5th WORKSHOP ON SOFTWARE AND USABILITY ENGINEERING CROSS-POLLINATION: Patterns, Usability and User Experience (PUX 2011)

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5th Workshop on Software and Usability Engineering Cross-Pollination: Patterns, Usability and User Experience

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Abstract. The workshop focuses on how process models, methods and knowledge from the area of Human-Computer Interaction can be integrated and adopted to support and enhance traditional software engineering processes. In its 5th edition this workshop will investigate the application of usability engineering methods that are adapted to fit the evaluation of advanced interfaces and how usability and user experience evaluation methods can be incorporated to support design decisions and changes in standard software development. This workshop is organized by the IFIP working group 13.2 "Methodologies for User-Centered Systems Design".

Keywords: Software Engineering, Usability, User Experience, Cross-pollination, Patterns.

1 Introduction

Software engineering and usability engineering are affected by a mutual influence that we call “cross-pollination”. Examples are task specifications, design patterns and life cycle models. These examples were invented in one field and later on adapted in a new context. Use cases [5] and Usability pattern languages [7] are only two out of many examples. New developments in intelligent and adaptive environments and mobile computing require new solutions, for usability evaluation methods [3] and especially for user experience evaluation [1]. The key attribute of user interfaces is that they need to adapt to time, location and usage which makes them very difficult to evaluate using standard techniques [2].

The workshop will focus on how to integrate and extend traditional development and evaluation methods in order get user interfaces that are usable and ensure good user experience. Additionally, it should be possible to optimally evaluate the usability of advanced interfaces in their specific context of use [4, 6]. Experts in HCI, software

and usability engineering need to learn from each other to facilitate and encourage this convergence.

The workshop aims to be a forum for sharing ideas about potential and innovative ways to cross-pollinate the expertise among the different communities and to show examples, which can stimulate industrial software development. Additionally it should provide a forum that will help to grow a community of interest in this area.

2 Structure of the workshop

The goals of this workshop are to provide HCI specialists, software engineers and usability specialists from industry and research institutions the opportunity to discuss both the state-of-the art and the cutting edge practice in usability and user experience evaluation. Topics of interest include, but are not limited to, the usability and user experience evaluation of advanced interfaces and interactive systems like adaptive interfaces, context-aware interfaces, human-robot interfaces or mobile interfaces and the integration of these methods in the respective application domains. Additionally, reports about the application of patterns in the different fields of HCI like [7] are welcomed.

The workshop is the official workshop of IFIP working group 13.2 "Methodologies for User-Centered Systems Design". http://wwwswt.informatik.uni-rostock.de/IFIP_13_2/. It expects HCI specialists, software and usability engineers from academia and industry as participants.

This workshop is planned for one full day including the following activities of an invited talk, papers presentations and a round table discussion. Participants have to prepare a position paper of 4 to 10 pages which will be reviewed by an international committee. Selected papers will be published on the workshop web site (http://CEURWS.org.) and will be presented during the workshop. The outcome of the workshop will be a white paper presented on the web site of the workshop.

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UX Modeler: A Persona-based Tool for Capturing and Modeling User Experience in Service Design

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Abstract. In software/service systems design and engineering, knowing the users and quantifying/modeling their needs is essential to give them the best possible user experience. As a format to capture and document user experience, the persona has gained popularity among interaction and service designers. A persona provides a comprehensive description of a desired user's everyday behavior or a story providing a picture of the user interaction and perceptions. However, designers lack tools to effectively capture and manage personas. Such tools would help create personas while ensuring that those personas are effective and usable descriptions of the potential user audience. In this paper, we propose a tool, UX Modeler, whose purpose is twofold. First, to service end users it is an online community to share experiences. To designers, it is a design platform to create and continuously improve personas related to a large variety of services.

Keywords: User experience, persona, patterns, user-centered design, tool support, service design

1 Introduction

The gap between the users as imagined by designers and developers, and who those users really are has been shown to be the biggest problem in interactive services development [1]. The concept of *user experience* can help designers to bridge that gap. User experience analysis helps to understand what the users want and need from the product, and whether they'll be able to use what designers have created.

User experience (UX) is about a person's expectations, feelings, and perceptions when using or applying a product, system or service in different contexts. ISO 9241-210 defines user experience as [2]:

> *"A person's perceptions and responses that result from the use or anticipated use of a product, system or service"*

In accord with this standard, a description of user experience includes the user's emotions, beliefs, preferences, perceptions, physical, physiological and psychological responses, behaviors and accomplishments that occur before, during, and after use.

In the field of human–computer interaction (HCI), the concept of user experience can be seen as a step beyond the scope of usability engineering and user-centered design. It is a much richer arena where users' feelings, motivations, and values are given as much, if not more, attention as efficiency, effectiveness and basic subjective satisfaction (i.e. the three traditional metrics used to assess usability). Therefore in user experience design, the goal is not just to make the user interface usable while following a user-centric design methodology and applying some guidelines and measures.

User experience is still an evolving concept in HCI. Several definitions have been proposed, which makes this concept confusing [3, 4]. User experiences are often captured in narrative form if not raw text. Personas, scenarios, stories, and task models may be used to document user experiences. However, there is currently no method or tool to systematically derive concrete design solutions from these representations. Typically, the use of user experiences captured via personas relies almost completely on the designer's intuition and expertise. This is an obstacle in particular for novice designers who lack the background and training required to make trade-offs, judge and interpret a design.

Thus there is a gap between user experiences and design concepts and there is no standardized format to document personas. What is needed is a tool that supports designers in capturing users' experiences, clustering those into a persona and then developing a design with that persona in mind. Such a tool should be systematic, traceable and practical. It should also leave room for design creativity.

Figure 1 highlights the current gap between user experience descriptions and conceptual designs. It portrays the framework we are proposing to bridge two major UX design artifacts: personas and patterns. Personas and patterns are correlated for the purpose of narrowing this gap between user experience and conceptual design. More precisely, our research is tailored towards the definition of a systematic process that identifies interaction patterns from personas and that suggests some rules to compose patterns when creating a conceptual design of user interfaces (UI). The conceptual design is seen as a pattern-oriented design. Such a process is the essence of the tool support that in turn can empower designers with concrete design solutions traceable to the users' experiences.

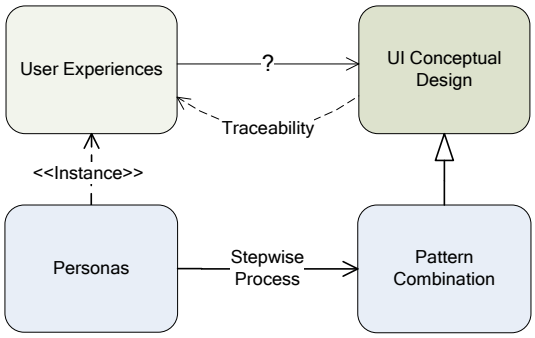

Fig. 1. The current problem and our solution for deriving a design from user experiences

This paper details the UX Modeler, the tool we are developing, mainly its concepts, features and uses. For a detailed description of the whole UX process of deriving a

design from user experience descriptions, the reader can see for example [Javahery, 2006].

2 About Personas as a Vehicle to Capture User experience

Initially, personas in software/HCI design were introduced by Alan Cooper, which he borrowed from marketing and consumer behavior research [Cooper, 1999]. In his original work, Cooper proposed the persona as a tool to focus on end users and their needs. Personas are constructed as fictitious characters based on composite archetypes and encapsulating "behavioral data" gathered from empirical analysis and ethnographical studies.

Since then, the persona concept has evolved from archetype to user experience. An archetype is a generic, sometimes idealized model of a person, object, or concept. A persona as an archetype is a model of a person, personality, or behavior. Personas have also been defined as fictitious characters representing different user types within a targeted demographic group. Personas have been assumed to be in or part of an environment based on known user situations that are then translated into a set of scenarios.

A persona description includes a user's name**,** context, goals and needs. Cooper proposes to describe personas in a textual format based on the initial investigation data gathered from interviews and ethnographic studies. Table 1 details the key user experience facts based on [Courage and Baxter, 2005]. These components are in text format, and can act as a guide in building personas. An example of a persona is available in the appendix.

Table 1. Persona components.

Persona Components	Description
Identity	Include a first and last name, age and other demographic information.
Status	Whether the user is a primary, secondary, tertiary, or anti-user of the application. Typically, only primary and in some cases, secondary users are included.
Goals	Besides goals related to the application, it includes personal and professional goals as well.
Knowledge and Experience	Knowledge and experience including education, training, and specialized skills. This should not be limited only to the application.
Tasks	Frequency, importance and duration of most important tasks related to the application.

Relationships	Include information about user associates, since this could give insight on other stakeholders.
Psychological profile and Needs	Include information about cognitive and learning styles, as well as needs such as guidance and validation of decisions.
Attitude and Motivation	Include information about the user's attitude to information technology and level of motivation to use the system.
Expectations	Information about how the user perceives how the system works, and how the user organizes information related to his/her task, domain or job.
Disabilities, etc.	Any disabilities, such as color-blindness, related to mobility, eyesight (wears contacts), etc.
Photograph	Include a photograph which fits with the name.

We distinguish between the five following personas, representing categories of users.

- Service end users – use the service to accomplish their work or to have fun – the service is created primarily for these people
- Indirect service users – use the service for other reasons than those listed above, including educators – evaluators, policy makers, etc.
- Service providers – develop and customize the service
- Service brokers – install services, manage and provide support
- Service stakeholders – have an interest in the service either because they pay for it or because its usage may have an impact on their life or their community

Initially each user is classified under one of these categories. This classification will, using our tool, be refined as explained later.

3 Overview of the Tool

The UX Modeler looks like and functions like an online social network. Groups within the network are represented by personas, and during the registration process members join a group by choosing the persona that they identify with most.

Designers who participate in the network as administrators may benefit from working with designers in other parts of the world, exchanging experiences and accessing data from a diverse group of users.

3.1 Personas

Initially the database contains five basic personas as detailed in the previous section. These personas are used as a starting point, and as the community grows and the administrator tweaks the set of personas, that set becomes more adapted to the set of users.

Administrators can add, modify, and remove personas, all while retaining a full history of all versions in order to enable rollbacks.

3.2 Services

In this report "service" and "product" are used interchangeably, referring to the artifact being developed, which may be either a service or a physical product. Users select the services they intend to use by reading their descriptions. Users may freely change their service selection.

When introducing a new service, an administrator may notify those users who are most likely to want to use it, based on their persona choices and previous service choices; all users will nevertheless find the service in the list of services. When removing an existing service, the administrator may suggest other services that might interest the affected users.

While some social networking websites focus on particular interests, others are general purpose. The UX Modeler aims for the former, with the set of services, or the community for which the services are created, binding all users together: they all have an interest in the services, their role being one of the previously identified personas. As an example, a town may deploy the tool to investigate how the urban planning should progress. Possible services include bus lines, roads, bicycle paths, housing, information on a web site, etc.

3.3 Clustering Algorithms to Aid the Administrator

In general, clustering is a statistical comparison technique aimed at dividing data points into a set of homogeneous groups containing data items as close to each other as possible. At the same time, clustering is sometimes considered a form of reduction of a large set of data into a smaller set of representative prototypes or clusters. Depending on the data and the application, different types of similarity measures may be used to identify classes, where the similarity measure controls how the clusters are formed. Some examples of values that can be used as similarity measures include distance, connectivity, and intensity [5].

In non-fuzzy or hard clustering, data is divided into "crisp" clusters, where each data point belongs to exactly one cluster. In fuzzy clustering, the data points can belong to more than one cluster, and be associated with each cluster by membership grades, which indicate the degree to which the data points belong to the different clusters.

During preliminary studies on user experiences and personas [5], it has been discovered that the designers intuitively apply a fuzzy clustering technique while

considering cognitive and demographic user variables. More precisely, the designer initiates an iterative process while considering a set of related user variables and the groupings of users within and between the variables.

The administrator may choose a number of parameters to assess, such as age, sex, and services chosen by the users. By comparing these user properties with those of their chosen personas, we can calculate discrepancies and visually suggest modifying a persona or creating a new one to the administrator.

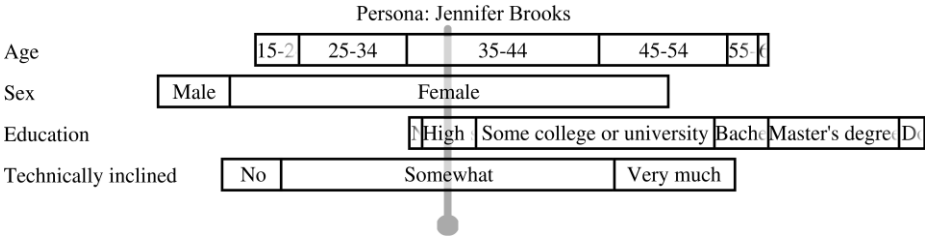

Fig. 2. Example visualization of how well a persona corresponds to the users who have chosen it. The persona's education level is significantly lower than the community users': almost all of them have been to the university.

Should two personas become too similar, the administrator has the option to *merge* them, in effect removing one of the personas while adding some of that persona's key characteristics and/or scenarios to the other persona. If, on the other hand, a persona becomes too complex or seemingly schizophrenic, the administrator may *split* that persona, thereby creating a new persona with some of the characteristics and scenarios of the original. Both of these operations imply significant changes and care should be taken to avoid creating unrealistic personas. When merging and splitting personas, the users adhering to those are notified of the change and automatically recategorized when possible.

3.4 User Features

Although the tool focuses on persona creation, providing additional features for users may be essential to success. Users have grown accustomed to features of existing social networks and will expect similar functionality when joining a new one.

