MEASURING THE USER EXPERIENCE THROUGH PHYSIOLOGICAL SIGNS

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1 Context

The user experience (UX) can be considered an extension of the concept of usability, being more focused on the evaluation of user satisfaction in reach specific goals while interact with the product. But as in usability, UX also considers the efficiency and effectiveness of the user in developing the task. (ARAUJO, 2014)

In order to evaluate users' satisfaction level in usability tests, questionnaires can be applied soon after user interaction with the product or with methods such as think aloud where the user verbally reports all the actions performed during the test. (HERTZUM, 2013) However, it is possible that information regarding user satisfaction will be lost during test development. Even with the help of video recordings, to evaluate the participant's movement and his facial expressions, some of these expressions may be too fast, subtle or difficult to interpret.

The technologies of measurement of physiological signals can aid in the evaluation of the usability tests, identifying these small variations that cannot be perceived by direct observation or recordings. Micro expressions, such as the contraction of the muscles of the face, variation in the level of sweating, among other organic variations, can help in assessing the level of satisfaction of the user while interacting with the product. But specialized measuring equipment is required to capture data from these variations. (ALBERT & TULLIS, 2013)

This study aims to identify the main physiological measurement equipment that can be used in usability tests and to discuss the general aspects of each of these technologies.

2 Method

This research was performed a systematic literature review (SLR) based on the method Sampaio and Mancini (2007). The authors describe the development of the systematic review of the literature in five stages:
1. Define the question;
2. Search the evidence;
3. Review and select studies;
4. Analyze the methodological quality of the studies;
5. Show the results.

Following the method proposed by the authors, the research question was defined:

- What are the main measuring physiological signals equipment, non-invasive or non-invasive, that can be used to quantify the level of user satisfaction in usability tests?

The search for evidence came in two of the major international databases: Web of Science and Scopus. We analyzed all the articles from the searches with the string: "physiological signal" AND ("user experience" OR satisfaction).

The articles identified in the databases have undergone two review stages to be considered relevant to the research. The first stage was based on the analysis of the title, keywords and summary of the articles found. The second step was the complete analysis of the articles that were selected in the previous stage, and the criterion of selection of the works was the level of contribution to answer the question of research proposed. The studies that did not show relevant contributions regarding the identification of emotions through physiological signals were excluded from the research.

3 Results

In total, 29 articles were found in the Scopus and Web of Science databases for evaluation. After evaluating the titles, keywords and abstracts, 18 articles with potential relevance for the research were filtered. After reading these articles, 10 articles with relevance to the theme were selected.

Almost all articles had a maximum of five citations, and three articles do not have any citation, except for the article by Nacke, et al. (2010) with forty-nine citations. This large number of citations can be explained by the consistency of the study, due to the great depth in the statistical analyzes of the data obtained by the researchers. Data referring to the number of citations were obtained using the Google Scholar database.

Half of the studies in addition to using the physiological measurement equipment to gauge the user's emotions during a task propose a new way of using this equipment. New methods of analysis have been proposed as well as the development of systems

that use various physiological signals to automatically measure the emotions of individuals during the tests.

In articles that work with emotional states such as frustration, immersion and boredom the use of electroencephalogram is more frequent. The exception in this SLR was the article by Foglia and Zanda (2014) that measure states such as boredom and concentration without the use of an EEG. Even with the divergence of this article, it is possible to assume that, for the development of usability tests and user experience, the EEG would be the most appropriate equipment, since research in this area values the measurement of user satisfaction levels while interacting with the product.

The equipment that appeared more frequently, in more than half of the articles were: Skin conductance (7 articles); Heart rate (6 articles); and electroencephalography (5 articles). These devices were used in conjunction with at least two more physiological measuring devices, including or not skin conductance and heart rate, except for one article, where the electroencephalography was exclusively performed. The use of various equipment can be explained by the presence of interference in the physiological signals, as described by Nacke et al. (2010), as well as by the suitability of the equipment for a certain emotion. In this way the identification of emotions in relation to the physiological changes becomes more precise.

4 Conclusions

The objective of the work was reached through the systematic literature review method proposed. The technologies present in all selected papers were identified and described, being analyzed as proposed by Sampaio and Mancini (2007). The selected articles were analyzed and discussed in this paper, as well as the 10 technologies discussed in this work.

Even with the difficulties of accessing the presented technologies, its use in the area of usability and user experience can be considered promising. The use of physiological measurement equipment in these areas can lead to a new level of understanding of both the users' emotions and their needs. These contributions can go beyond the academic area, helping in the development of products and systems that best suit the needs and capacities of its users.

5 References

1. ALBERT, William; TULLIS, Thomas. Measuring the user experience: collecting, analyzing, and presenting usability metrics. Newnes, 2013.
2. ARAUJO, F. S. Avaliação da Experiência do Usuário: uma proposta de sistematização para o processo de desenvolvimento de produtos. Tese (Doutorado), Universidade Federal de Santa Catarina, Florianópolis. 2014.

3. FOGLIA, Pierfrancesco; ZANDA, Michele. Towards relating physiological signals to usability metrics: a case study with a web avatar. WSEAS Trans. Comput, v. 13, p. 624-634, 2014.
4. HERTZUM, Morten; HOLMEGAARD, Kristin Due. Thinking aloud in the presence of interruptions and time constraints. International Journal of Human-Computer Interaction, v. 29, n. 5, p. 351-364, 2013.
5. NACKE, Lennart E. et al. Electroencephalographic assessment of player experience: A pilot study in affective ludology. Simulation & Gaming, 2010.
6. SAMPAIO, Rosana F.; MANCINI, Marisa C. Estudos de revisão sistemática: um guia para síntese criteriosa da evidência científica. Braz. J. Phys. Ther.(Impr.), v. 11, n. 1, p. 83-89, 2007.

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