Enhancing and Evaluating the User Experience of Interactive TV Systems and their Interaction Techniques

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ABSTRACT
This paper describes the focus of my PhD thesis on how to enhance and evaluate the User Experience (UX) of interaction technologies that are applied in interactive Television (iTV) systems. Interaction technologies for iTV systems are different from standard work on desktop interactions; my thesis will thus describe the following aspects: (a) the usage context (how iTV usage, e.g. in the living room, is differing from other usage situations), (b) the set of currently available methods on how to evaluate UX and (c) how to enhance the UX of interaction technologies for iTV systems. Given that UX evaluation methods and especially methods that support UX-oriented development are rare, the following research objectives were defined: to understand (1) How users' UX concepts are related to interaction technologies that are used for iTV systems and how an interaction technology does contribute to the overall UX when interacting with an iTV system. (2) How usability and user experience are related in that specific domain (e.g. does the enhanced UX of a gesture based interaction really contribute to a positive UX in the long term, or is usability the key factor for a long term use). (3) How to inform the design and development process to improve UX of the interaction technique and the system (before a product is available), and finally (4) How the consumption of iTV content on a variety of devices (cross-device-usage) will change the overall UX. The main contribution of this phD thesis lies within the developed evaluation methods which should allow to better understand and evaluate the UX of iTV services and their respective interaction technologies in the future.

Categories and Subject Descriptors
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Measurement, Human Factors

Keywords
User Experience Evaluation, iTV, interaction techniques

EuroITV2011, June 29th-July 1st 2011, Lisbon, PORTUGAL.

1. INTRODUCTION
The living room, sometimes called the "campfire" of the new age, is still one of the most central and important areas in the home. It is a place where people can relax, but also gather together and enjoy leisure activities including entertainment and games. Interactive systems used in the living room are receiving only limited attention from the HCI research community: While there is lots of work on how to improve future generations of games including UX measurement [1], as well as work on social media, personalization, recommendation, and communities, less work is dedicated to understanding the user experience of entertainment applications including interactive TV, especially when it comes to the evaluation of interaction techniques for the living room.

Interactive systems that are mainly used in the living room are currently subject to a dramatic change: the ways how to consume TV and other media is changing due to new forms of interactive TV services including IPTV and new generation of TVs. The user does not only have the possibility to watch a certain amount of TV channels; new TVs and Set-Top boxes enable the user to e.g. access Internet on his TV, rent Video on Demand (VOD) movies, play games, access weather and traffic information, watch video clips, communicate with others and use "apps". Concerning the interaction techniques, controlling the TV and its services is also changing: TV and entertainment services found in IPTV offers today are no longer controlled with a standard remote control, but also simply by the mobile phone, game-oriented input devices allowing motion control (e.g. Nintendo Wii, Free Box 6.0) as well as gesture recognition (Microsoft X-Box 360 Kinect).

When measuring the UX of these new forms of interaction techniques the following problems occur: it is unclear to what extent the user experience of an interaction technique in the living room can be investigated in the same way as in other domains (e.g for a mobile phone). Same holds true for the comparison of user experience evaluation of games: are the same factors important for entertainment activities in the living room? Games are different to standard interactive TV applications, as they are not task-oriented, and typically focusing primarily on the fun aspect, which is not the case at e.g. a VOD service. But is the User Experience in terms of interaction with an interactive TV really comparable to a game? Is it comparable to a mobile phone interaction? Or will we simply fail to understand the User Experience in the living room when applying UX evaluation methods from other areas? We thus see the need to develop specialized methods that are appropriate for the evaluation of interaction techniques for iTV in the living room context. These methods subsequently can help to improve UX of interacting with iTV already in the design process and early development stages.

2. STATE OF THE ART

Given our research goals and objectives, our research is focusing on UX and its evaluation, which will be briefly discussed in this section. A lot of effort has recently been put in by researchers and practitioners alike to find a clearer definition of UX and its evaluation methods [7], but nevertheless the HCI community has still no unified definition of UX. An ISO Standard defining UX exists (ISO 9241-210), but leaves a lot of room for interpretation: *"A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service"*.