- **Messaging.** Interacting with other members is the core of any community. The tool could allow for instant messages as well as traditional private messages, read at a later point, to one person or to multiple people.
- **Contacts.** A user can have any number of contacts on the site, and in particular, the site promotes contacts among users who have chosen the same personas. This allows users to connect with people with similar or related interests and characteristics. A contact is asymmetrical: when adding another user as a contact, the recipient party will receive a notice, but won't need to confirm.
- **Other Social Network Features.** Current social networks entice users to be more active or create better content by using a wide array of features such as

photo galleries, video, forums, status updates, public messages between individuals, and/or "karma".

- **Improving the Product and Being a Privileged User.** The main user incentives may be to be able to directly improve the final product, or to get special privileges such as access to a preview version of the services or receiving a discount when buying later on. These are discussed in section 4.1.

3.5 Tasks and Responsibilities of Administrators and Designers

The main responsibilities of the persona designer are:

- To add, develop, and delete personas and services.
- To track and view persona history (users may also be able to do this, thereby improving transparency).

The responsibilities of the administrator, who can be a designer, include monitoring user activity, banning users, and removing content as needed. The roles of being persona designer, administrator and site owner may be held by one single person, or by multiple people.

4 Open Questions, Next Steps

This section discusses certain open questions and envisioned next steps, both general ones and specific improvements.

4.1 Broadening the Scope with Feedback

Users, like most people, want to have their opinions taken into account, indeed some of them want to help create good products. The tool could easily include more active ways of participating than merely providing personal information. Channels for participation may include direct suggestions to the persona designers, an idea and issue forum, and the rating of items in a roadmap. Participants might also have specific domain knowledge which they want to share, in cases where this is applicable.

These participation channels may be well outside the scope of a persona creation tool, but would render it a unified tool for understanding users' needs and could help when creating the project road map and the products' scope. In addition, this could be a step towards having a single, unified community around the product, and might even create a devoted (possibly future) user base.

Another strong user incentive would be if community users were given a preview or beta version of the services. This would also allow them to provide feedback on their actual, possibly daily, use. Yet another incentive would be to be eligible for discounts on future purchases.

4.2 Representing the Actual User Base

The main goal of a persona being to put a face to a desired target group, persona designers should take great care to ensure that this goal is fulfilled. Our tool is intended to aid designers by providing a community of to-be users, so that the personas can evolve around the target groups. While being an improvement, the persona designers must pay attention to cases where the community's user base doesn't correspond to the service's desired or actual one.

People who are not interested in online social networks, lack technical skills, or simply haven't gotten an invitation might be underrepresented; on the other hand, early adopters and power users might be overrepresented.

4.3 Artificial Scarcity

Swartz describes how to successfully launch software, using what he calls the "Gmail launch", based on how Google launched Gmail [6]. The idea is to restrict membership, initially only allowing selected members, such as administrators or their friends, to invite others, and gradually allowing more users to invite, until the community is open for all. This kind of launch has three advantages:

- Manage community growth rate and thus avoiding any outages due to site traffic spikes.
- Find bugs that annoy users, improve the product before a public launch.
- Drive interest in the project, make its members feel special, let the users advertise the project.

Successful examples of use of this technique include, apart from Gmail: Github which began as a private beta, Spotify which required invites for signing up, and Facebook which instead of using invites only allowed Harvard students to obtain an account, later certain universities. We are using the model described by Swartz for the UX Modeler, thus starting with only administrator invitations.

4.4 Visualizations

The administrator would be aided by clear graphical visualizations showing discrepancies between the personas and the users that adhere to them, as previously suggested in section 3.3.

Persona creation being the main goal of the tool, the simple list of revisions currently implemented might not be sufficient to present their progress – a visualization would be more useful. That visualization should present the personas over time. It should show any persona merges or splits, their relation to services, and the number of users per persona, with any age or other restriction. There may be other data that is also interesting to visualize.

5 A Concluding Remark

The proposed tool could be a valuable support for a designer. An additional venue that should be explored is a clustering of scoring techniques. For example, neural networks with learning capabilities can be used to enhance the results produced by the tool. The resulting score can be a combination of the scores of the currently proposed set of rules that declines in importance as the neural network evolves, thereby increasing reliability. Thus, the scoring engine can become a commonly shared component similar to a pattern library.

At the time of writing this paper, the UX Modeler has not yet been fully developed, and many features are yet to be implemented. We expect to finish these to have a proof-of-concept ready for the conference, while the longer-term plan incorporates several of the above ideas and more, which may be implemented, depending on feedback.

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Appendix: Example Persona

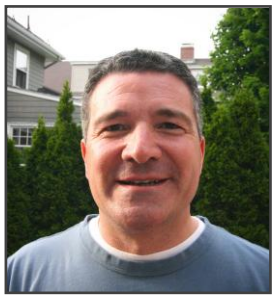
Personal profile

For the last few years, Mr. Dupont has used his computer to plan trips with the family. He uses travel websites and other on-line resources to find the most important information: what are the wonders of this region, are there particularly unique churches or important museums?

He then compiles it all in a Word document and spends a lot of time making it readable, even when the itinerary is uncertain, for example the exact arrival and departure times for each city. For every single city he adds a list of museums, churches, and other places which may interest him. He prints the document before departure, but given the frequent changes while traveling he will inevitably have to depart from his itinerary. When he and his family arrive in a new town, they visit the tourist office to ask if there are any events or cultural venues that they've missed.

As the kids have grown up they have become more demanding, and Mr. Dupont would like to find activities to please them. Unfortunately, he finds it difficult to know what they like. When Mr. Dupont inquires at the tourist office, more often than not, they recommend events that will take place when the family has already left.

Mr. Dupont thinks that his Word document works well enough, but if there was an appealing unified system which could offer him the same functionality or better, he'd use it.



Clovis Dupont

"The museum or the cathedral?"

Background

- Proud family father, 45 years old, married with three children, 10, 14 and 16 years old
- Catholic, but seldom goes to church
- Was near the top of his university class
- Well-paid office worker, but has a very demanding job
- Wants to educate his children culturally
- During their holidays, he likes to travel with his family, which both unites and educates them

Attributes

- Man
- Comfortable middle class
- Quite interested in technology and wants to show that he masters it
- More educated than most
- Fond of cultural visits
- Interested in the customs of cultures in all the corners of the world, and knows a lot about architecture

Customer needs

- The application must be rather simple
- The application should be easier to use and provide more functions than a Word document
- The client wants to plan his trip together with his family, even though he always has the final word
- He needs a lot of information on each potentially interesting place to be able to make an active choice
- He wants to show that he has some technical skills

Scenarios

Scenario	Needs	Feature	Behavior
Dupont wants to travel in Champagne-Ardenne with his family because they have never been there. He uses the internet to try to find what there is to see.	Information	Word document Web sites Map	Mr. Dupont searches for cultural venues on the internet. He finds a few sites that guide and show him the wonders of the region. He also uses a site which specializes in architecture and finds some unique buildings. He looks at a lot of information and writes down the most interesting sites in a Word document in order to later suggest them to his family. He copies the URL, the place name and sometimes a photograph or a short description. Since the Word document becomes rather poorly organized, Dupont takes a long time to reorder and categorize the items.
He creates their itinerary using the information he has found on web sites.	Planning Choice validation Being the only one who can make final decisions for the itinerary	Map Word document Calendar	He opens his Word document and looks at the cities, comparing them to a map of the region. He plans their vacation in large steps by reorganizing categories and entering the preliminary dates. He shows his family his document. They comment, give their opinion and Dupont changes the itinerary.

Context. Within an educational project, students created prototypes for an array of services to be used by tourists to a small city. This persona was conceived of for the online mapping service.

Photo: Greg Peverill-Conti, retrieved May 30th 2011
http://www.flickr.com/photos/gregpc/4656838019/

Training Software Development Practitioners in Usability Evaluations: An Exploratory Study of Cross Pollination

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Abstract. Successful integration of usability evaluation into software development processes requires software companies to employ personnel that possess skills within both usability and software development. However, the sheer lack of usability specialists and their cost are two limiting factors for software companies wanting to integrate usability evaluation. A possible solution to these problems is to cross pollinate by training existing personnel in conducting usability evaluations and analyzing the collected data. This exploratory study extends previous research by showing that it is possible to provide software development practitioners from industry with key knowledge on usability evaluation. Results show that a pair of practitioners can identify the same number of problems as one usability specialist after 14 hours of training. Furthermore, software practitioners are better at providing clear and precise problem descriptions than at describing the impact, cause, user actions and providing data support for observations.

Keywords: Usability evaluation, training, software development practitioners, problem identification, problem descriptions.

1 Introduction

For the past decade software companies have increased their focus on integrating usability engineering (UE) into development processes. A considerable challenge for these companies is the limited supply of usability specialists in the industry, which leads to integration problems caused by missing key knowledge [12], [16]. Another challenge, which especially relates to small software companies, is that these have to cope with the constraint of low budgets. In practice this means that small companies do not have the funds to pay for comprehensive consultancy or staffing of usability specialists [9], [13]. A survey conducted by Gulliksen et al. supports this by showing that usability specialists are primarily employed by medium-sized or large companies [8]. The fact that small companies usually do not have staff that possesses usability knowledge is expressed as one of the main barriers for integrating UE into software development processes [14], [17].

One way of solving these problems may be to cross pollinate disciplines by increasing usability knowledge across existing personnel, an approach which previously has provided positive results. Metzker and Offergeld for instance describe a software project in which developers participated in contextual task analysis, which motivated them to produce components with a high level of usability [14]. However, a recent literature review presented in [2] shows that the majority of related studies are applying university students as the empirical basis, which leaves room for further studies on software development practitioners' ability to apply UE methods. Another point for consideration is the fact that the majority of related work focus on measuring quantitative aspects of e.g. usability evaluations such as the number of problems identified. Thus in the case of usability evaluation, there is also a need to report findings on aspects such as the quality of problem descriptions and in particular which parts of the descriptions that software practitioners find difficult to fulfill.

This exploratory study extends previous research by studying how software development practitioners from industry perform in identifying usability problems and by providing insights in the quality of their problem descriptions. We have chosen to train practitioners in user based evaluation methods, as such methods have proven to be effective in creating the wake-up calls necessary for companies to start focusing on UE or to increase the awareness of developers [11].

The paper is structured in the following way. First we provide a description of the experimental method applied after which we present our findings and discuss these with respect to related work. Finally we provide the conclusion and point out avenues of future work.

2 Method

In this section we describe the scientific method applied which consisted of a training course that provided key usability knowledge and an evaluation experiment that assessed software practitioners' performance in analyzing usability evaluation data. We start by presenting the participants of the training course and experiment.

2.1 Participants

Software Development Practitioners. Five software development practitioners (henceforth mentioned as "SW-P" or "practitioners") employed in a small software company participated in the experiment. Table 1 shows an overview of their job functions within the company and experience with usability work in general. SW-P 1 had 1.5 years of job experience as a systems developer and did not have any experience with usability evaluation during his employment at the company. However, as part of his education he had previously participated in a HCI course and in the conduction of 4-5 usability evaluations (7 years back). SW-P 2 was a test manager with 8 years of job experience in the company and did not have any practical experience in applying usability methods. She had read a single chapter on the subject during her education. SW-P 3 had 2 years of experience as project manager and systems developer, but had no previous experience with usability work. SW-P 4 had

3.5 years of experience as a systems developer in the company and did not have any experience with usability work before this study commenced. SW-P 5 had worked as a systems developer for 2 years in the company. Additionally he had participated in a HCI course during his education and had experience from conducting a single usability evaluation 13 years back.

Table 1. Overview of the software development practitioners' (SW-P) job functions within the company and experience with usability.

SW-P no.	Function	Usability Experience
1	Systems developer	HCI course + 4-5 evaluations
2	Test manager	Through literature
3	Project manager + systems developer	None
4	Systems developer	None
5	Systems developer	HCI course + 1 evaluation

Trainers. The two authors prepared and held a usability training course for the practitioners (see course description in section 2.2 below).

External Raters. Three usability specialists acted as external raters of the problem lists produced during the evaluation experiment as we did not want to evaluate the outcome of our own training (see section 2.3 for further details). None of these raters had taken part in the training or the conduction of the usability evaluation and are thus considered to be unbiased.

Test Users. Six test users were recruited for the evaluation experiment, all of which were representative end users of the evaluated system.

2.2 Training Course

The authors conducted a two-day training course (14 hours) on user based usability evaluations. The course was held as a combination of presentation and exercises. At the end of the course we gave the practitioners a homework assignment in which they were asked to analyze five video clips from a previous usability evaluation of an e-mail client. We collected the resulting problem lists and gave the participants feedback on how they could improve their problem descriptions.

2.3 Evaluation Experiment

The emphasis of this study is based on the usability evaluation conducted by the 5 practitioners after completing the training course. Due to planning time and busy participant calendars this was executed one month later.

System. The system evaluated was a web application that citizens may use when they move from one address to another. The system was partly developed by the software company in which the 5 practitioners were employed but none of the practitioners had participated in the development of the particular system.

Setting. The evaluation was conducted in the usability laboratory at the university which consists of a test room with cameras and a microphone and an observation room behind a one way mirror. During each session a test user was sitting at a table in the test room using the web application. Next to the user a practitioner acting as test monitor would be positioned.

