Transactions of the SDPS:
Journal of Integrated Design and Process Science
16 (4), 2012, 3-18
DOI 10.3233/jid-2012-0021
http://www.sdpsnet.org

Pair-Wise Preference Comparisons Using Alpha-Peak Frequencies

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Abstract Understanding of user needs and preferences, and incorporating them into product designs are crucial for new products to be successful in today's highly competitive marketplace. This paper introduces a unique methodology to capture user preferences from biological signals. The proposed method successfully utilizes one of the most complex phenomenons of the human body, bio-signals for preference extraction. Bio-signals are magnetic fields that are generated by the neurons as a response to a person's surroundings. Due to its complexity, interpretation of bio-signals in the form of natural communication channels is extremely difficult. On the other hand, our experiments with potential users of various types of products revealed that detectable shifts from steady state levels of brain signals in the positive or negative direction are strongly correlated with the individual's preferences on alternative designs. From experiments conducted on 14 different subjects we conclude that when the alpha-peak frequencies (EEG signals at the 8–12 Hz band) are captured during a user's interaction with two competing product design solutions, the lower alpha-peak value indicates a higher preference over the competing product for right-sided subjects. The opposite effect is observed for the left-sided subjects.

Keywords: preference extraction, electroencephalography (EEG), alpha-peak, emotional valence, pairwise evaluation

1. Introduction

Capturing customer preferences accurately is an important ability for product designers/manufacturers. Traditionally, companies have used survey techniques, observations and usability tests in order to retrieve user preferences. While user expectations from a product can be collected through surveys and the importance of such expectations can be ranked through prioritization techniques such as Analytic Hierarchy Process (AHP), the interaction between a user and a product and the effect of aesthetics on the user can only be assessed through experiments with products (physical or virtual prototypes) (Akgunduz, 2002). Furthermore, our experiments as well as the literature suggest that, although survey techniques are effective in retrieving user preferences, results may sometimes include situational bias of the participant (Buchanan & Henderson, 1992). From the results of the experiments presented in this paper, we concluded that the confusion of the participant regarding his/her true preferences plays a role in the response. Social trends frequently cause confusion concerning a person's preferences.

In this research, we investigate the possibility of measuring unbiased user preferences from bio-signals. Consequently, we developed a preference extraction methodology from bio-signals using a single electrode (signals are received from only a unique part of the brain using a single receiver). Bio-signals (alpha-peak frequencies, in our case) were collected while an individual interacted with the virtual

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 Published by IOS Press