The difficulties in getting a more refined definition of UX are caused by several reasons. UX is associated with a broad range of "fuzzy and dynamic concepts" [7] having a multitude of meanings, ranging from "being a synonym for traditional usability" to beauty, hedonic, affective or experimental aspects of technology usage. Additionally, the term UX is also influenced by several concepts from other areas, like fun, playability, or flow. Within this multitude of concepts, it has been pointed out [5] that the inclusion and exclusion of particular variables seem arbitrary, depending on the author's background and interest.

For our research on understanding UX in the living room, we compiled a working definition of UX, based on definitions by Hassenzahl & Tractinsky [4] and Desmet & Hekkert [3]:

"The user experience when interacting with an iTV system in the specific living room context is mainly influenced by: the subjective perception of the quality of experience that is elicited by the interaction of a user with the interactive TV system, which may change dynamically depending on the situational context of usage and time. Factors influencing the quality of experience include feelings and emotions that are elicited (emotional experience), the degree to which our senses are gratified by the system (aesthetic experience), meanings and values that are attached to the system, the perception of system characteristics like utility, purpose and usability, and how well these factors fit the current situational and temporal context."

In the current literature, UX is described as being dynamic, context-dependent, and subjective (individual) [7]. It highlights non-utilitarian aspects of interactions, shifting the focus to user affect, sensation, and the meaning as well as value of such interactions in everyday life [7]. More generally, UX focuses on the interaction between a person and a product or service, and is likely to change over time and with an embedding context [4],[7].

A broad variety of UX evaluation methods is available today. To measure the user experience beyond the instrumental, task-based approach, Hassenzahl introduced the AttrakDiff[1] questionnaire. Approaches focusing on the evaluation of emotion and affect include approaches that evaluate the emotional state of the user with questionnaires, while other evaluation approaches include physiological measurements or evaluation of valence and arousal. To evaluate situational or temporal experiences, some approaches in mobile UX exist, using conceptual-analytical research and data gathering techniques [11]. For prototypes, usability evaluation methods can be enhanced by including experiential aspects to the evaluations, e.g. experience sampling in long-term field trials [11]. To be able to get a clear picture how UX changes over time, it has also been proposed [8] to measure various aspects of UX both in different contexts and at different points of time.

[1] See also http://www.attrakdiff.de/AttrakDiff/Publikationen/

For the development and application of UX evaluation methods, it is important to start from a clear definition of UX [8] with an appropriate underlying model [5]. The formal definition of UX issued by ISO suggests that UX can be measured in a way similar to the behavioral and attitudinal metrics of usability (i.e. users' performance and satisfaction) [8]. As a result of the still ongoing research to define the scope of UX, current methods, techniques and tools used to evaluate UX are most of the time taken from the large pool of traditional usability methods [8], thus established techniques such as questionnaire, interview, and think-aloud remain important for capturing self-reported data [8]. For the development of a new UX evaluation approach it would be important to understand the relationship of UX to other factors which are important for the development of interactive systems. Especially usability seems to be connected to user experience and is likely to be a sub-factor within UX [12], which also matches our position (cf. working definition above), while others [3] just see it as a source of product experience.

Based on our research goals and objectives, other research topics that will be investigated within the thesis, but will not be further discussed in this paper due to page limit constraints, include: the evaluation of interaction techniques; research about influences of the usage context, e.g. for cross-device usage; design- and development methods which are supporting UX-models; and models that explain the interrelation of usability and UX.

3. RESEARCH PROBLEM

The goal of the presented research is to develop a set of methods to better capture the UX of interaction technologies, as well as entertainment services and systems in the living room, focusing especially on interactive Television (iTV). The living room itself incorporates a special usage context and serves many specific usage situations during leisure time. This includes various aspects of entertainment and social activities, where different usage situations are arising when using different devices, some of them passive and laid-back, others requiring active usage and participation. The factors context and usage situation heavily influence the user experience when interacting with an iTV system; while the users likely wants to change the volume simply by pressing a button on the remote control blindly while being immersed in watching a movie, other activities, especially games-related ones, may be enhanced by performing gestures to interact with the user interface (as can be observed with recent developments for games with gesture input e.g. Microsoft Kinect).

The major problem is that currently available UX evaluation methods do not support various aspects that we are interested in our research – e.g. factors related to the properties of the remote control or the interaction technique itself.