Procedure. All practitioners took part in planning the test while three of these (SW-P 1, 2 and 3, see Table 1) conducted the evaluation. Afterwards, all 5 analyzed the obtained video material and described the usability problems. The usability evaluation was conducted in one day where SW-P 1, 2 and 3 acted as test monitor two times each. After completing the evaluation all 5 practitioners analyzed the video material from the lab individually. One of the authors analyzed the same video material and this person is mentioned as the "HCI specialist" from this point on. The practitioners and the HCI specialist used the same template for describing problems in order to promote a consistent format. The three unbiased external raters were then asked to evaluate the quality of the problem lists created by the 5 practitioners and the HCI specialist. Finally, the HCI specialist held a meeting with the five practitioners in which the 6 individual problem lists were merged into a total list of usability problems, which served as a white list to calculate the thoroughness in identifying problems. At the same meeting a debriefing interview with each of the developers were conducted.

Analysis of Problem Description Quality. The three unbiased external raters were asked to evaluate the quality of the problem lists created by the 5 practitioners and the HCI specialist. To measure the quality of the lists, the raters were asked to first read each problem list and then provide a rating on a scale from 1 – 5 (1 = "Not fulfilled", 2 = "Scarcely fulfilled", 3 = "Partially fulfilled", 4 = "Almost fulfilled" and 5 = "Fulfilled"). These ratings were given on the following attributes (based on the research presented in [3]):

1. Be clear and precise while avoiding wordiness and jargon
2. Describe the impact and severity of the problem
3. Support your findings with data
4. Describe the cause of the problem
5. Describe observed user actions

Finally the external raters were asked to provide a qualitative assessment of each list, i.e. to provide arguments of the ratings given and examples from the problem lists.

4 Results

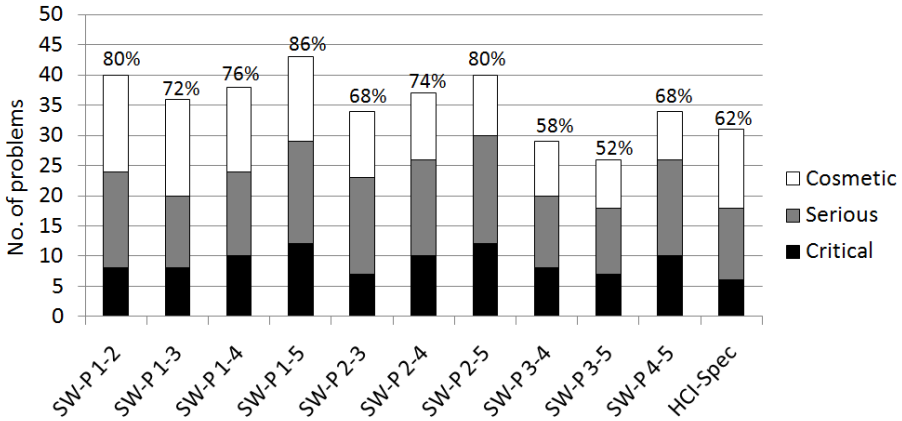
This section presents our findings and is divided in two subsections where the first describes practitioners' ability to identify problems while the second provides qualitative details on their ability to describe usability problems.

4.2 Identification of Usability Problems

Results show that a total of 50 usability problems were identified of which 12 are critical, 19 serious and 19 cosmetic, see [15] for elaboration of severity categorizations. The HCI specialist identified 31 of the problems (62 %) and the practitioners identified between 14 (28 %) and 33 (66 %), the mean being 24.2 (SD=8.1), or 48.4 %. On average practitioners identified 78 % of the problems found by the HCI specialist. Considering the amount of critical problems practitioners identified a mean of 6.8 (57 %) (SD=2.6) where the most and least thorough found 83 % (SW-P 1) and 25 % (SW-P 3) respectively. In comparison the HCI specialist identified 6 (50 %). Considering the serious problems practitioners found 10 (SD=3.9) on average (53 %), the highest being 79 % (SW-P 2) and the lowest 21 % (SW-P 3). The HCI specialist found 12 serious problems (63 %). In the case of cosmetic problems the average is 7.4 (SD=3.2), or 39 %, where SW-P 1 identified most (63 %) and SW-P 4 fewest (21 %), while the HCI specialist found 13 (68 %).

Pair wise Identification. In practice it can be too resource demanding to utilize five evaluators in analysis of usability data, thus in the following we study the effectiveness of each pair of practitioners. Figure 1 provides an overview of the number of problems identified by all pairs of practitioners. All pairs identifies an average of 35.7 (SD=5.2) of all problems (71.4 %), where SW-P 1 and SW-P 5 was the pair that identified most problems (86 %) and SW-P 3 and SW-P 5 identified fewest (52 %). In comparison, the HCI specialist identified 62 %.

Figure 1. Overview of the number of problems identified by all pairs of practitioners.



It should be mentioned that the best performing pair (SW-P 1 and 5) had previous practical experience with conducting usability evaluations, see Table 1**.**
By removing all pairs consisting of SW-P 1 or 5 we see that the average number of identified problems is lowered to 33.3 (SD=4), which amounts to 66.7 % of all problems. Considering the severity categorizations we find that the average number of critical problems identified for all SW-P pairs is 9.2 (SD=1.9), 14.8 (SD=2.4) for serious problems and 11.7 (SD=3.1) for cosmetic problems, or 77 %, 78 % and 62 % respectively.

4.3 Quality of problem descriptions

This subsection describes the software development practitioners' ability to describe usability problems according to the five quality attributes of clarity, impact, data support, cause and user actions, which are derived in [3].

Table 2 provides an overview of the median quality ratings given by the three external raters where higher ratings indicate a higher level of fulfillment according to the quality attributes (1-5 scale). The table shows that problem descriptions written by practitioners 1 and 5, who received the median scores of 4 and 3 respectively, described their usability problems with a quality comparable to that of the HCI specialist (median = 4). The other three practitioners scored lower as their median rating was 2. The table also shows that practitioners are better at being clear and precise (clarity) in their problem lists than any of the other attributes, which is elaborated upon below along with qualitative comments made by the external raters.

Table 2. Median quality ratings given by the three external raters to the problem lists written by the software development practitioners (SW-P) and the HCI specialist.

Participant	Clarity	Impact	Data	Cause	Actions	Overall median
SW-P 1	4	3	4	4	4	**4**
SW-P 2	2	2	2	2	2	**2**
SW-P 3	2	2	2	2	1	**2**
SW-P 4	3	2	2	2	2	**2**
SW-P 5	4	2	3	3	3	**3**
Overall median	**3**	**2**	**2**	**2**	**2**	**2**
HCI specialist	**4**	**3**	**4**	**3**	**5**	**4**

Clarity. Table 2 shows that the practitioners were better at fulfilling the clarity attribute than any of the other attributes as they scored an overall median of 3. In comparison the HCI specialist received the median rating of 4 by the external raters. This was also the case for practitioners 1 and 5. As an example on the qualitative comments given, one of the raters mentioned that 5's list provided *"Good insights in the problems experienced"*. Practitioners 2, 3 and 4 scored the lowest median ratings on this attribute where one rater mentioned the following about practitioners 3's list: *"Extremely short and imprecise descriptions. Actually the descriptions are so poor that you in most cases cannot find out what the problem is"*.

Impact. Table 2 also shows that lower median ratings were given with respect to the impact attribute compared to clarity, which is the case for both the practitioner and HCI specialist descriptions. Practitioners got an overall median of 2 and the HCI specialist 3. Practitioner 1 performed on par with the HCI specialist on this matter and got a higher median rating than the remaining four. One of the external raters commented that practitioners in some problems describe the impact on the user's task but other elements such as business effects and affected system components are left unmentioned. This is also the case for descriptions provided by the HCI specialist.

Data Support. Practitioners' descriptions received an overall median rating of 2 by the external raters where practitioner 1 and 5 scored highest (4 and 3 respectively). In comparison the HCI specialist received the median rating 4 on this quality attribute. One of the raters commented that practitioners in general describe how many test users that experience given problems and that they in certain descriptions state whether or not the task was a success or a failure. Another mentioned that: *"Many problems are not clearly connected to observations"*, thus this rater found that practitioners did not always consider objective data. The same rater additionally mentioned that practitioners made use of vague statements such as: *"The user does not understand"* or *"the user is in doubt"*, statements which are of a speculative nature. However, the practitioners did describe how many test users that experienced the problems and whether or not the tasks were completed, which is similar to the information provided by the HCI specialist. Additionally it was commented that the HCI specialist provided *"good descriptions of the critical incidents"*.

Problem Cause. On this attribute an overall median rating of 2 was given on practitioners' descriptions and the HCI specialist received a median of 3. Practitioners 1 and 5 once more scored higher median ratings than the other three. One of the external raters mentioned the following about practitioner 1's descriptions: *"The list is ok with good descriptions that to a great extent describe causes"*, which was agreed upon by another rater. The third rater, however, found that this practitioner was guessing on the users' thoughts and the cause of the problem in some of his descriptions. Practitioners 2, 3 and 4 were given the lowest ratings in which case all three raters agree that no causes or arguments are provided.

User Actions. Finally Table 2 shows that practitioners and the HCI specialist received median ratings of 2 and 5 respectively on this attribute. Two of the raters mentioned that several of the practitioner descriptions provided examples on users' navigational flow, but that reactions are sometimes described implicitly by stating that users *"are in doubt"* or *"overlooks"* certain elements in the interface. However, according to one of the raters, practitioners 2 and 3 do not describe user reactions at all. Yet again practitioners 1 and 5 scored the highest ratings compared to the other practitioners, where they received medians of 4 and 3 respectively. Two raters found that the descriptions written by the HCI specialist contained detailed information on users' navigational flow and reactions.

5 Discussion

Findings from this study suggest that practitioners are able to identify 48.4 % of all usability problems where the one who identified most problems found 66 % and the one who identified fewest found 28 %. Considering related work, the studies presented in [1], [7] and [21] show that university students are able to identify between 11 % and 33 % of all problems. We additionally found that practitioners on average discovered 78 % of the problems identified by the HCI specialist. In comparison study presented in [20] show that students identified a mean of 37 % of the problems identified by specialists. Thus, in our study we see that the performance of software development practitioners performed closer to the HCI specialist compared to findings in related work.

As mentioned previously, it can be too resource demanding in practice to utilize five evaluators in analysis of usability data, which is why we also examined how many problems each pair of practitioners identified. Our study shows that the most effective pair found 86 % and the least effective found 52 %, where the average was 71.4 %. Also, looking at the number of problems in each severity category, we found that, on average, all pairs identified 77 % of the critical problems, 78 % of the serious and 62 % of the cosmetic. In comparison the HCI specialist identified 50 %, 63 % and 68 % of the critical, serious and cosmetic problems respectively. Thus, we see that two software development practitioners from this study are able to identify more critical and serious problems than the HCI specialist while they have comparable performance with respect to cosmetic. To validate the performance of the HCI specialist in our experiment we found a study conducted by Jacobsen and colleagues which shows that four specialists conducting video based analysis identified an average of 52 % of all problems [10]. This is comparable to the 62 % identified by the specialist in our study. In relation to this it should be mentioned that SW-P 1 and SW-P 5 was the pair that identified most problems (86 %), a finding which may be explained by the fact that they had practical usability experience from their education (7 and 13 years ago respectively, see Table 1). Thus, it could be argued that these practitioners are not novices compared to the participants applied in related work. However, our results indicate, that even by removing all pairs consisting of SW-P 1 or 5 we still find that a pair of practitioners on average perform better than the HCI specialist in terms of number of identified problems.

In the above we have compared the performance of the software development practitioners in this study to that of students', which are used as the empirical basis in related work. The higher level of thoroughness of the practitioners in our study could be caused by differences in the amount of training given and in [7] the students received 6 – 9 hours of training in the form of reading instructions of the methods to be applied. The 14 hours given in our two-day course as a combination of theory and exercises differs considerably from this. On the other hand it is reported in [20] that students received 40 hours of training as a combination of lectures and exercises. Another cause for the differences may be motivational factors, as software development practitioners, due to a competitive market, are more dependent on increased sales of their software products than university students. Also, students may lack incentive in cases where they do not receive payment or if the experiment is part of a mandatory course, a notion which is supported in [20].

Findings also revealed that practitioners on average were unable to fulfill the quality attributes in their problem descriptions to the same degree as the HCI specialist. Exceptions to this, however, were SW-P 1 and 5 who provided a quality comparable to the specialist, which as mentioned earlier may be caused by their previous experience with usability evaluations. Still, the average result corresponds to the findings in [20] in which it is reported that qualitative aspects of the problem descriptions written by students are poorer than that of HCI specialists. Our study extends this quality assessment by dividing it into the five quality attributes mentioned in [3]. This enables us to express that practitioners were better at providing clear and precise problem descriptions than they were at describing the impact, cause, user actions and providing data support for observations. A reason for this may be located in the fact that some of the software development practitioners in our study are used to provide code comments in their software. During one of the debriefing interviews a practitioner mentioned: *"I find it important to write understandable comments because it's easier to get back into the code if you've had one or two weeks of vacation"*. Thus, clarity as a quality attribute is important to industry practitioners in a different context which could indicate why they fulfill the clarity attribute better than any of the other.

6 Conclusion

This exploratory study indicates that cross pollinating usability and software development disciplines may be accomplished by training software development practitioners. Findings show that the practitioners after a two-day training course gained key knowledge on how to conduct usability evaluations as they were able to identify a mean of 48.4 % of all usability problems and that two practitioners are able to identify 71.4 %. This exceeded the performance of an HCI specialist, who identified 62 % of all problems. We also observed that practitioners were better at providing clear and precise problem descriptions than they were at describing the impact, cause, user actions and providing data support for observations. Their problem descriptions, however, were of a lower quality compared to the specialist with the exception of two practitioners.

Findings from this study should be backed up by further studies based on more participants. Also, as our study is conducted at a fixed point in time, we still need studies of long term effects of letting such practitioners do the testing in order to validate that such cross pollination will be carried out in everyday work situations. Also, it would be interesting to conduct further studies on learning retention, e.g. how knowledge within the area increases or diminishes over time.

