Towards a Walkthrough Method for Universal Access Evaluation

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Abstract. This paper presents a walkthrough evaluation method for assessing, in a Universal Access perspective, interactive systems. The methodology is an adaptation of the traditional cognitive walkthrough used for many years in the usability engineering community. Cognitive walkthrough involves a simulation of the *problem-solving process* of an *average user*, to ensure that the user can easily learn to perform tasks that the system is indented to support. The proposed method, described here in brief along with the underlying theoretical framework, extends this approach by: (a) involving a simulation of the users' reasoned action process, to ensure that users will be in favour of accessing, exploring, utilising, and, ultimately, adopting the system; (b) addressing the diverse needs of all users, rather than of the average user, thus incorporating accessibility for all target users as an intrinsic measurement. A set of printed forms with specific questions reflecting the proposed methodology has been developed to guide the new walkthrough procedure. Early experiences with the application of the method in the domain of eServices are also discussed.

Keywords: Universal Access, evaluation, walkthrough, system acceptance.

1 Introduction

The ubiquity of Information Society Technologies (IST) necessitates progress towards the development and adoption of methods that comply with the Universal Access (UA) principles, addressing accessibility, usability and acceptance of IST by anyone, anywhere, anytime [1]. Towards the realization of this vision, previous research work has established knowledge, instruments and building blocks for ensuring that interactive applications and services are developed by taking into account the needs and requirements of all target user groups, in potentially any context of use, thus introducing profound methodological and technological innovations in all aspects of the user interface development lifecycle. In this context, design and development methods and tools for UA have been elaborated and applied [2].

Admittedly, however, no systematic approach has been proposed so far towards providing evaluation methods and tools in a Universal Access perspective. A variety of definitions and evaluation methods exist for usability or accessibility alone (for an

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overview, see [3]), but these approaches seldom take into account all human-perceived system qualities collectively and in a systematic way. For instance, they do not take into account the user's beliefs, intentions to perform, experience and expectations, and their evolution throughout the interaction with a system.

To address these issues, a UA evaluation framework has been elaborated, based on [4], that offers a holistic approach for the evaluation of the design and delivery of interactive systems. This framework has lead to the development of a walkthrough inspection method, supported by a form-based instrument, called ORIENT[1] [3]. ORIENT has been employed in the course of a large case study for the inspection of ten popular eServices in Europe [5].

2 A Universal Access Evaluation Framework

In the perspective of UA, taking into account accessibility and usability for all means assessing how individual users, with different characteristics and requirements can interact effectively and efficiently with the system throughout user experience lifecycle, both as a first experience and in the longer-term.

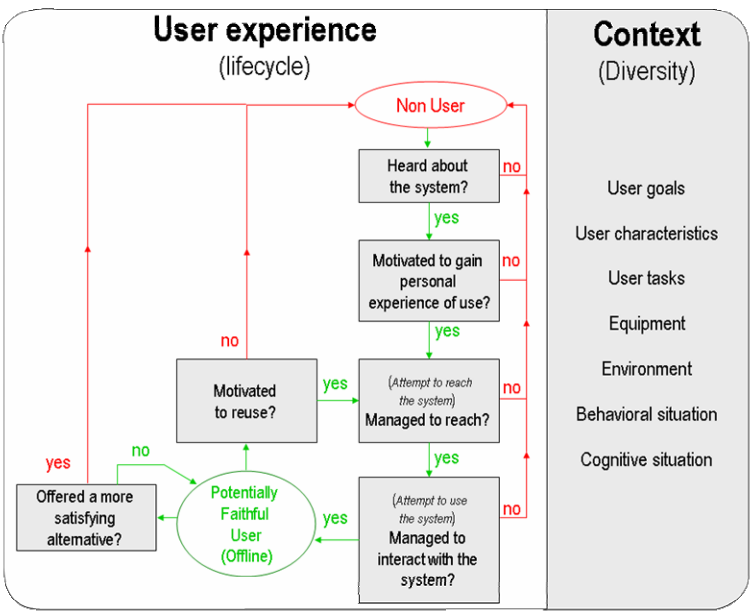

Fig. 1. Overview of the evaluation framework

In these terms, the Universal Access evaluation framework (see Fig.1) aims at taking into account individual differences and measuring the extent to which [3]:

[1] ORIENT stands for "User-orientation inspection" [2].

