Chapter 9
Monitoring User’s Emotions Using Brain Computer Interfaces

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ABSTRACT

This chapter discusses the use of commercial Brain Computer Interfaces to monitor the emotions and interactions of a subject as they use a system. Tracking how a user interacts with a system, and the emotion-based responses that are invoked as they interact with the system, yield very valuable datasets for the development of intelligent, adaptive systems. The proliferation of mobile devices as an emerging platform offers scope for the development of the relationship between Brain Computer Interfaces and mobile technology, towards ubiquitous, minimally invasive, mobile systems.

INTRODUCTION

Recent growth in the eLearning sector has resulted in the rising popularity of interactive and adaptive systems as learning tools. Mobile learning, interaction design and serious game design are all areas that are expanding as the mobile device market grows. Learning and assessment go hand in hand, and the importance of monitoring the learning progress of a user is paramount to any pedagogical tool. In fact, monitoring the interaction of a user with any system is a very important task. Gathering information on how the user interacts with a system/device can provide invaluable data to the system, the designer, the instructor and even the user themselves. With growth of ubiquitous computing, how a user feels is also very valuable feedback data for intelligent and adaptive systems.

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The growth of mobile devices, along with advances in minimally invasive wearable sensors, offers promising scope for the development of intelligent, adaptive, sensor-based mobile devices. What applications are there for such devices? This chapter discusses Brain Computer Interface systems and some of their applications when used with mobile devices. We discuss the state of the art in mobile Brain Computer Interfaces and their role in tracking user response and interaction with a system, as well as highlighting the benefits, drawbacks and scope of using BCI mobile devices to monitor user’s emotions and interactions. Studies will be reviewed that reflect how BCIs can be used to measure secondary data (e.g. emotional response data) relevant to assessment, learning and emotional response.

BACKGROUND

User Interaction

As a subject uses a system, a large amount of data can be gathered including assessment and interaction data. This data can be categorized into primary and secondary data. Primary data is any essential information that must be collected by the assessment process. This would include answers or responses given by the user to the system, for example, multiple-choice questionnaires. A system is usually designed with the purpose of gathering such primary data. Secondary data is data that is often indirectly captured within a scenario or during an interaction, and that helps advance the system or assessor’s understanding of the user’s action.

There are various reasons why it relevant to monitor how a user interacts with a system. Monitoring how a subject uses a system makes the system interactive and potentially adaptive, and this feedback is important for intelligent human-computer interaction. The most effective models for interactive systems work with a three phase approach: (1) Evaluate (2) Compare (3) Adapt. The evaluation phase can consist of assessing primary or secondary data. Monitoring secondary data such as how a user interacts with a mobile device can be a minimally invasive method of developing an intelligent, adaptive, interactive system.

An array of literature exists in the human-computer interaction domain that highlights the relevance and importance of monitoring and tracking user interaction and experience (Goecks, 2000; Cockburn, 2001; Jacob, 2003; Thüring, 2007; Coyle, 2008). Dedicated disciplines have been established that are concerned with understanding how the user interacts with a system in order to improve system design (interaction design), user experience (usability), augment user feedback (human factors) and enhance learning, to name but a few. Maglio et al (2000) believe that the future of user interaction with pervasive devices lies in attentive user interfaces (AUI), systems that attend to user actions by monitoring the user through sensing mechanisms such as gaze, speech, hand gestures, or by multimodal devices that track keystrokes, mouse input or even accelerometer actions.

Attentive systems can monitor user behavior, model user goals and interests, anticipate user needs, provide users with information and interact with users. A system that monitors user interactions can, for example, assess the ability or learning style of a subject and adapt the difficulty (or other parameter of the system) accordingly (Mehigan, 2012). A system that monitors interactions can profile a user in terms of their response to various aspects of the system; including emotion-based responses such as attention and meditation, which can reflect the applied effort of the subject (Crowley & Sliney, 2011).

Brain Computer Interfaces

A Brain Computer Interface is a communication system in which messages or commands that an individual sends to the external world do not pass