Thesis Overview:

Methods and tools for the development and evaluation of refactorings to improve the user experience in web applications.

Métodos y herramientas de desarrollo y evaluación de refactorings para la mejora de la experiencia de usuario en aplicaciones web

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Motivation

User experience (UX) is a crucial factor that determines the success of web applications. While the importance of providing an optimal user experience is recognized, UX evaluation and improvement practices are often neglected. Beyond the resources needed as UX experts and users to test, the time required for these practices is the main reason why it is difficult to integrate them into today's widely used agile methods.

With the aim of facilitating UX evaluation, different automatic methods have been developed to detect and solve interaction problems. One of the proposed methods is the usability refactoring technique, which is based on applying small transformations (refactorings) through scripts executed in the browser that, without altering the functionality of the application, aim to improve the UX. However, this technique was proposed as an automatic solution, in which refactorings appear as definitive solutions without first being able to validate how they impact on users' experience.

In this thesis we developed a set of methods and tools to support UX designers in the tasks of evaluating and improving the user experience. First, we present a method to explore design alternatives using the refactoring technique. This method is developed in a tool called UX-Painter. The tool is intended for UX designers, who can create different versions of a web application using refactorings to generate design changes, without the need to code them. In this way, it is possible to visualize, validate and evaluate design changes in the same web application without having to code them.

Regarding design evaluation, it is not only important to determine the impact of a design change on the user experience, but it is also essential to be able to compare different alternatives. Especially because refactorings in some cases offer more than one possible solution to the same problem. For this reason, in this thesis we also worked on a metric called "interaction effort" for evaluating and comparing alternative designs in web pages. It is a score assigned by UX experts on the different widgets of a web page. With the aim of calculating this score automatically, we developed prediction models that take as input different user interaction logs that are called micro-measures. The fact that the metric is transparent to the users means that it can be used to evaluate designs with multiple users in online experiments such as A/B testing or similar. As a proof of concept, UX-Analyzer, a web tool that allows to calculate and visualize the interaction effort of different versions of a web application, is implemented.

Finally, once it is verified that certain refactorings improve the user experience, they must be implemented in the target application codebase. In order to facilitate this task for developers, we developed a mechanism to generate a preliminary implementation of the refactorings using the frameworks and libraries currently used for web interfaces development.

Contributions

- An End-user Development approach to explore design alternatives using refactoring technique.

- The addition of new UX refactorings to the catalog developed in previous works.

- A style adaptation mechanism to customize certain aesthetic properties of the design changes imposed by refactorings.

- A web-extension called UX-Painter. With this tool, UX designers can create alternative versions of a web application through the assisted application of CSWRs. Additionally, UX-Painter gives the possibility to generate a preliminary implementation of the refactorings applied in each version, to facilitate the developers' work in the implementation stage.

- The metric *interaction effort*, which is used to evaluate the performance of the different UI elements or widgets that are modified by the refactorings. The widget types considered are 6: *text fields*, *selects* (dropdown menus), *links*, *radio buttons*, *datepickers* and *date selects*.

- A set of micro-measures for each of the 6 widget types that analyze different aspects of user interaction.

- Prediction models to estimate the interaction effort of a widget using automatically calculated micro-measurements as input.

- A tool called UX-Analyzer that uses the prediction models to calculate and visualize the interaction effort of different versions of a web page. This tool not only allows to inspect the interaction effort of individual widgets, but also provides the overall effort for a web page, which facilitates the comparison of alternative designs.

Publications with this Thesis Work

Julián Grigera, Juan Cruz Gardey, Alejandra Garrido, and Gustavo Rossi. (2018). Live versioning of web applications through refactoring. In Proceedings of the 33rd ACM/IEEE International Conference on Automated Software Engineering (pp. 872-875).

Julián Grigera, Juan Cruz Gardey, Andrés Rodriguez, Alejandra Garrido, and Gustavo Rossi. 2019. One Metric for All: Calculating Interaction Effort of Individual Widgets. In Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (CHI EA '19).

Juan Cruz Gardey and Alejandra Garrido. 2020. User Experience Evaluation through Automatic A/B Testing. In Proceedings of the 25th International Conference on Intelligent User Interfaces Companion (IUI '20). Association for Computing Machinery, New York, NY, USA, 25–26.

Juan Cruz Gardey, Alejandra Garrido, Sergio Firmenich, Julián Grigera, and Gustavo Rossi. 2020. UX-Painter: An Approach to Explore Interaction Fixes in the Browser. Proceedings of the ACM on Human-Computer Interaction. 4, EICS, Article 89 (June 2020), 21 pages.

Juan Cruz Gardey, Julian Grigera, Andres Rodríguez, Gustavo Rossi, and Alejandra Garrido. (2022). Predicting interaction effort in web interface widgets. International Journal of Human-Computer Studies, 168, 102919.

Juan Cruz Gardey, Julian Grigera, Andres Rodríguez, Gustavo Rossi, and Alejandra Garrido. (2022). An Interaction Effort Score for Web Pages. In Proceedings of the 18th International Conference on Web Information Systems and Technologies - WEBIST (pp. 439-443).

Juan Cruz Gardey, Julian Grigera, Gustavo Rossi, and Alejandra Garrido. (2023). UX-Painter: Fostering UX Improvement in an Agile Setting. In Agile Methods. WBMA 2021. Communications in Computer and Information Science, vol 1642. Springer, Cham.