- a system[2] is made widely visible to non-users;
- non-users are motivated to gain a personal experience of the system;
- actual users find it easy and acceptable to reach the system;
- actual users find it useful, easy and acceptable to interact with the system;
- users are motivated to become long term users;
- users are not offered more empowering and satisfying alternatives.

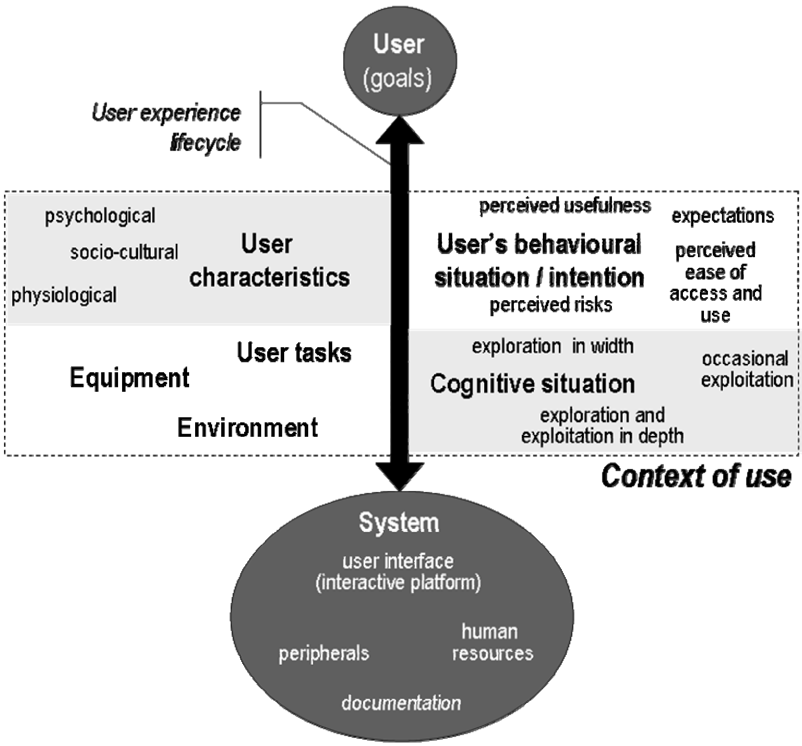

Fig. 2. Context of use of an interactive system

The framework reflects the overall system quality as a total of the following quality measurements described in [3]: visibility, perceived usefulness and perceived ease of use, availability, quality of interaction, relationship maintainability, and competitiveness. These qualities need to be granted for all target users groups and diverse *contexts of use* (see Fig.2 Fid.1), since the contextual conditions may determine the outcome of the user experience with a system. Such diversity may be induced by: (i) user goals; (ii) user characteristics (physiological, psychological,

[2] Note that the term "system" is used to refer to various types of interactive artifacts including services, software or hardware products, user interface components and their underlying functionality or any combination of these.

socio-cultural [7]); (iii) user tasks; (iv) equipment (at the user site); (v) social and environmental conditions; (vi) the user's behavioural situation; and (vii) the user's cognitive situation. In terms of user characteristics, key personal differences may involve variances in gender, physical and cognitive abilities, language, culture, experience, background, etc. In terms of the user's behavioural situation, salient factors are identified such as perceived usefulness and perceived ease of use [8], perceived risk, and expectations [9]. Finally, the user's cognitive situation builds on the theory of action [10] and on the model of learning by exploration [11]. Indicatively, different levels of knowledge structures [12] can be identified as the user's focus shifts, in the long term, from *exploration in width*, to *occasional exploitation*, and, ultimately, to *exploration and exploitation in depth*.

In terms of user interface and user dialogue with a system, accessibility can be defined [6] as the extent to which the sequences of input actions of a system, and the associated feedback that lead to successful system use, are possible to be performed by the user, with respect to the individual's limitations emerging from the particular context of use. Similarly, further to the presented UA framework, quality of interaction for all (i.e., quality of the user interface and user dialogue with a system) can be defined as the extent to which the sequences of input actions of a system, and the associated feedback that lead to successful system use, achieve all the quality measurements described above (visibility for all, etc.), thus granting subjective accessibility, usefulness, ease of use, and satisfaction with respect to the individual's limitations emerging from the particular context of use.