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Providing Guidance to Software Developers on Selecting Usability Methods through Usability Planner

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Abstract. There is a growing interest in the software development world about adequately managing the usability of the software products produced. HCI (Human-Computer Interaction) literature offers a variety of usability techniques to apply in the development of interactive systems. Software developers with a software engineering background encounter a high difficulty in interpreting, selecting, and integrating these usability methods in the overall software development process. Usability planner offers guidance on usability method selection by providing a categorization of techniques by the software process stage where they are applicable, and filtering the variety of techniques for each stage according to project and organizational constraints.

Keywords: usability-software engineering integration, usability techniques in the software development process, UCD method selection

1 Introduction

Software development organizations need to cater for a variety of quality attributes in the software products they build. Among them, usability has been receiving a greater deal of attention in the last decade.

The growing emphasis on usability may be related to the increasingly wide use of systems by the general public, and the need to deal with the user experience in consumer products. But there is also a wider acceptance of usability techniques in companies developing software systems as a way to obtain higher quality systems, and of UCD (User Centered Design) as the approach to build systems with a high usability level. As a result, more and more companies have started paying attention to the usability of their products, raising their awareness about usability and UCD, and investing resources in introducing usability practices in their day to day practice [15].

When faced with the need to increase the usability level of their products, software development teams and organizations face some obstacles that hinder the integration of usability practices into their development processes. In the first place, there is a terminology breach and a disparity in the concepts handled between SE (software engineering) and HCI (Human-Computer Interaction) [4], in particular in terms of

software process descriptions. For example, the term 'method' is used with slightly different meanings in HCI and SE. A method in HCI can be applied in conjunction with other methods to fulfil the objectives of a particular activity in an UCD process. For example, brainstorming is a method that can be applied for understanding the context of use, and it can be combined with other methods like field observations. On the other hand, a 'method' in SE implies "a notation (or set of notations) supported by a process which guides the application of the notations" [7], suggesting a more organized set of activities, and typically at a higher level than HCI methods. We can say that the term 'technique' in SE is typically used to refer to a similar level of detail as HCI methods, according to its usage in the SWEBOK (Software Engineering Body of Knowledge)[7]. We will use in this paper the term 'method' in the HCI/UCD sense.

Additionally, there is a great variety of existing usability techniques to be considered. For example, [3] identified 95 different techniques described in six different books. It is not surprising that UCD structure and techniques are not very well known and difficult to master for common developers and small and medium-sized development teams [11].

Usability Net [13] offers a good overview of UCD for a software developer. It presents an organized view of usability practices, but it does not offer specific guidance in the process of selecting usability methods appropriate for a particular context.

ISO documentation provides some guidance for the problem of usability method selection. In the first place, ISO PAS (Publicly Available Specification) 18152:2003 [8] offers a process framework that would allow a software engineer to understand the basics of the UCD overall process approach. It can serve for understanding the advice contained in the ISO TR (Technical Report) 16982 [9], which specifically addresses the issue of UCD method selection. ISO TR 16982 offers recommendations on categories of methods to be applied considering specific project, user, task and product characteristics, along with the availability of usability expertise. Nevertheless, these ISO documents are not straightforward to use in a practical situation, they are quite academic, as the Special Interest Group in Software Testing from the British Computer Society [1] highlights.

Usability Planner is an online tool [14] that has been conceived for offering advice on usability method selection through a highly practical approach. It is based on the recommendations present in ISO TR 16982, supplemented with the author's experience in usability integration in software engineering development processes. In order to help in the choice of the stages where usability methods are to be planned, the base practices in ISO PAS 18152 are linked to each stage offered in the tool.

The tool offers two versions (see Fig. 1): A version addressed to users belonging to the HCI field, aimed to help them to introduce new techniques they are not that familiar with; and a version addressed to software developers, which offers a set of stages based in a SE software process view. We will focus on the latter version in this paper.

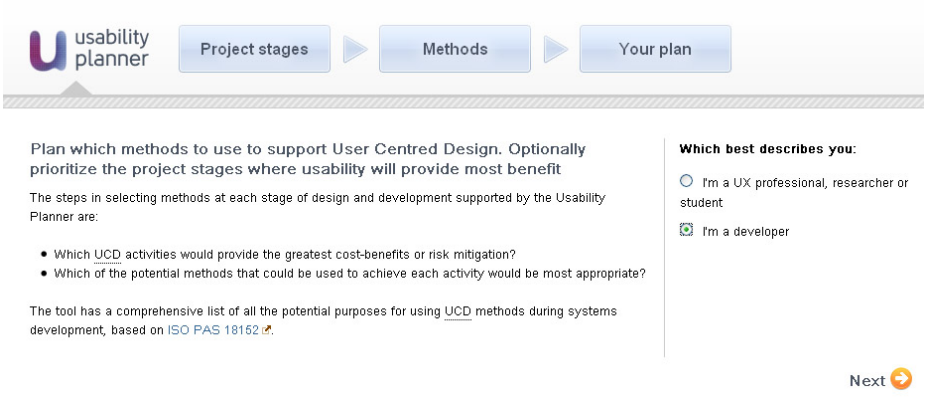

Fig. 1. Home page of the Usability Planner tool.

We consider that the version addressed to software developers can be also valuable to students with a SE background following an introductory HCI course.

2 Software Development Process Stages

Software development processes vary from organization to organization, and even from one software development team to another. Nevertheless, for offering advice on usability techniques to be applied, we have to resort to a generic iterative software process, so that the description of software process stages is easily recognizable for a software engineer. Even if an organization or team uses a specific terminology in terms of stages, such specific terminology should be easily fitted into the generic stages used in Usability Planner.

We have chosen a basic set of four stages, to make them generic enough to be fitted into more fine-grained processes. The following set of four stages and their description to the tool user are based on the RUP (Rational Unified Process) phases, adapted from the RUP description in [10] and [5]:

- **Inception**: During inception, you establish the business rationale for the project and decide on the scope of the project. This is when you get the commitment from the project sponsor to go further. Therefore, the focus is on handling the risks related to the business case: Is this project financially worthy? Is it feasible?
- **Elaboration**: In elaboration, you collect more detailed requirements, do more extensive design and you establish the baseline software architecture. The main focus is on the technical risks, exploring the main technical decisions, and maybe revisiting the scope again, as the requirements become better understood.
- **Construction**: During construction, you carry out the mass of work for detailed design and implementation activities. The focus is on the "logistical" risks; on making every design decision taken previously fit into the built system. The result of this stage is something that can be installed at the end's user workplace, which can be part of the system or the whole system.
- **Deployment**: In the deployment stage, you handle the risks associated with the logistics of deploying the product to its user base, and it also includes monitoring the use of the system when already installed. It can include activities like beta testing, performance tuning, and user training.

The user will be asked for which of these stages he or she plans to introduce usability methods in the software process (see Fig. 2). The advice on the particular methods suggested will be structured according to the stages selected.

3 Constraints to Produce the Recommended Usability Plan

Usability Planner offers its guidance on usability technique selection particularized to the specific constraints of a particular project and organization.

The constraints considered are based in ISO TR 16982, with some rephrasing after iteratively evaluating low-level prototypes of Usability Planner with usability professionals.

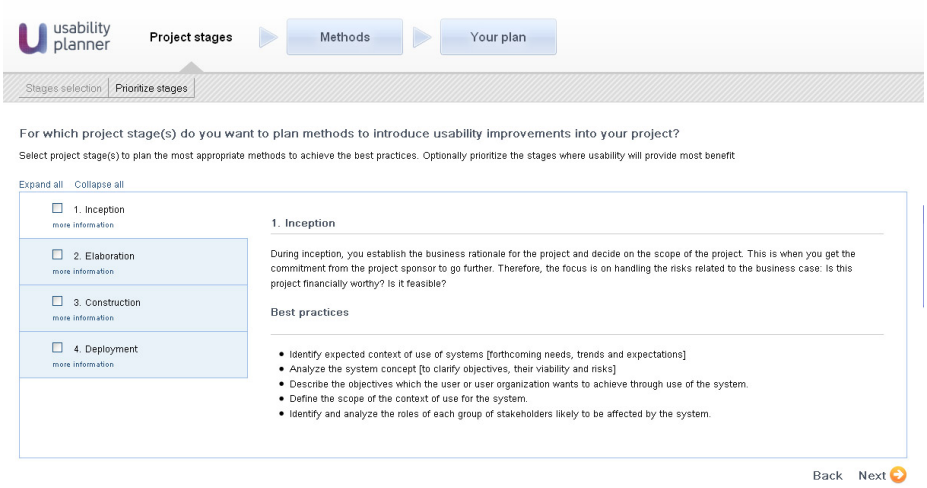

Fig. 2. Selection of process stages where to introduce usability techniques.

The tool gives real-time feedback to the user on the prioritized list of usability methods recommended according to the particular constraints selected. Some methods are taken out of the list when certain constraints are set, while others just change their degree of appropriateness, illustrated by stars besides each method (see Fig. 3).

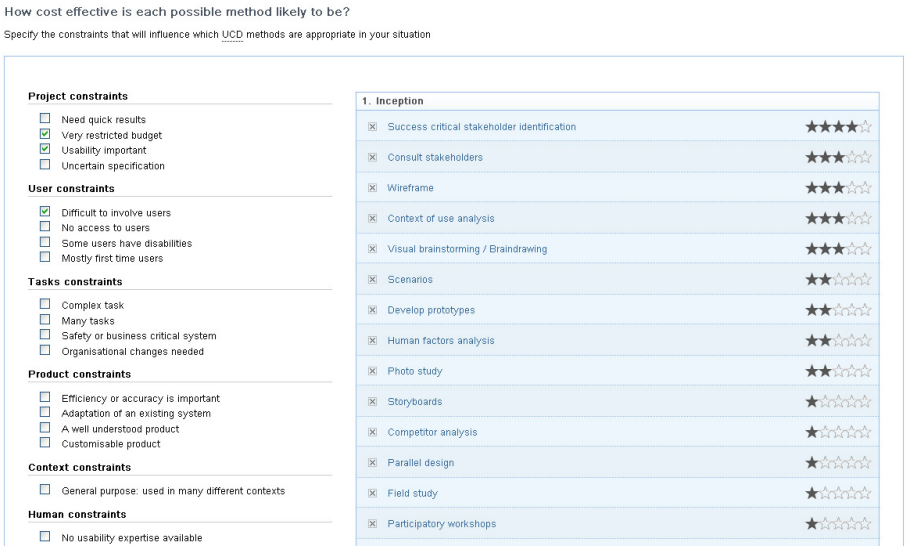

Fig. 3. Setting constraints to produce a specific recommendation of methods.

The user may get a description of any particular method clicking on its name (see Fig. 4). Where available, a link to the preview of the Usability Body of Knowledge [12] is also provided to offer additional information. If the user decides not to apply several methods there is the possibility of deleting them, so that the final plan only contains the methods the user has chosen from the selection of methods recommended by Usability Planner.

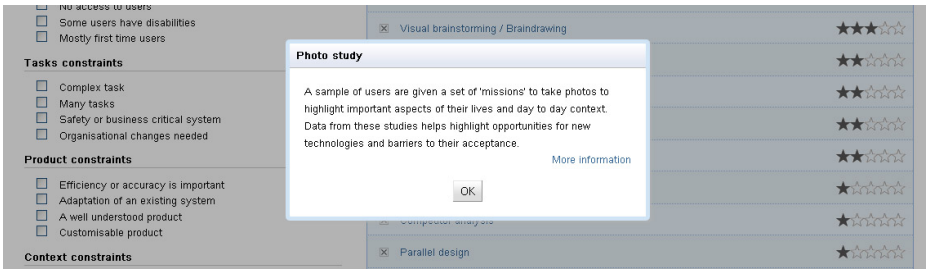

Fig. 4. Description of the Photo study method.

The final usability plan presents the list of methods suggested - and not deleted by the user - organized according to the considered project stages (see Fig. 5).

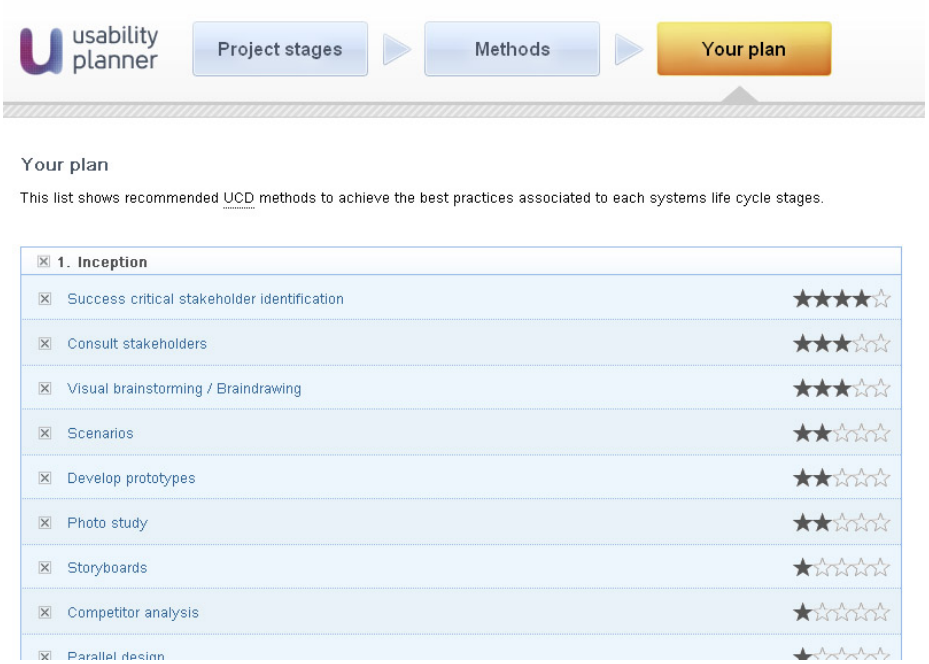

Fig. 5. Usability plan gathering the recommendations of the tool.