Evaluation of UX in games showed that user experience can be quite independent of usability. While games have to provide a minimum degree of usability (e.g. possibility to control the game), it is just a sub-factor amongst other factors within UX (e.g. presence, involvement, and flow [12]) that seem to shape the UX more intensely and gain a lot of importance once a certain level of usability is given. UX evaluation in games today includes a broad variety of factors, one being playability [6] amongst others. In the context of the living room, it can be assumed that different factors are of importance and influencing the media usage and UXs than in a work environment: e.g. voluntariness or mood may be named as a major difference between work and leisure.

Another important aspect that has to be kept in mind, especially when focusing on the evaluation of interaction technologies in the living room, is the differentiation between the content that is delivered via the means of a certain device and the usage experience of the device itself. Existing evaluation methods tend to focus on either a certain aspect of UX or still on basic usability targets [13]. Combined methods (e.g. Attrakdiff) exist but seem to lack some aspects of importance for our focus area, the living room and iTV, like haptic properties of the remote control that could influence UX. Another question is if the UX evaluation should be included in the usability evaluation or whether it should be evaluated separately or not – and if, when, and how.

Thus, the research focus should be on the identification, analysis and evaluation of factors that are important and contributing to UX in this specific context of use, the living room, if possible at the real location of usage and within a normal usage situation, keeping in mind and being adaptable for recent and future technological changes as well as changes in usage situations.

4. RESEARCH GOALS

The research objectives are: to understand (1) How users' UX concepts are related to interaction technologies that are used for iTV systems and how an interaction technology does contribute to the overall UX when interacting with an iTV system. (2) How usability and user experience are related in that specific domain (e.g. does the enhanced UX of a gesture based interaction really contribute to a positive UX in the long term, or is usability the key factor for a long term use). (3) How to inform the design and development process to improve UX of the interaction technique and the system (before a product is available), and finally (4) How the consumption of iTV content on a variety of devices (cross-device-usage) will change the overall UX.

This leads to the research goal, which is to develop a set of methods to better capture the UX of interaction technologies, services and systems in the living room, focusing especially on iTV. The methods should fit the living room context and properly incorporate factors that are important to evaluate the UX of media usage and interaction technologies for this context from a user's perspective. These methods should allow evaluating UX of a system and its accompanying interaction technologies quickly and easily applicable during product development as well as for existing products. The set of methods developed within this phD thesis are aiming to be general enough to be applicable for various devices and interaction technologies, taking into account recent and future technological changes, while at the same time being focused enough to still properly grasp the UX of media and interaction technology in the living room. This will be approached by thoroughly choosing and addressing UX factors that seem to have high importance and impact in this context of usage, identified within current UX literature as well as during studies focusing on this issue. The methods thus do not claim to provide a comprehensive evaluation of the multi-facetted construct of UX, but are rather trying to provide valuable insights for our small area of research.

5. METHODOLOGY

In order to identify factors that are influencing UX, a literature review has been conducted as a first step to get an overview on concepts, evaluation methods and related work, followed by research conducted to identify factors from a user's perspective.

5.1 Previous Work

In previously conducted studies, we already compared field usability studies to lab usability studies, where we evaluated the same system in both conditions [14]. Within the field study, we already addressed the topic of user needs during the pre-interview in order to identify important aspects from a user's perspective. During the study, participants stated that they wanted the system to be easy to handle, user-friendly, and without the need of an operating manual. Other user needs stated were individualization and safety issues, as well as the reduction of devices via an all-in-one device. UX has been evaluated in this trial using the AttrakDiff questionnaire. Concerning the evaluation of Interaction Technologies, we also conducted a lab study, comparing touch-based to button-based interaction (using the same remote control shape and functionality) and investigating the relation of user experience and usability [9]. iTV usability might still be an important factor in the early usage phases of the system (allowing to access content), but user experience is becoming more and more important. When investigating the relation between usability and user experience, it has been noted that for the compared product, a remote control, good usability values do not necessarily impose a better UX, and low usability values can at the same time lead to high UX ratings. As a result of a high rating of hedonic quality and a good assessment of the touch-based interaction technology, it is concluded that product design as well as visual appeal are influencing the users' willingness to use a product.