3 A Walkthrough Method

The methodology discussed here is an adaptation of the cognitive walkthrough method that has been used for many years in the usability engineering community. Cognitive walkthrough [13] involves an explicitly detailed process to simulate an average user's problem-solving process at each step in the human-computer dialogue, cheeking to see if simulated the simulated user's goals and memory for actions can be assumed to lead to the next correct action [14]. The method presented here, extends this approach:

- from the level of human-computer dialogue, to the level of user-experience lifecycle (see Fig.2);
- from a simulation of the user's problem-solving process (can the user use the product? i.e., cognitive perspective), to a simulation of the users' reasoned action process (i.e., does the user want use the product? i.e., behavioural perspective).
- from the simulation for the average user, to the simulation of diverse contexts of use (i.e., from usability evaluation for the average user to UA evaluation);
- from ensuring that the system design is appropriate for users to learn and use, to ensuring that system design is appropriate for users to get motivated, access, explore, utilise, and, ultimately, adopt the system.

The main objective of the method is to facilitate the rapid assessment by experts of interactive systems in terms of the factors discussed in the previous section. In brief, the method involves inspecting the user-perceived characteristics of a system and deriving conclusions about the design and delivery features of the system that affect it's UA qualities (i.e., visibility for all, etc.). The proposed method can be applied from one individual (called "the inspector"). Nevertheless, in order to achieve less subjective and more exhaustive results, it is suggested that a group of at least three inspectors work independently of each other and, ultimately, have their reports combined (i.e., group inspection). The input to such a walkthrough session includes a detailed incarnation of the system (e.g., design, interactive prototype or final product), a task scenario, and explicit assumptions about the user population and the context of use. During the inspection, the experts, having in mind the appropriate instances of the context of use, step through the user-experience lifecycle (to any desired depth) and attempt to examine at each step whether users can and intend to identify a sequence of actions that lead to the next lifecycle step and, ultimately to successful and satisfying task completion. Claims that a given step will not lead the user to abandon the process should be supported by theoretical or normative arguments, experimental data or relevant experience of the inspection team members.

In order to support experts in applying the presented methodology in practice, without the need for extensive training, a number of printed forms with specific questions have been developed. These questions guide the walkthrough and reflect the described model. The forms employ open-ended questions that accept narrative responses supplemented by scores ranging from -4 (assigned to UA catastrophes) to 4 (reserved for good practice examples). An example of the forms adapted for the inspection of eServices, constituting the ORIENT tool, is available in [3].

4 The Walkthrough Procedure (ORIENT)

The proposed walkthrough involves four phases, start-up, preparation, inspection, and reporting. In the start-up phase, the general and specific objectives of the inspection are identified, the limitations of the inspection are specified (e.g., available time, budget, and the required size and expertise of inspection team). The preparation phase is collaborative and comprises mainly the documentation of background information regarding three different aspects: inspection background information, information about the system, and assembly of the respective context of use. During this important phase, the user groups (i.e., reflecting distinct user goals and tasks) of the system are identified, and a prioritised set of system functions (task scenarios) for each group is elaborated. Depending on the desired depth of evaluation, it is possible to further break down the analysis and cover sub-functions or smaller interaction items. Then, the context of use for each user group is elucidated and analysed (see Fig.2 Fig.1.). Section 5 presents in detail an example of analysis of the context of use for eServices. At this stage, inspectors are ready to start working individually and undertake the actual inspection process. Each inspector follows a step-by-step procedure to assess the system as a whole, inspecting the perceived system qualities (see section 2) for each individual user group. In order to assess the quality of interaction, inspectors evaluate and summarise the assessment results for all functions in each user group, by implementing for each function separately the same step-by-step process that applies to the whole system.

Once all individual inspectors have examined the system, a member of the group (e.g., the inspection leader) gathers all comments and scores and produces summary forms, initially for each user group and, as final step, for the system as a whole. The outcomes of the inspection produced by means of the printed forms are mainly a list of problems identified along with their corresponding severity scores and, potentially, the recommendations for fixing problems (redesign) and improving universal access to the assessed system. A detailed description of the process is available in [3].

