PhD Presentation: “On data-driven systems analyzing, supporting and enhancing users’ interaction and experience”

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Abstract

This is the presentation of the Juan Cruz-Benito’s PhD “On data-driven systems analyzing, supporting and enhancing users’ interaction and experience” that was defended on September 3rd, 2018 in the Faculty of Sciences at University of Salamanca Spain. This PhD was graded with the maximum qualification “Sobresaliente Cum Laude”.

The research areas of Human-Computer Interaction and Software Architectures have been traditionally treated separately, but in the literature, many authors made efforts to merge them to build better software systems. One of the common gaps between software engineering and usability is the lack of strategies to apply usability principles in the initial design of software architectures. Including these principles since the early phases of software design would help to avoid later architectural changes to include user experience requirements. The combination of both fields (software architectures and Human-Computer Interaction) would contribute to building better interactive software that should include the best from both the systems and user-centered designs. In that combination, the software architectures should enclose the fundamental structure and ideas of the system to offer the desired quality based on sound design decisions.

Moreover, the information kept within a system is an opportunity to extract knowledge about the system itself, its components, the software included, the users or the interaction occurring inside. The knowledge gained from the information generated in a software environment can be used to improve the system itself, its software, the users’ experience, and the results. So, the combination of the areas of Knowledge Discovery and Human-Computer Interaction offers ideal conditions to address Human-Computer Interaction-related challenges. The Human-Computer Interaction focuses on human intelligence, the Knowledge Discovery in computational intelligence, and the combination of both can raise the support of human intelligence with machine intelligence to discover new insights in a world crowded of data.

This Ph.D. Thesis deals with these kinds of challenges: how approaches like data-driven software architectures (using Knowledge Discovery techniques) can help to improve the users' interaction and experience within an interactive system. Specifically, it deals with how to improve the human-computer interaction processes of different kind of stakeholders to improve different aspects such as the user experience or the easiness to accomplish a specific task.

Several research actions and experiments support this investigation. These research actions included performing a systematic literature review and mapping of the literature that was aimed at finding how the software architectures in the literature have been used to support, analyze or enhance the human-computer interaction. Also, the actions included work on four different research scenarios that presented common challenges in the Human-Computer Interaction knowledge area. The case studies that fit into the scenarios selected were chosen based on the Human-Computer Interaction challenges they present, and on the authors’ accessibility to them. The four case studies were: an educational laboratory virtual world, a Massive Open Online Course and the social networks where the students discuss and learn, a system that includes very large web forms, and an environment where programmers develop code in the context of quantum computing. The development of the experiences involved the review of more than 2700 papers (only in the literature review phase), the analysis of the interaction of 6000 users in four different contexts or the analysis of 500,000 quantum computing programs.

As outcomes from the experiences, some solutions are presented regarding the minimal software artifacts to include in software architectures, the behavior they should exhibit, the features desired in the extended software architecture, some analytic workflows and approaches to use, or the different kinds of feedback needed to reinforce the users’ interaction and experience.

The results achieved led to the conclusion that, despite this is not a standard practice in the literature, the software environments should embrace Knowledge Discovery and data-driven principles to analyze and respond appropriately to the users’ needs and improve or support the interaction. To adopt Knowledge
Discovery and data-driven principles, the software environments need to extend their software architectures to cover also the challenges related to Human-Computer Interaction. Finally, to tackle the current challenges related to the users’ interaction and experience and aiming to automate the software response to users’ actions, desires, and behaviors, the interactive systems should also include intelligent behaviors through embracing the Artificial Intelligence procedures and techniques.

Keywords
Human-Computer Interaction, Software Architectures, Knowledge Discovery in Databases, Data-driven, Data, User Experience, Interaction, Users’ performance, Artificial Intelligence, Machine Learning, Deep Learning, Virtual Worlds, Massive Open Online Courses, Web forms, Quantum Computing, Programming.

Links to the PhD
PhD memory: https://goo.gl/uNd7u6
PhD Extended Abstract (in Spanish): https://goo.gl/5m5LHU

Link to the presentation
https://goo.gl/pwSxDU

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