5.2 Studies to Identify Major UX Factors

In order to address the research goals and get a better understanding of what UX concepts and factors are important for the evaluation of an iTV system in the home, two ethnographically oriented studies have been conducted in 2010. Within these studies, the question which factors are contributing to a positive UX was addressed in order to identify factors that are really important from a user's perspective and in the real usage context in the home. The studies were conducted in two different countries with overall 69 participating households and 179 participants (149 adults). Besides other topics that are beyond the focus of this paper, factors influencing the UX of media usage in the home and especially in the living room were addressed and led to first insights for the further development of the UX evaluation method. The factors aesthetic experience (including visual and haptic experience), utility, purpose, the elicitation of emotions, functionality and usability were the UX factors that were most stated and relevant for our context of research. Other UX factors that were not named directly but observed during analysis were the need for stimulation and identification, as well as the contextual factors time, place/situation, social influences and whether a device is perceived as personal or not. Others, e.g. the need for diversion, were omitted because they are more content- and not interaction technology related. Also the need for relatedness, respectively its fulfillment, was only observed for technologies that allow communication features and may thus be neglected for our research focus; nevertheless it may gain importance when new services that are offering communication features will reach a mass audience in the iTV sector. Additionally, based on the identified UX factors, our conclusion is that media content is not that much interfering with the evaluation of the iTV system, services and interaction techniques, especially when combining expert and user oriented evaluation, and thus might be neglected, as the influences of the mediated content on the UX are beyond our research focus.

5.3 Current State and Future Work

At the moment, the findings gathered during the ethnographic studies [2] [10], combined with those identified in the literature and in previous studies, are used to develop an UX questionnaire for our domain as a first step, which is currently subject to first evaluations and examination of its validity within user tests. It focuses on the UX evaluation of interaction technologies in the living room, and should allow investigating and measuring UX factors already in early design phases. The preliminary version of the questionnaire and the underlying framework will be presented at doctoral consortium. As described previously in the methodology section, first steps have already been taken within the thesis, a first version of the methodology is developed and in the course of being evaluated. At this point, the thesis has progressed far enough to present first results and receive feedback from the community that is working within the same or related areas to further improve the research within the remaining one to one and a half years of the phD thesis.

The doctoral consortium thus should serve as a forum to provide valuable feedback for the further development of the UX methods. Especially interesting would be feedback about the methodology chosen, also regarding the question if all important aspects of UX can be addressed accordingly with a questionnaire and the viability and requirements for expert evaluation. Additionally, feedback about the UX factors identified and how to incorporate other UX factors, how methods could be further combined, what benefits they could offer in the development process and which insights the methods could provide would be interesting topics for further discussion. The community of the conference seems to be an ideal possibility to further discuss potentials of the proposed approach and methodology, possible drawbacks and areas where further investigation might be necessary.

The next steps of the thesis will include the development of expert guidelines that can be used in the tradition of heuristic evaluation to understand if and to what extent future systems support major UX factors. Here the application and adaption of evaluation methods taken from structural and functional playability [6] seem reasonable, as they are already addressing functional (i.e. more usability-related) as well as structural (i.e. more aesthetic-related) concepts which have a substantial interconnection to current UX concepts and models. These guidelines should offer valuable benefits for the fast-paced industrial product development cycle, where other means of UX evaluation may not be appropriate due to project time constraints or time and manpower needed to carry out the evaluation.

6. CONTRIBUTION AND CONCLUSION

To sum it all up: for the evaluation of UX of interactive TV systems and the respective interaction technologies, factors from other areas like gaming and mobile usage, as well as product related factors are important. Based on the factors that we identified in several studies and the literature, a set of methods is being developed that allows investigating and measuring these factors already in early design phases. The current approach is to use method triangulation with a questionnaire as a first step, including evaluation of the user interface, the interaction technique and the orthogonality between interaction and user interface, which will be followed by guidelines for expert evaluation in the future.

The main contribution of this phD thesis lies within the proposed framework and evaluation methods in order to better understand and evaluate UX of interaction technologies for iTV and its services in a living room setting. The research conducted to identify the UX factors in this setting will contribute to a better understanding of which aspects are really important in this context, which influencing factors might change the UX and which factors should be included in an UX evaluation method for interaction technologies in the living room. The UX evaluation methods will offer the possibility to quickly and easily evaluate UX within the whole product design and development cycle.

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