4 Evaluation

Previous versions of the tool (with only the version for users coming from an HCI background) have been tested in different venues, including the NordiCHI 2010 conference [2]. The feedback gathered has been positive in terms of the tool usefulness, and it has allowed for a refinement of the tool up to the current version.

The possibility of adapting the set of weights used by the tool to the particularities and experience of a given company or usability expert were highlighted as a positive feature of the tool.

The tool has been offered to students following an elective Interaction Design course, part of a SE Master degree. One of the objectives of the course is that the student is able to map usability activities and techniques to software engineering practices from a software development process perspective. For this purpose the students have been asked in a first phase to select usability methods to apply in a concrete practical project they will work into, by means of a bibliographical research. In a second phase they have been requested to re-evaluate their decision on method selection after applying them, and they have been offered the possibility of using Usability Planner as a source for this latter assignment.

The feedback from the nine students who have chosen to use the tool highlights its usefulness for the purpose of selecting UCD methods. They have also pointed out possible improvements for usage in a learning environment, like the possibility of giving more prominence to certain methods that should be chosen in almost every class project. Additionally, some misunderstandings with the meaning of the star ranking will have to be considered for the design of the next version of the tool.

As mentioned above, we consider that the tool may be of interest to a wide range of possible users, including software developers with interest in usability and UCD; HCI students; and junior usability professionals. Even senior usability professionals may have interest in the tool as a support to push the adoption of usability practices into organizations. Nevertheless, further evaluation is needed to get evidence of the tool utility for different groups of users.

5 Conclusions

Usability Planner is offered freely as a web tool to anyone needing support in the decision of which usability methods to apply in the development of interactive systems, according to the particular constraints for the project or organization. The code will be offered as an open source license (GNU General Public License, version 3 [6]), to ease the possible extension of its functionality and to favour its use.

While the tool initially embodies the knowledge of the authors, this will be refined by iterative evaluation. The content is customizable so that expert HCI consultants may employ their expertise modifying the criteria for method selection present in the tool to match their own situation.

The preliminary evaluation of the tool has offered promising results about its usefulness.

The next steps for improving the tool in future versions include:

- Offering the possibility of saving the current project to allow sending a usability plan to colleagues, or to re-evaluate selection decisions in another session.
- Refining the set of methods and criteria, and the internal weighting, to improve the quality of the recommendation, comparing the output of the tool to recommendations by usability professionals.
- More formal evaluation of the usefulness and usability of the tool for the intended users, in particular for practitioners with a software engineering background.
- Including an easily understandable way of grouping particular methods to be applied in a stage according to UCD terminology, to allow easier communication between software engineers and usability professionals.

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A participatory design approach to use Natural User Interface for e-Health

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Abstract. This paper presents a study on developing a cross-pollinate solution to software for e-health considering Natural User Interfaces (NUI) as a paradigm for interaction with ICTs and also the Participatory Design (PD) to ensure accessibility and usability. The research methodology involves performing a reengineering process in a game known as "*What is it?*", reaching the construction of games to approach citizenship concepts. The reengineering process consists into derivate a new collaborative self-sustainable application, which is also culturally context-aware. In this scenario, the NUIs stand out focusing on interaction styles enhancing people skills, making this interaction more natural, while the PD includes the effective people participation in the environment development process, ensuring their needs. Thus, it's expected to allow a greater amount of individuals using these environments, motivated to participate during those environments development.

Keywords: Natural User Interface, participatory design, cultural context aware, e-health.

1 Introduction

Through technological advances, the communication and integration engines are being progressively explored and expanded. This provides an increasing amount of new environments to information and knowledge exchange that must be developed to meet specific needs of its users. Thus, such environments should ensure accessibility and usability principles to make their use pervasive and ubiquitous.

Based on this context, this paper supported by MICROSOFT-FAPESP (proc. 2010/52135-9) aims to present an approach to such environments, especially within e-health context, evolving principles that increase their use and promote the easiness the user interaction with system. The proposed approach proposes a cross-pollination between DP and NUI in the development of computer-based information environments target to e-health, presenting potential scenarios to apply the proposal.

The participatory development of digital environments intended to ensure user needs, considering the participation of all stakeholders, where each contribute with their experience and knowledge. It's important to note that DP identifies detailed the contextual restrictions of the application use, differing from usability guidelines,

which tend to be more comprehensive. In addition, NUI covers new interaction styles, focusing on personal skills, making the interaction between people and technology as natural as possible.

This Section presents the main goals and motivation of the work and how the work is conducted. The theoretical background overview about DP, NUI and e-health is presented on Section 2. On Section 3, it's described the potential scenario where the proposal cross-pollination approach will be developed. Finally, conclusions and further works are presented on Section 4.

1.1 Motivation

Computer-based environments can contribute to the work of health professionals, as well benefit patients. Considering a hospital context for chronic patients, the adoption of such technologies on appropriate design of computational tools for health professionals and patients may provide better support tools and devices, helping professionals in the challenge of monitor and assist patients, potentially allowing a soft and gradual process of transition from patient to society.

1.2 Methodology

To develop proposed approach, it is suggested a reengineering process to be conducted in a specific application, the "What is it?" which was chosen because it is a computing environment that potentially make easy the teaching and learning, also enabling the authoring of guessing games based on cards with content that may be appropriate to local culture and the needs of people who are going to use the game [12]. The goal is to tailor the refactored application into e-health context in order to make the interface more natural.

In complement, it's performed a bibliographical and documental research, as well a descriptive and exploratory analysis to develop the proposed approach, identifying issues to help developers in the participatory preparing of environments based on natural flexible interfaces to increase the interaction into e-health context.

2 Background

In this section it's introduced the concepts that found the background of the work.

2.1 Participatory Design (PD)

Participatory behavior is a collaborative process that takes isolated people around a common problem and validates their experience as a base to for understanding and critical reflection, contextualizing issues and weakness, linking them to political realities and development activities [4]. On PD there are different ways to define and classify the user participation. The kind of participation refers to which stakeholder is

going to participate, implicating in involving different roles. On PD, it's also possible to have a direct participation, where the system's stakeholders are included into the development process, while in the indirect participation only a set of stakeholders participate [2].

As the user participation is to the development of the proposed environment, the DP usually must involve employees, customers, citizens and end users to ensure that the developed product match stakeholders needs and if it's usable. Consequently, all stakeholders must agree with what will be done in order to make it a clear goal to all.

Prior to discuss the system, the participants usually discover new insights regarding the living situation and the effect of these insights on their own situation, where they can be well aware of their everyday political role to trace the society [1].

The PD is closely related with other Human-Computer Interaction (HCI) approaches, such as User-Centered Design, Interaction Design, Collaborative Design, Interface Design and others. However, these approaches take into account focus on how users interact with the product but do not involve them on the development process.

So, the proposed PD approach on this work aims to involve user participation on the development process through techniques that enable user to actively participate on the definition about what will be developed. Some of the techniques that may be used are: interviews, workshops, prototype, group dynamics, ethnographic studies, social networks and scenarios.

2.2 Natural User Interface (NUI)

Natural User Interface doesn't have a formal definition and its concept is too wide, usually relating to GUIs (Graphical User Interface) and devices that recognizes and reacts to gestures, vision, motion, touch, and voice [5][6] and also allow direct manipulation of systems and devices.

The intention of NUI is to enable an interaction between user and system centered on the information processing and make the interface more intuitive to use and close to interaction behavior of the real-world, spanning several devices [5]. So, the users may easily learn and operate an interface by bringing interaction behaviors they are familiar with, making them do not focusing on the interface itself and device constraints, but on the task to be performed, defining a natural interface.

A common associate with NUIs is multitouch and surface computing, which are the orientation used in this work. NUI go ahead the traditional GUIs and adds a rich intuitive interaction model, potentially improving usability and user experience. However, as it is an emerging field, not all usability issues are known [7].

As NUI are based more in cognitive functions rather than physical functions, it "seeks to harness the power of a much wider breadth of communication modalities which leverage skills people gain through traditional physical interaction" [6].

2.3 e-Health

Although there is no consensus regarding the definition of e-health (electronic health), as it is similarly wide as NUI, it commonly refers to devices or computer-based applications that support to health activities. It's an emerging field that intersects medical informatics, public health and business, involving a way of thinking about how to improve health care locally, regionally and worldwide through the use of ICTs [8], suggesting a perspective of interaction between healthcare systems [9]. The use of ICT on healthcare industry purposes the improvement of "access, efficiency, effectiveness and quality of clinical and business process utilized by healthcare organizations, practitioners, patients, and consumers in an effort to improve the health status of patients" [10].

On this work, e-health is assumed as Internet and related technologies that supports healthcare and well-being services to conduct relationship between health professionals, patient and the society.

3 Potential Scenario to Develop NUI for e-Health systems

The proposal deals with the development of a culturally context-aware environment for flexible and natural interaction. A potential scenario to apply this proposal is a Brazilian hospital for mental health treatment with focus on psychiatric disorders and neurological damages, where the environment can support the deinstitutionalization of the hospital, as it is a public policy on Brazil.

The environment is culturally context-aware because it's intended to cover physical, cognitive and emotional skills from health professionals when dealing with patients in transition. To support this feature, it's used the Open Mind Common Sense Brazil (OMCS-Br) [11][12][13][14] knowledge base, which is built collaboratively by Web volunteers, making possible to explain certain themes through contextualization and use an easy vocabulary in accordance with users' reality.

The main feature of this environment proposed it's the natural, adaptable and adaptive interface, which involves system adaptation by and for the user in an intuitive mode, based on NUI approach to provide a natural interaction between people and technology.

The environment must handle the whole socialization process of patients, supporting the adaptation and transition of them to get back to live in society. Thus, the environment become complex by implicate in the incorporation of several components. The project expects to reach the following goals:

- Improve information management between health professionals;
- Establish competences to patients and make them participate in society;
- And support communication between health professionals and the patients' community.

3.1 The *"What is it?"* framework

Originally, the "*What is it?*" is a common sense-based framework to develop culturally contextualized quiz games for educational purposes. The framework aims to offer teachers the support to contextualization of educational games in order to promote a meaningful and effective learning for students [11][13][14]. Several themes are covered into the framework, highlighting health themes.

The framework have a player's module (Figure 1), as main interface, where students can play the game proposed by the teacher through the editor's module, that is a "seven-step wizard which guides the teacher to create game instances, which fit to their pedagogical goals" [12]. The web-based application is currently limited onto provide feedback for the OMCS-Br knowledge base according to students answers on quiz.

Fig. 1. Player's module, where students play the game by selecting cards (*clues*) and try to guess the correct answer.

3.2 Reengineering Process

The proposal integrates multiple platforms and involves interoperability between distinct interfaces, hardware, databases and applications such as: organizational games in virtual environment, applications restrict to hospital context and interaction between patient and society via NUIs.

To accomplish this requirement, the environment is developed to be self-sustainable, providing feedback to OMCS-Br knowledge base, leading to continuous evolution of the system, in which health professionals can change and insert needed information and functions.

4 Conclusions and Further Works

Rather than focus on users competences, HCI researches are converging to focus on users' abilities, associating technologies they already know and using computer-based resources to exchange information and knowledge. This implies the existence of wide factors set, reaching since emotional and affective aspects of sociability and human values until technical issues as security, scalability and performance. For this, a PD approach is required to involve stakeholders and integrate different users' view to meet their needs.

The Ability-Centered Design (ACD) is the focus of this work's continuity, including the proposed environment that aims to project NUIs that use voice, movement and direct manipulation, respecting users' abilities to operate collaborative computer-based applications, used in conjunction with different devices.

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Unifying contextual descriptions in patterns

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Abstract. When describing good solutions to given problems in patterns, the consideration of context and the description of different contexts in design patterns is an essential task. Based on the varying requirements, goals, and intentions that are addressed with design patterns in different research areas such contextual descriptions can be ambiguous. In this paper we analyze existing pattern forms and show the relevance of contextual descriptions in patterns. We further introduce categories and a structure for defining and describing context within patterns. This builds the basis for a tool concept that has the goal to unify the usage of contextual descriptions within patterns. This approach allows to regard to such specific descriptions from patterns originating from different research areas.

Keywords: Human Computer Interaction, Software Engineering, Patterns, Context

1 Introduction

Using patterns in the area of software development has a long tradition in computing. Based on the first definition of patterns in the form of architectural patterns by Alexander [1], patterns represent a way of providing a structured description of a validated solution to a given problem. This was picked up by the area of software engineering (see [6,12]) where patterns were used to depict approaches for software architectural design problems. In the last twenty years the usefulness of this approach was recognized and became essential in the area of human computer interaction (HCI) (see [5,9,16,18,19]). Patterns in the form of user interface design patterns, interaction design patterns, and user experience patterns [15] describe different aspects of HCI. They address problems occurring during the design of user interfaces as well as on the users' side when interacting with the user interface. Due to the generalizing and structuring nature of patterns, patterns can act as a method bridging the areas of software engineering and human computer interaction.

All the different description approaches are based on pattern forms that describe the structure of the particular patterns. We investigated state of the art pattern forms to evaluate the usage of context within the particular patterns (see Section 3.1).

