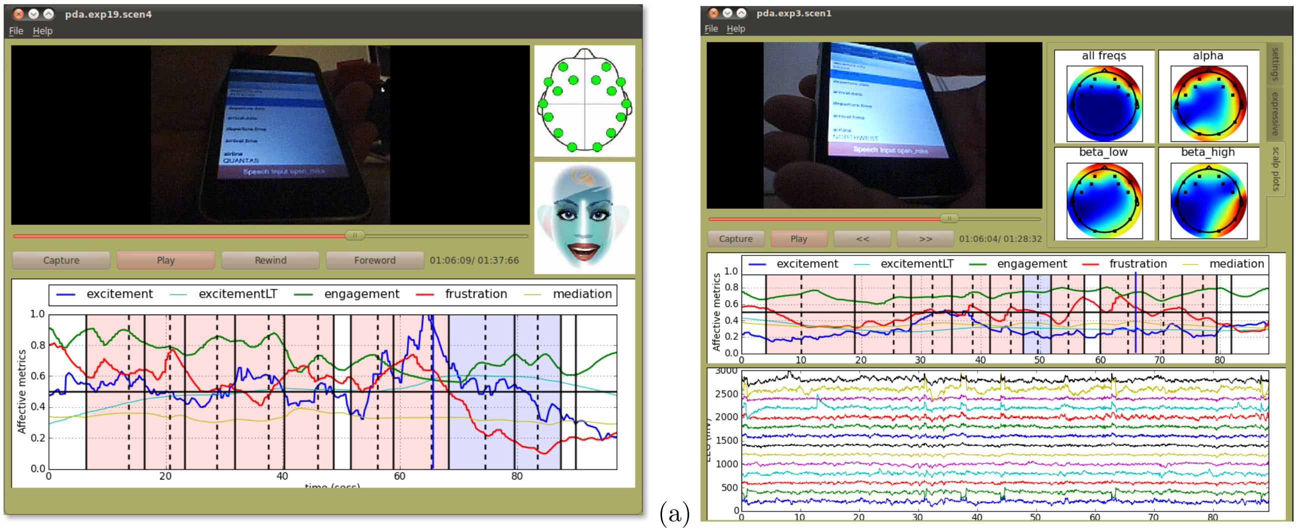
Figure 1. Evaluation setting used for the multimodal iphone application. Depicted counter clockwise is the iPhone device, the GSR apparatus the Emotiv device, the audio headset and the PlayStation Eye camera.

AFFECTIVE EVALUATION STUDIO

The EEG device used is the Emotiv EPOC[1], a 14 electrode wireless neuroheadset device (see Fig. 1). The Emotiv SDK provides a suite of detections, such as affective, expressive and cognitive. The affective suite provides affective metrics such as frustration, engagement and excitement, while the expressive suite detects user's face expressions.

A dedicated tool was developed to collect in real time, data from the Emotiv device (affective and EEG[2]) and a video camera (which records users interacting with the evaluated system). Screenshots of the affective studio are shown in Fig. 2 for the standard and research (which additionally provides raw EEG signals) versions of the Emotiv SDK respectively. The tool was used to capture, record, replay and analyze user evaluation sessions with a multimodal interaction system described in [2]. A short list of its capabilities include:
In capture mode, real time data from Emotiv device and video camera are captured. This is useful for the examiner to check and resolve any problems such as the correct contact quality of Emotiv or GSR. In recording mode, affective, EEG and video data are all concurrently saved while also been displayed for the duration of the interaction session. The real time information allows the examiner to fully monitor the evaluations session. In play mode, data are displayed, annotated and analyzed (e.g., affective annotations and EEG spectrograms and scalpmaps - see Fig. 2(b)) offering valuable insights for the course of an interaction session.

[1] `http://www.emotiv.com`
[2] GSR data were also collected during the evaluation.



(a) (b)

Figure 2. Screenshots of the affective evaluation studio replaying previously recorded sessions. (a) Standard edition. The two main components depicted are the video and affective plot (see Fig. ??) widgets. The vertical blue line indicates the playing position in the affective data corresponding to video frame displayed. The user can click on any position of the plot to move in that particular moment in the video stream or vice versa using the video slider. The two widgets in the right of the video widget display the 14 electrode contact quality and the user face expression widget. (b) Research edition. Offers additional EEG processing capabilities such as EEG plot (found below affective plot) and single channel analysis plot and spectrogram (shown when selecting specific channel). It also provides real time scalp plots (next to video widget) which show EEG power distribution for selected spectrum bands animated through time.

The Studio serves as a valuable tool for inspecting in detail how users interact with the system in real time. This allows the person conducting the evaluation studies to easily monitor the quality of interaction, to find hot spots, i.e. parts of interaction that may cause frustration or parts of interaction that engage and excite users. Additionally, since these values constitute a real time stream of information, data mining, and classification algorithms can be applied; for example to categorize parts of interaction, build user profiles, or adapt the system to users.

AFFECTIVE EVALUATION CASE STUDY

We used the Affective Evaluation Studio for the detailed evaluation analysis of a multimodal mobile application for the iPhone. The evaluated application [2] [3] is a dialogue based travel reservation application that uses both GUI(touch) and speech modalities.

We investigated the affective patterns of speech recognition errors and associated repairs. Overall, we have found that speech recognition errors lead to increased frustration levels, followed by higher excitement levels. In addition, affective interaction patterns vary significantly by input modality. Speech input (when compared with touch input) is associated with higher excitement and frustration levels (probably due to speech recognition errors) and lower engagement (probably due to speech being the more natural interaction modality).

CONCLUSIONS AND FUTURE WORK

Incorporation of biosignals such as EEG in the user experience design process, provides a rich amount of data not previously available. The software tool presented in this work provides a first step towards collecting and analyzing in real time physiological signals for affective evaluation of use interface evaluation. We have also found that the use of affective signals can provide significant insight during evaluation which can be exploited in the UI design process.

In the future, we intend to further augment the capabilities of the system with: 1) Incorporation of multimodal sensors (e.g. EEG, GSR, EKG, etc). 2) Incorporation of error related negativity potentials (ERNs)[1] to detect user error responces 3) Cognitive load estimation (that relates to the perceived mental effort) using the physiological signals 4) Integration with an eye-tracker to better estimate visual attention, engagement and cognitive load (pupilometry).

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[3]For a video demonstration see `http://goo.gl/rIjS3`