5 Experience with the Method in the Eservices Domain

The method has been tried and tested under full inspection circumstances in an effort to refine the process of inspection, identify gaps, locate problems or misconceptions that may affect the work of the inspection team and in general calibrate the step-by-step procedure. To this aim, a pilot application of the method was conducted for a well-known eGovernment service of a European member State.

After obtaining preliminary results and consequently refining the method, an extensive pilot application of the method was conducted. The full inspection results are reported in [5]. The inspection was held on a sample of ten online public services from both new and old member states, indicative of three major public service domains, namely eGovernment, eHealth and eLearning. Of the selected eServices, eight were inspected by means of selected task scenarios, due to various limitations, while two underwent a fully-fledged application of the method that allowed deriving comprehensive and full assessment results.

For the purpose of the above study, a detailed investigation of the context of use of eServices has been carried out identifying the factors that are likely to impact UA, and which should therefore be taken into account during the walkthrough of such systems.

5.1 Context of Use for Universal Access to Eservices

The context of use for UA (anyone, anytime, anywhere, any system) was examined through various dimensions of diversity, leading to the identification of corresponding interaction requirements induced by:

- user characteristics, which encompass physical and mental user characteristics;
- user task characteristics, which include various real-life user tasks in terms of task characteristics and conditions, e.g., often interruptions, duration, interrelations with other tasks;
- user equipment characteristics, e.g., compatibility and performance;
- user environment characteristics, e.g., noise, luminance and privacy issues;
- user expectations and perceived risks, which concern user expectations that may emerge, for example, from previous experience, personal needs, implicit service communication, values and beliefs, views about the provider, explicit service communication, and word-of-mouth communication;
- any combination of the above (for the needs of this pilot study, requirements of this type were not elaborated).

Concerning user characteristics and accessibility to people with disability, a number of interaction requirements have been identified. A major group, gathering three types of users is persons with visual impairments. These include blind users, who can only receive information though alternative channels (e.g., auditory and tactile) or though third parties. For instance, in terms of interaction with technology, they cannot use visual displays, therefore system information, messages and output should be offered in a “non-visual” form (e.g., in Braille). Low vision users may need their magnifiers to work well with the system, related pieces of information to be presented close together (since the user might miss elements due to a narrower field of view), and critical information and messages to be rendered in a non-visual form to increase visibility. When it comes to colour blind users, colour alone cannot not distinguish items (e.g., for signalling information). A second major group is that of motor impaired users, who may need minimal, if none, physical activity. For instance, in terms of interaction with technology, they may not be able use keyboard and mouse and, therefore, require interaction through binary switches and keyboard simulation software. A third group is users with some kind of hearing or speech impairment. For instance, deaf users, any audio information is restricting and thus should be given in alternative visual or tactile forms. Cognitively impaired users, who have difficulties in understanding complex information, require simple syntax and vocabulary, and navigation should also be kept simple. Furthermore, low literacy users, who plod text rather than scan it, should have short messages and sentences. For instance, in terms of technology, menu, button labels, etc. should be short. Dyslexic users should be able to alter presentation elements such as font size, background colour, contrast, line spacing, etc. Another specialised case are photosensitive epileptics whose health may be endangered by certain repetitive visual stimuli, thus the system should avoid flashing banners and flickering lights. Furthermore, a common user category is persons with low familiarity to the Internet and computer technologies that may encounter difficulties in understanding technical jargon, and following complex procedures. A final group of users that joins together all previous requirements in combination and in variant degrees is elderly users.