Contextual descriptions within patterns are used to describe the constraints for the problem addressed in the patterns. In this paper we analyze existing

pattern forms according to the applicability in different areas, i.e. software engineering and human computer interaction (HCI).

To be able to use such a contextual description also computationally and to be able to find, filter, and relate to contextual descriptions in different patterns but also other tools that could benefit from contextual descriptions we first structured contextual descriptions to be applied for interactive systems (see Section 3.2).

In Section 3.3 we base on this idea and propose a concept for the *Context Browser* tool. The tool allows to use and reuse contextual descriptions in different patterns and thus provides a way to integrate contextual aspects in different patterns based on different areas. The tool itself will provide extensive functionality to find, adjust, and adopt different contextual situations.

The paper is concluded in Section 4 with a discussion about the limitations and potentials of such an approach as well as an outlook of our plans to develop such a tool.

2 Related Work

Patterns have a long tradition especially in the area of software engineering. Alexander [1], an architect being one of the pioneers in the field of design patterns defines patterns in the following way. *"Each pattern describes a problem that occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice."* This approach was picked up by different areas of research and engineering.

Gamma et al., also known as the Gang of Four – GOF, address the problem of developers reinventing the wheel over and over again by introducing a pattern library that provides proven solutions to problems in software engineering. They define their own pattern form (GOF) that was applied in their book containing an extensive amount of object oriented software engineering patterns. [12]

Further work introducing organizational and process patterns into software engineering was done by Coplien [7]. He focused on the use of organizational patterns and their use within a software engineering process.

First approaches towards the usage of patterns in HCI have been established by Welie and Tidwell, who focus on design patterns in the area of user interface design [18,19]. Both use an extended alexandrian pattern form and provide an extensive collection of state of the art user interface design patterns.

Borchers developed a hypertext model for interaction design patterns. He especially focused on the usage of patterns within a usability engineering process and elaborated on the different approaches of software engineering and HCI. [4] In the CHI workshop on perspectives on HCI patterns in addition a computationally usable pattern form was agreed by introducing the pattern language modelling language (PLML) [10].

In [15] a pattern language of user experience patterns based on the pattern form introduced by Borchers was developed.

Further work in the area of HCI patterns comprises [2,8,9,13,16].

Although both areas, i.e. software engineering and HCI, use patterns within their design and development process, the field of application of patterns differs in both. Folmer [11] addresses this in his approach for using and matching HCI patterns within a software engineering approach. He derives bridging patterns that relate usability problems and software engineering problems. Folmer's bridging patterns rely on Welie's pattern form while addressing both perspectives in his patterns. His approach is based on not only providing solutions to an interaction design problem but further to provide appropriate software engineering approaches to a given problem.

In Biel et.al [3] we extend this work by defining a software architecture analysis method that uses a repository of HCI patterns to identify areas that could lead to usage problems. We further showed that usability evaluation and software architecture complement each other leading to more specific and better evaluation results of software.

The approach described in this paper differs by focusing on common characteristics of patterns, where context plays a major role. The contextual descriptions that are evident in existing pattern forms describe context mainly in free text. This leads to ambiguous and misleading interpretations when defining and using contextual descriptions within patterns. To be able to computationally address contexts we elaborated a way of describing context based on a context description model (see Section 3) with the goal to introduce proper categorization of contextual descriptions as well as having a computationally processable description of context. Additionally we propose a first concept of a tool that allows to use and define contextual descriptions in patterns.

3 Context Browser

The context browser is a concept of a tool that allows to find and use different contexts or contextual situations within design patterns. To be able to identify the role and reasonable ways of using context we first elaborate on the role of context in existing pattern languages. Based on existing contextual descriptions we introduce a categorization and structuring approach of contextual descriptions that shall be covered by the tool.

3.1 Context – a bridging factor in patterns

The role of context regarding design patterns is indisputable. Context plays a major role in the appropriate definition of a pattern, which was already identified in the early works in the area of design patterns [1,12,19].

In Table 1 we analyzed existing patterns forms applied in pattern libraries mainly in the areas of software engineering and human computer interaction. 18 different pattern languages represented through their own particular pattern form have been analyzed. The main evaluation focus was the role of context and the way of how context was represented in the particular pattern form.

Table 1: Context in Pattern Forms

Form name	Type*	Base Form**	Type of description of context
Alexandrian	A	–	Free text describing contextual restrictions for a design problem.
Canonical	D	Alexandrian	The context section is describing the contextual restrictions. Free text.
Coplien	D	Canonical	The context section is describing the contextual restrictions. Free text.
GoF	SE		The "applicability" section is describing the contextual restriction.
POSA	SE	∼GOF	The context section is describing the contextual restrictions. Free text.
Compact	SE		Free text describing contextual restrictions for a design problem.
Cockburn	PM		Forces describe the constraints that are related to the given problem
Portland (ThereforeBut)	D		Free text describing contextual restrictions when explaining the problem
Beck	SE	∼Compact, Portland	The context section is describing the contextual restrictions (optional).
Fowler	SE	∼Portland	Free text describing contextual restrictions for a design problem.
Tidwell	HCI-UID	∼Alexandrian	The context section is describing the contextual restrictions.
Tidwell II, Welie	HCI-UID	Common Ground [1]	The "Use when" section refers to contextual restrictions. Context information is also desribed in the problem statement.
Yahoo Design Pattern	HCI-UID	∼Alexandrian mixed with Welie,Tidwell ...	The context section is describing the contextual restrictions. Free text.
Toxboe, Endeca (UIDPL)	HCI-UID		The "usage" section is describing the contextual restrictions. Free text.
Quince	HCI	Tidwell	The context section is describing the contextual restrictions. Free text.
Borchers	HCI-IxD	Alexandrian	Borchers constructs a hypertext based form where the context section describes the constraints in free text.

Legend

*Types: A ... architecture; SE ... software engineering; PM ... project management; HCI ... human computer interaction.; D ... general design pattern

**Base Form: "∼ XXX" ..."similar to XXX"

[1] Common ground is a pattern language for Human Computer Interface Design by Jenifer Tidwell – `http://www.mit.edu/~jtidwell/common_ground.html`

Based on this comparison we could identify that all pattern forms have in common that a representation of context was evident within the analyzed pattern descriptions. The way how context is described was based on free text. The semantic content of the descriptions is based on constraints and requirements evident in the contextual descriptions. This allows to us to infer that different perspectives on context as well as different approaches of describing context have been identified in existing context description approaches in design patterns.

3.2 Describing Context

In order to properly address context and contextual descriptions that address an interactive system where a user interacts with a system via a user interface, different perspectives on context need to be addressed during the description of context.

The two main roles as described in [14] are the user and the system. These two roles represent the two areas of human computer interaction (HCI), where the user has a central role, and the application or interactive system defined and developed through software engineers. The user interface in between builds the bridge between both areas and is designed and defined by usability engineers working in the area of HCI and made functional through the system that connects and links the user interface to the particular functionality and features to be provided by the system and implemented by software engineers.

In order to be able to map and properly describe and categorize any contextual information relevant to an interactive system we defined three different basic categories of context.

As shown in Table 2 the *Usage Context* represents the user's perspective of an interactive task and contains the contextual perspectives of the user himself, the task, and the constraints describing specifics of the interaction context the user resides in. The *Development Context* represents the application or system's perspective of an interactive task. Such a task usually is based on functionality and features that need to be implemented. Contextual parameters specify such functionality on one hand and outline the parameters that could be used to implement such functionality on the other hand. The *Design Context* in between is representing the potentials and restrictions of a design process and the respective design objects.

Table 2: Context Factor Categorization

Category	**Goal (Sub-)Contexts Parameters**	**Description**
Usage Context	Goal	Identify and define the context of use
	User Context	Represents the context relevant to the user
	Task Context	Represents the potentials and constraints regarding a specific task

Table 2: Context Factor Categorization

Category	**Goal (Sub-)Contexts Parameters**	**Description**
	Parameters	Temporal Context Environmental Context Social Context Information Context
Design Context	Goal	Defining the relevant contextual parameters regarding a design task
	User Interface	User Interface Design
	Situational Context	Interaction Design
	Tools & Methods	Design Tools Design Environment Design Approaches
Development Context	Goal	Define the approach (software architecture, development approach, etc.) of how to implement a distinct interaction scenario
	Functionality & Features to develop	The system architecture, workflows, etc.
	Parameters	Temporal Context Environmental Context Social Context Information Context

This allows us to introduce a categorization of different context descriptions to different research areas as well as to structure contextual descriptions in a way so that they are applicable within tools requiring a contextual description.

3.3 The Context browser – A tool for introducing a common description approach to context in patterns

The Context Browser is a concept for a tool that allows to use and manipulate contextual descriptions. The primary goal of this tool is to allow to address context and contextual descriptions within other tools like e.g. pattern repositories.

Figure 1 depicts the concept for the Context Browser tool.

To allow finding and filtering of existing context descriptions, the descriptions themselves shall be stored in a repository based on ontology that allows to use and identify contextual descriptions. The Aspect-Scale-Context Model of Strang et al [17] is currently evaluated whether it could provide a basis for such an ontology. The contextual descriptions themselves and the structure to be represented by such an ontology shall contain categorizations, aspects, and context factors based on the context description model see [14]. These identified parameters of contextual descriptions allow on one hand to provide more complex

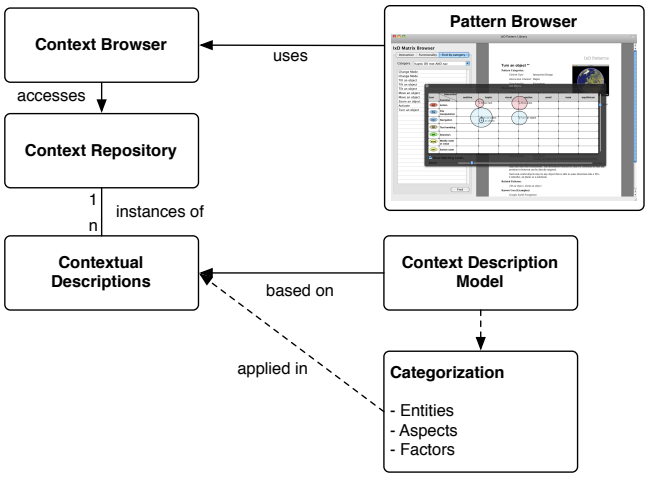

Fig. 1. ContextTool

search functionality and on the other hand to filter the amount of existing context descriptions in a way useful to be applied within other tools.

The Context Browser tool itself allows to access the previously described repository and efficiently find and re-use existing contextual descriptions.

The functionality provided by the context browser shall be made available to third party tools like a pattern tool that could use such contextual description to introduce a proper description of contextual situations of an interactive system. Such an integration can be done via the integration of web-services in order to be able to use such a context browsing tool also in already existing pattern repositories.

4 Conclusion and Future Work

In this work we elaborated on the role of context and contextual descriptions within patterns. We identified the mutual usage of contextual descriptions in the area of software engineering and HCI. Based on these findings we developed a categorization that allows us to describe context in a structured way. This allows to use contextual descriptions also in a computational way by analyzing the semantics of existing contextual descriptions, updating, verifying, and categorizing contextual descriptions based on an e.g. ontology and techniques already developed in the area of the semantic web.

We further proposed a first concept for a tool that supports the required functionality and integrates into existing pattern tools. To show the usefulness of the approach and to identify wether the potentials of unified contextual descriptions exceed the more restrictive description approach, the tool needs to be applied and evaluated with designers and developers.

Future work comprises the more concrete definition and development of such a tool. This includes the implementation of a repository of contextual descrip-

tions, the tools that are analyzing and defining existing contextual descriptions, as well as a web-service providing the required functionality so that the Context Browser tool can be used and applied. An evaluation and iteration of the context description model in different areas like e.g. the automotive and factory area will be conducted to establish such a repository.

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Methodological Challenges of UX Evaluation in the Living Room: Developing the IPTV-UX Questionnaire

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Abstract. In our daily practice evaluating user experience (UX) for interactive TV (iTV) systems we have found that currently available evaluation methods and their outcomes do not help us improve the overall user experience for these systems. From a practical/industrial perspective, methods are missing that allow to evaluate user experience at early stages of the development cycle and in combination with standard usability evaluation methods, as well as methods that help to inform the design on how to improve the overall experience. This paper presents the first step in our approach: the IPTV-UX questionnaire. The IPTV-UX addresses key UX factors in the iTV domain (aesthetic impression, emotion, stimulation, identification, relatedness and meaning and value) and evaluates product attributes and interaction technology, usability and personal attitude. We present each of the factor and the items uses within the questionnaire, as well as first results from the validation.

Keywords: **User Experience, IPTV, Evaluation, Questionnaire**

1 Domestic Interactive Media Systems: A Classification

Interactive TV today is a frequently used term describing a variety of approaches, services, devices and possibilities enabling a user to interact with media content, especially TV, but also radio, videos and other forms of media content as well as access to the Internet including latest trends like social media. As there is no common definition for interactive TV, we use the term "Domestic Interactive Media Systems" following initial descriptions in this area of research [25].

What has changed since the initial studies and attempts to describe interactive systems in the home context starting in the early 1990ies is that today in 2011:

(1) the availability of a broad variety of systems and services allowing to consume the same content on a variety of devices (cross-device) has increased.
(2) the ability to get and consume the same content via different media sources (e.g. an episode from the Simpson can be watched on live TV, requested via

video-on-demand for the mobile phone or can be enjoyed in the in-car entertainment on DVD) is given in most of the European households,

(3) the majority of people in Europe is well educated in terms of technology, for example 91 of 100 households in Austria own at least one mobile phone [33] and the availability of other technical equipment is steadily increasing [2].

To define our working definition of *domestic interactive media systems* we conducted a usage context analysis following ISO 9241-11 (users, goals, tasks, equipment). The usage context for these domestic interactive media systems has been changing considerably with respect to the last five years [18]. Today there is a broad and varied user base for domestic interactive media systems, for example today, globally about 45 million users watch TV via IPTV (Internet Protocol television). The goals for media consumption are changing from mere watching TV to enjoying media in various (socially connected forms). Especially when looking at the available technical infrastructure, a considerable change is noticeable: Equipment for interactive media systems includes set-top boxes, DVD players/recorders, standard TV's and Internet TV's, home gateways, mobile phones, a range of remote controls and so on. Compared to a former analysis of this kind of context (see e.g. [18]), the number of devices has been growing and the equipment for interactive TV does no longer only consist of a combination of TV, set-top box and remote control.

3 Research Problem

Goal of our research is to develop a set of methods that allows us to evaluate usability and user experience of new forms of technologies that are (at least partly) used in the home context for any form of media consumption (domestic interactive media systems). The research objectives of our current projects in the domain of interactive TV are (1) to understand how an interaction technology (e.g. the remote control) does contribute to the overall user experience when interacting with an iTV system. (2) How usability and user experience are related in that specific domain (e.g. does the enhanced user experience of a gesture based interaction really contribute to a positive user experience 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 (before a product is available). The research is motivated by the industrial context. Given that we produce up to 40.000 remote controls on a daily basis, the improvements in the overall user experience can affect up to 15 million people every year.

The research problem we address in this paper is related to the third research topic and investigates **how to evaluate user experience of domestic interactive media systems** to inform the design and development process at all stages of the development.

4 State of the Art

4.1 The Concept of User Experience

Improving user experience for interactive TV systems in important within the industrial context, as UX has become a key factor in the buying decision of the consumer and as UX is one of the few elements that allow competitors to differentiate. Within the HCI community UX is still said to be not well-defined [9, 21]. Despite several attempts to define and better explain the user's experience when interacting with an interactive system in the past, the HCI community still has no unified definition of what really makes up UX, which factors to measure, and how to rate it. An ISO Standard defining UX exists, 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." [13].

The difficulties in getting a more refined definition of UX are caused by several reasons: (1) As opposed to the task-based, efficiency- and effectiveness-based usability [12], user experience is associated with a broad range of "fuzzy and dynamic concepts" [21] having a multitude of meanings, ranging from "being a synonym for traditional usability" to beauty, hedonic, affective or experimental aspects of technology usage. (2) It is still unclear if user experience is a measurable concept. Given the current approaches to refer to a set of factors related to user experience, it becomes clear that the set of factors might be different for various application domains. In areas like games for example, factors like fun, playability, or Csikszentmihalyi's concept of flow [3; 15] are more important than for example in the area of safety-critical systems. Within this multitude of concepts [21] the inclusion and exclusion of particular variables seem arbitrary, depending on the author's background and interest.

Hassenzahl [9] summarized the current approaches and concepts in three groups:

1. *Beyond the instrumental*: Usability's task-based evaluation and the focus on the instrumental value were repeatedly challenged, e.g. Alben [1] identified the aesthetic experience as an important quality of technology usage.
2. *Emotion and Affect*: Goal of UX is to understand the role of affect as an antecedent, a consequence and a mediator of technology. It rather focuses on positive emotions and emotional outcomes such as joy, fun and pride.
3. *The experimental*: The third perspective looks at temporal and situational influences, asking for the dynamics of an interaction, how unique, complex, temporary or situated an experience is. In this view, an experience is a unique combination of various elements, such as the product and internal user states (e.g. mood, expectations, active goals), which extend over time with a definitive beginning and end. The experiential assumes all these elements to be interrelated – to interact and modify each other. The outcome of this process is the actual experience. [6]

4.2 Measuring User Experience

A broad variety of UX evaluation methods is available today. To measure the user experience beyond the instrumental, task-based approach Hassenzahl [8] introduced the AttrakDiff questionnaire. Approaches focusing on the evaluation of emotion and affect include approaches like EmoCards [5] that ask the user to indicate the emotional state based on graphical representations. Other ways to measure the emotional response include physiological measurements (e.g. heart rate, skin conductance) or the evaluation of valence and arousal, which are currently a topic of detailed investigation especially in the games area [23].

To evaluate situational or temporal experiences, some approaches in mobile UX exist, using conceptual-analytical research and data gathering techniques. For prototypes, usability evaluation methods can be enhanced by including experimental aspects to the evaluations, e.g. in long-term field trials, where diaries, experience sampling, questionnaires, and focus groups can be used to collect additional data [31].

Law and Schaijk [20] summarize that user experience measurement should essentially be self-reported, trajectory-based and adaptive, in accord with the common understanding of UX as subjective, dynamic and context-dependent [5]. Thus, traditional techniques such as questionnaire, interview, and think-aloud remain important for capturing self-reported data [20].

For the development of a new UX evaluation approach for interactive TV it is important to understand the contextual influences of this application domain. Especially usability seems to be connected to user experience [34]. In the area of iTV it is still rather unclear if usability should be seen as one of the factors that contributes to the overall user experience, if usability is a necessary prerequisite for an overall positive user experience or if the subjective component of the classical usability definition "satisfaction" can be simply replaced by UX. In a first study for the area of iTV we have shown recently [29] that good usability does not necessarily impose a better user experience, and lower rated usability values can at the same time lead to high user experience ratings. For this product related finding it became clear that product design as well as visual appeal are influencing the users' willingness to use a product

For the development of a specific user experience evaluation method for the area of domestic interactive media applications the following aspects are important:

(1) In the context of the living room, different factors are of importance than in other domains, e.g. in a work environment. Media consumption is more related to entertainment and leisure and the specific context of usage (e.g. the home) has a major influence on the user experience.

(2) The user experience of domestic interactive media applications is related to the usage experience of the interactive media application (access to the content using a certain form of interaction technique with a specified interaction mechanism), but is influenced by the consumption of the content (e.g. if I like the movie might influence my overall experience of the system). An evaluation methods for this area has to take this possible influence into account.

(3) The usability of the system and its interaction technique might heavily influence the overall user experience (especially if content simply cannot be accessed).

5 Solution Framework

To develop a set of UX evaluation methods that enables the evaluation of interactive media systems, the following methodological approach was chosen [27]: First we conducted a field study, to investigate what factors users relate to user experience [28], second - based on an extensive comparison of UX approaches and product evaluation approaches - a set of additional UX factors was identified. This built the basis for the UX-IPTV questionnaire. In a third step we will conduct a set of expert interviews for this domain to lay a basis for a set of expert based UX design patterns for domestic interactive media applications.

In the field study [28] the following factors were confirmed (from a user perspective (!)) to be contributing to the overall user experience: (1) Aesthetic experience, (2) emotional response and pleasure, (3) usability and utility, and (4) relatedness, especially for systems that offer communication features. We replicated previous findings [26] that spatial, temporal, social, personal and technological context and the context of context are the main contextual factors that have to be taken into account in that area. An important finding was the relative importance of usability within the framework of user experience. Users rated overall usability as a concept being more important in the domain of interactive media applications than user experience.

For the identification of core UX factors, an extensive literature review identifying factors related to user experience was carried out . The comparison of these factors is beyond the scope of this article, but will be presented in the upcoming thesis report of the second author. We compared more than twenty user experience approaches with a set of over fifty methods. The following factors were additionally taken into account: stimulation, identification, status, value and the role of the product and the interaction technique for the overall UX.

6 IPTV-UX Questionnaire

The IPTV-UX questionnaire was developed based on the key UX factors identified in the field user study and in the extensive literature review. It consists of the following:

(1) The core user experience factors: Aesthetic visual impression (beauty and classic aesthetics); Emotion; Stimulation; Identification; Relatedness; and Meaning and Value.

(2) User experience aspects related to the interaction technology used: a set of specialized questions about the interaction technique and mechanism used to control the media application, the product attributes (e.g. shape and form of the remote control) and their relation to the overall user experience.

(3) Relation between perceived user experience and the interaction technology as well as the possible influences of content and services (e.g. how having new and unique services affects the television experience).

(4) Attitude of the user, evaluating how important the concepts stimulation, status (identification) and relatedness are for the specific participant.

(5) The relation between usability and user experience (e.g. asking how having to use trial and error to perform a task affects the TV experience).

To assess the affective aspects of user experience we used a semantic differential with seven bi-polar adjectives (following Hassenzahl 2004). Opinion, values and judgments, as well as the questions on the interaction technology were based on a 5 point Likert scale. The questionnaire is structured in five sections. The initial version of the questionnaire is in French. Items and scales were translated to English for this article.

6.1 Core User Experience Factors

The **visual aesthetic experience** deals with the pleasure gained from sensoric perceptions [11], it includes beauty [8] and Jordan's [16] concept of physio-pleasure, as well as classic aesthetics (e.g. clear, symmetric) [19]. It follows Alben's [1] statement that objects have to be aesthetically pleasing and sensually satisfying, and Quinn and Tran's [30] observation that attractiveness, aesthetics and efficiency have a significant influence on perceived usability. The IPTV-UX questionnaire included items like beautiful vs. ugly, clear vs. irregular, well arranged vs. confusing, appealing vs. unappealing, symmetric vs. asymmetric, flawless vs. imperfect, stylish vs. unstylish etc.

Emotion has been identified as a key factor of user experience [9]. For Desmet and Hekkert [4], the emotional experience is one of the three main factors contributing to product experience, including feelings and emotions elicited (based on the emotion appraisal model). Also Alben [1] addressed the factor emotion as the emotional response as an outcome of the interaction. UX from our point of view focuses on positive experiences. Izard [14] described 10 basic emotions, of which the three clearly positive emotions were chosen to be included in the questionnaire, which are interest, joy and surprise. Competence as a need fulfillment has been described by Sheldon et al [32], Hassenzahl [10], and Nacke et al [23]. Mahlke [22] states that affect and emotion are considered as important parts of the user's experience with interactive systems and it is aimed to incorporate emotional aspects in the interactive system design process, referring to Norman [24]. The IPTV-UX factors uses for example pleasant/unpleasant, fascinating/uninteresting, impressive/unimposing, fun/boring, entertaining/unamusing to evaluate the emotional reaction toward the system or competent/incompetent, happy/sad, proud/embarrassed for the personal emotional reaction.

Hassenzahl [8] describes **stimulation** as a hedonic attribute of a product, which can lead to new impressions, opportunities and insights. Sheldon et al [32] state the

need for pleasurable stimulation to encapsulate the single most basic motive according to hedonistic philosophies. Hedonic experiences were subsumed by Karapanos et al [17] under the term innovativeness to describe hedonic experiences and the ability of a product to excite the user through its novelty. In the area of games, Jääskö and Mattelmäki [15] defined product novelty as one of the qualities of user experience. The IPTV-UX uses inventine/typical, creative/standard, innovative/conservative, novel/commonplace amongst others to evaluate the stimulation factor.

The construct of **relatedness** as a social factor was mentioned by Hassenzahl [8], which includes it in his identification dimension. In order to clearly separate it from identification in the sense of self representation and highlight the social aspect of relatedness, it is treated separately in our questionnaire. Relatedness is also addressed by Gaver and Martin [7] under the term of intimacy, where they refer more to nonverbal, inexplicit forms of communication. According to Jordan 2000, Socio pleasure deals with interaction with others. Thus, products that facilitate communication as well as those that serve as conversation pieces contribute to socio pleasure. As media applications are becoming more and more social, especially when looking at recent attempts on social interactive TV systems, relatedness seems to become an important factor for the evaluation of future systems. Relatedness is included with items like "the system supports me in activities I like to do together with others" or "I would like to use it together with others".

Meaning and Value is referring to "Ideo pleasure" [16] indicating values the product can satisfy. This means that products are sometimes chosen because they reflect or represent values that are important to the person. Desmet and Hekkert [4] are referring to the experience of meaning and the meaning attached to a product. For Hassenzahl [8], the identification dimension addresses the human need to express one's self through objects. Identification can be seen as self-expression through an object to communicate identity. To evaluate meaning and value we used items like "I want to use [the system] again", "I would miss [the system]", "I would recommend [the system] to friends".

6.2 Domestic Media Application Specific Factors

The sub-part of the questionnaire focusing directly on the technology used to interact with the system consisted of two part, a general one and one focusing on certain characteristics of the interaction technology. The more general part is independent of the characteristics of the interaction technology, and included items like "operating the TV with the interaction technology felt well", or whether the interaction technology was intuitive. The part focusing on the characteristics of the interaction technology was in the case of the first version of the questionnaire shaped to fit the demands for evaluation of current IPTV systems in France, so the interaction technology was set as a remote control. Factors addressed within this part of the questionnaire included e.g. the shape, size or texture of the interaction technology.

Another part of the questionnaire was aiming to bridge the gap between the interaction technology to the core UX factors and how the Interaction technology is related or contributing to these UX factors for the overall system evaluation. The UX factors Emotion, Value, Stimulation and Identification were addressed within questions, and items included questions like e.g. The IT is creative (stimulation). The next part of the questionnaire focused on evaluating the personal importance of UX factors stimulation, identification and relatedness for the particular responder.

The last section of the questionnaire addressed as a first point the influences of new and unique ways to control the TV and the influence of having new and unique services and features on the enjoyment of the television experience. Furthermore, the connection of usability problems and their influences on the enjoyment of the television experience was evaluated in this part of the questionnaire, with items like e.g. “How does needing to use trial and error to perform a task or solve a problem affect your TV experience?”. At the end of the questionnaire, the usability of the evaluated system was evaluated using the already existing and validated SUS questionnaire, whose items were included in the questionnaire to get an usability metric.