In the second category of requirements, the specific characteristics that apply to specific user tasks according to the type of service in question have been analysed. Thus, in a series of user tasks specific to eGovernment, including information retrieval, public databases, questions about administrative procedures, obtaining and sending forms, online transactions, registrations, declarations, etc. there are some major recurring user requirements: need for updated information, transparency in transactions, impartiality and equal rights, security and privacy of personal data, control over administrative procedures, participation in administrative and political actions, efficiency of procedures and last but not least personalisation of rendered services. eHealth related tasks include simple tasks such as finding information on health matters, looking up pharmacies, hospitals or medication online, as well as more advanced ones such as online consultation with a doctor and/or diagnosis, communication and advice, maintaining a health record. All these tasks require advanced structures for communication, security of transactions, reliable and up-to-date information, timely system response and personalisation of services. The eLearning sub-group involves tasks related to getting information about the eLearning offer, participating in computerised courses – whether self-or-employer-initiated – and accessing online material. The induced user requirements give great emphasis to the need to control the process of learning, such as being able to monitor one's performance and keep track of essays, exams, etc. and the need to have equal treatment of all students. Also, all sorts of transactions should be secured and privacy of students needs to be guaranteed.

In the third category of requirements, various types of equipment that users may utilise when accessing the system have been reported, namely various types of operating systems, visual or other displays such as PDAs, mobile phones, etc., assistive technologies such as screen readers, low rate connections and various (types of) web browsers. Disabled users who can only access a service through a public system (e.g., a kiosk) should be able to configure the accessibility of the platform.

In the fourth category, the environment in which the system is accessed has been examined in terms of external conditions (lighting and noise), security and privacy. For instance, mobile phone presupposes the following requirements for users: sound alerts should also be available in visual form, and colours and contrast should be in appropriate forms for various lightening conditions. In addition, when a service is accessed through a public device privacy of data is crucial, since users do not want sensitive information to be stored locally in the computer.

The fifth category addressed user requirements related to expectations and concerns sensed by all users, regardless of the type of service used. More specifically, this category gathers perceived user risks related to cost, time, privacy, accidents and errors during system manipulation, user or system performance, system accessibility and lastly, security of financial transactions.

5.2 Results and Discussion

For each of the inspected services, a comprehensive presentation of the results was prepared, revealing the strengths and weaknesses of the service in question with respect to the qualities addressed by the framework (visibility, perceived usefulness and perceived ease of use, availability, quality of interaction, relationship maintainability, and competitiveness), and providing suggestions for improvement. Additionally, a summative analysis of the results has also led to the identification of recurring positive and negative issues for each of these aspects in the three application domains of eHealth, eGovernment and eLearning [3]. Considering the above, it is deemed that these results may be of relevance to stakeholders involved in the design, development and evaluation of eService, as well as to service providers.

Overall, the conducted study has demonstrated both the usefulness and the applicability of the method and of the ORIENT tool in the domain of eServices. The inspection was conducted by a team of twelve experts, two of which acted as inspection leaders. The entire process was also supervised by the developers of the method. The background of the inspection team included user-centred design, web design, accessibility and usability evaluation, and Design for All. However, only the two supervisors were initially familiar with the method and the ORIENT tool. The required time was of two weeks for the set-up, preparation and inspections, and other two weeks for result reporting. The experience of the assessment team was positive, and the study allows drawing the conclusion that the application of the method is feasible and requires minimal training. An aspect which may require improvement concerns redundancy in forms. This is planned to be addressed through the development of an on-line tool supporting the conduct of assessment experiments.

6 Conclusions and Future Work

This paper has presented a framework that provides a holistic approach for expert-based or user-based evaluations of interactive systems under a UA perspective. In particular, the paper has focused on the deployment of the framework in defining an UA evaluation walkthrough method, as an extension of the cognitive walkthrough.

The paper has then presented an inspection tool based on the proposed method, named ORIENT, for conducting expert-based walkthrough assessments of eServices and predicting potential adoptability by their target users. In general, the proposed model can be applied at various evaluation depths, and can be used to inspect clusters of systems, stand-alone systems, system sub-components, and / or system functions, user interfaces, devices, interaction controls, etc. This work is intended to contribute to UA by providing a theory-based method that (a) involves a simulation of the user's problem-solving process as well as reasoned action process to ensure that users will be motivated and able to access, explore, utilise, and, ultimately, adopt a system; and (b) addresses the diverse needs of all users, rather than of the average user, thus incorporating accessibility for all target users as an intrinsic measurement.

Future work will include testing the evaluation capacities of the method with systems other than eServices. There are also plans to create an online interactive version of supporting tool with many steps of the evaluation and reporting phase automated. Finally, further studies are required to examine the issues involved in repeated system usage in the long run, and to incorporate them into the design of the interactive tool.

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