6.3 First Validation

To validate the questionnaire we started an online survey on standard interaction with current iTV systems in France. We asked users to describe their last usage of their interactive TV system with their standard interaction answering the five sections of the questionnaire. This session was defined as the last time when they were using the iTV system including decoder and remote control for at least 20 minutes.

The questionnaire has been administered online and has been spread using various mailing lists, social networks, word of mouth and personal invitations sent out via email. It was accompanied by a recruiting text that included information about the questionnaire’s goals, the time needed to fill in the questionnaire and a privacy statement that all data will be treated strictly anonymous. It was also highlighted that the questionnaire should be filled in spontaneously and that the focus is on the evaluated system, and not the user. Questionnaire items were inverted on a random basis to prevent schemes when filling it in. No monetary incentives were given to questionnaire participants.

Until mid July 2011, 120 questionnaires have been filled out. A first statistical analysis shows that the majority of factors is meaningful in this context, but some items might need a re-phrasing to better address the factor. We will present the results of the statistical analysis which (is still ongoing) in the presentation during the workshop.

7 Summary and Conclusion

The main contribution of this workshop paper lies in the presentation of the IPTV UX questionnaire, which focuses on the evaluation of domestic media applications. Given the difficult evaluation task - various user groups, broad variety of technology available and used - the questionnaire is a first attempt to enable a more general view on UX factors that are important in that area. The questionnaire was developed based on an extensive field study, investigating users' concepts on UX factors in the living room. First validation results indicate that the validity of the factors, but some of the used items will have to be rephrased. The results of the validation and the finalized set of items will be presented during the workshop.

What we can conclude is that user experience evaluation in the living room is a difficult endeavor. Given the broad range of available services, devices and infrastructure a general and flexible questionnaire seems helpful to help evaluate domestic interactive media applications (including iTV systems) at all stages in terms of UX. Our goal in the near future is to validated the questionnaire and its translations to English, German, Spanish and Portuguese (the languages were chosen on the immediate application requirements from industry). Within the next year we also want to extend the set of UX evaluation methods for domestic interactive media applications by an additional expert oriented UX method, enabling a more detail understanding on how new forms of interaction technologies (like touch, gesture, movement) contribute to the overall user experience.

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Mobile Incident Reporting in Urban Contexts: Towards the Identification of Emerging User Interface Patterns

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Abstract. Incident reporting is a very well know technique in application domains such as Air Traffic Management and Health where specialized users are trained to provide detailed information descriptions of problems that were encountered. In recent years several governments have started to make use of mobile technology to allow citizens to report incidents in their neighborhood to the local administration (for example broken street lamps, garbage collection, etc). Such applications provided by governments are aimed to be accessible by the general public with a minimum or (quite often) no training. Despite the fact that incident reporting systems using mobile technology are becoming more and more common, little is known about its actual use by the general population. In this position paper we present the preliminary results concerning our attempts to identify user interface patterns candidates for building usable and effective incident reporting systems using mobile technology. We start by analyzing the idiosyncrasies of this application domain and then we identify some trends in existing applications. Rather than definitive results, this paper aims at providing some insights for establishing a research agenda in the field.

Keywords: Incident reporting, mobility, geo-localization, user interface patterns, m-government, e-government.

1 Introduction

The emergence of new information and communication technologies (ICTs) has changed the way we work completely, not only in the private sector but also in all branches of government [1]. Currently, citizens expect from the government the same quality of service which is provided by the private sector: efficient and effective interactive technologies that are available anytime. In this context, the Web is still the preferred platform for providing government online services (*e-government*), however, mobile technologies are developing very quickly. Mobile technologies have reached a high degree of market penetration all over the world and reach even up to 90% of users in Africa [2]. These results motivate the development of specific strategies targeting at the evolution from *e-government* to *m-government* [2].

M-*government* applications are emerging and offer innovative ways for interaction between citizens and government [3]. The state of Virginia (US) was a pioneer in deploying *m-government* applications such as weather information, election monitoring, tourist information, [4] etc… New applications such as BlueTo [5] use geo-location functions (GPS) embedded into cell phones to deliver personalized information to citizens (e.g. tourist information, emergency phone calls, event in the city, etc…) Although most of *m-government* applications concern an urban environment (e.g. traffic jams warning due to road accidents, notification of parking available in town, free WIFI access, etc…), applications begin to be used even in rural areas [6].

Mobile technology offers many opportunities for m-government but also imposes some constraints [7]. For example, due to the small screen size and low resolution m-government solutions have to avoid the display of the same quantity of information compared to a standard computer. Same holds true for interaction resources (e.g., data inputs) which are also restricted. In addition, safety and respect for privacy are a challenge for any mobile phone application, as the device, the mobile phone, can be easily misplaced or stolen.

Overall, the acceptance of *m-government* services is directly related to their ability to address the users' needs [9,10]. The issues of interface design are critical in the development of interactive systems, and usability of applications should be a central objective of conception [8]. A high quality interface allows user to achieve their purpose (e.g., notify an incident as a street water leak), with efficiency and satisfaction. Otherwise, the user is dissatisfied and sometimes upset if s/he failed to reach a required goal, or if s/he commits an unwanted action (e.g., initiate a purchase without wanting to do so). For quite a while now it became clear that users do not only expect to receive information from the government, but citizens also expect to inform the government of their specific needs [11]. Currently, many *m-government* services are focused on publishing information through citizens' cell phones, but few services allow citizens to be involved in the interaction with the administration. For example, the City of Athis-Mons (France) has developed a system allowing users to report incidents in the city [12], however the user interface provided is only available on Web platforms and does not take into account the specifics of mobile technology. The willingness (and need) of direct citizen involvement is often highlighted during natural disasters and massive accidents [13].

Generally, critical incidents (CI) are events or circumstance (or may have) a negative influence (or positive) on the objective of the system. Management of incident reports is a topic widely studied in fields such as Air Traffic Management [14] and Health [15, 16]. However, little is known about incident reporting by citizens in the field of *e-government*. Moreover, to our knowledge, there is no study on the problems faced by citizens to report incidents in the city by use of mobile technology.

This paper presents some preliminary results of the project ERDF Ubiloop which is focusing on the development of usable and effective applications for incident reporting by citizens using mobile technology. Section two presents the idiosyncrasies in the application domain. Section three reviews a set of existing applications worldwide. Section four describes some emerging patterns of these applications. Finally, section five presents conclusions and future work.

2 Context and Requirements

Reporting urban incidents in a mobile setting seems to be a quite complex activity as it requires a certain amount of knowledge to describe successfully the observed problem (attributes enabling the identification of the incident itself), time and spatial constraints (ex. incident reporting might not occur by the time/space of the incident itself), privacy issues (ex. anonymous declaration might encourage incident reporting but also spam), … In this section we list the basic requirements, on our view, to complete this activity. To properly identify these requirements we will first focus on a generic activity that we are working on. Then we theoretically explore the activity requirements with the purpose to build a first grid to analyze existing *e/m-services*. To gain a detailed understanding on the requirements, a set of meetings within the project ERDF Ubiloop (including participants from the major house and local administration) and a set of interviews with citizens have been conducted.

2.1 Activity Description – (Problematic)

Despite that incident reports might be virtually used in different situations, we focus on the following: *an activity allowing a citizen to digitally declare, in a mobile context, an urban incident*. This activity involves several preconditions we describe hereafter.

First, a citizen must identify an urban incident. To be identified as an incident by a citizen, the state of an urban element (e.g. a wall, a street, a bench, a street light,…) must match partially or fully a citizen's mental representation of an urban incident. In this way one can consider that an urban incident may be relative to citizens' mental representations. From there, we face a difficult topic. Indeed, it is well know that mental representations are strongly depended on background, education, cultural values, demographics, involvement, and many other factors. Classical approaches to solve these difficulties should be (a) the clinical approach allowing people to explain their own point of view of an urban incident, (b) the classification approach providing citizens an urban incidents taxonomy, on condition that the taxonomy fits the main urban incidents of a considered city (e.g. *beach incident* category will fit Rio de Janeiro, Cannes or New York, but will not fit Madrid, Frankfurt or Washington DC).

Second, the citizen must be aware of the existence of the urban incident report service, and then estimate that service can solve the incident better than any other effort from the citizen him/herself.

Third, the citizen must have a device to digitally declare an urban incident in a mobile context. For the declaration there are three subsequent questions to take into account:

- *What is an incident declaration?*

We can subdivide this major question in *mandatory issues* and *optional issues*. There are *two mandatory issues*. (1) **Where is the incident?** The localization of the incident is a mandatory issue to report an incident. If this issue is not completed, it will almost be impossible to solve the incident. (2) **What is the incident?** This issue, in a sense, is less important than the first one. But, one can consider that to know an

issue will help to solve it more efficiently. Usually this issue concerns everything that is linked, one way or another, to the *incident description*. The *optional issues* helps to refine the two *mandatory issues*. These **optional issues** may concern the *date*, the *incident evolution / status*, the *peer review report*, the incident *context description*.

- *What is a mobility context?*

In the context of the activity we are analyzing, *mobility* describes the fact to take advantage of citizens' mobility (coupled with a crowd effect) to find urban incidents more efficiently. In this way *mobility* should not be shortened to *mobile technology* but should be understood as *citizens' mobility* (by foot, by bicycle, by bus,..). From that point we can envision which technology could support the activity.

- *What device is adapted to digitally report in this mobility context*?

Based on the citizens' memory, a citizen can fill in a form on a desktop computer and then send it by email. This seems to be efficient to reach the task, if we consider that omissions are rare events in human memory (that is not the case at all). Of course, every technology supporting the human memory, orientation sense and the categorization tasks will be useful in this activity (e.g. a digital camera with GPS to take a picture and locate the incident). Furthermore, this technology should help to conciliate space and time between the incident observation and the incident report. Therefore, we can see a kind of mobility continuum supported by different technologies such as **online Web forms** to report incidents from home to **Smartphones** to report incidents when going around the city.

At this point, along the activity we are analyzing, the citizens have all they need to digitally report an urban incident. To complete the task there would be still the post-condition to this activity. It concerns the feedbacks about the report and refers to the resolution of the incident. This point mainly depends on the back-office activity (within the local government administration), which is not the focus of this paper.

2.2 Activity Requirements

The section above shows us the different stages and needs inherent to *an activity allowing a citizen to digitally declare, in a mobility context, an urban incident*. We focus now on the different main requirements to complete this activity. To complete the previous reflection we used several methods, in the context of the Ubiloop project, such as six *requirements interviews* with final users (more are planned), *workshops* and *meetings* with the agents of the *Tranquility Office* (i.e. a call service for the management of civics incidents in Toulouse). The early results, from these complementary methods, are convergent with the requirements categories we found and listed hereafter.

- *Localization techniques* - required to precisely locating an incident [LT]
- *Incident reporting*
    - *Scope* – to manage the incident types [IS]
    - *In* – to describe an incident [II]
    - *Out* – to expose an incident [IO]

- *Social and Crowdsourcing* – to properly collect peer review and collective reporting or comments [SC]
- *User Guidance* – to inform users how to use the system [UG]
- *Mobile technology used* [MT]

And from the web and the application domain of incident reporting we added:

- *Privacy*
    - *In* – personal data forms [PI]
    - *Out* – personal data online [PO]

To illustrate these requirements categories we wrote a scenario embedding some real situations and representations from the requirements interviews we were conducting. To refer to the dimensions identified above we use the dimension key abbreviations [in brackets, see above].

Scenario: Early in the morning, Bob is leaving for work and sees, just in front of his house, a *huge heap of green waste* [IS]. He thinks: "Maybe this was dropped there by my new rough neighbor!!!" He decides to check if *this incident was reported* [IO] to the city *e-service*. He opens the *e-service* [MT], explores *a map and, in his street* [LT], he find the incident that *somebody already reported* [PO]. He opens it and reads that a *"van will clean the heap in the afternoon"* [IO]. He says: "Ok *I will add a picture of it, that's missing* [SC], because a van will be never enough to remove all that waste, they need a truck." He takes a picture of the heap and ensures himself that his *privacy will be respected* [PI] (He does not want to have any trouble with his new neighbor), but he *posts a comment* [SC] attached to the *incident report* [IO]: "See the size of the heap! Take a truck, a van will never be enough!" Then he receives a call back *from the Recycling Service* [IO + UG] saying: "Thanks for your comment and surely we will take a truck. This heap is really huge!"

Bob thinks: "*Great! This incident is solved!* [UG] Now it is time to go to work. He takes his bicycle and while riding he thinks: "This service is really great, *they will clear this heap from the front of my house* [LT] and *I will have no trouble with my new rough neighbor* [PO]." Thinking about it, he does not see a *pothole_just on his way and falls down* [IS]. A car stops. Bob's new neighbor steps out of the car and arrives to help him up. Bob's neighbor says: "Hey guy! What are you dreaming about? Didn't you see this pothole? Are you ok? Nevertheless, this pothole is really *dangerous I will report it now to the city e-service [II]*." Bob's neighbor *localizes the pothole, describes its size and its position in the street, takes a picture of it and comments this pothole as "really dangerous* [II] and probably *due to a water leak* [II]". Bob's neighbor validating the report says: "*I'll report this water leak later [MT], I have the good localization* [LT]. This e-service is really great! Do you know it? *I heard about it last week!* [UG] I used it *this morning at home* [MT] to report a huge heap of green waste in the *front of my neighbor's house* [LT]. I can not understand who would drop it there?" And Bob responds: "Uh, I don't know too... But thank you very much, I introduce myself, I'm Bob your neighbor…". Maybe this was the start of their friendship ... The scenario above shows us how the requirements categories fit with a fictive activity description. In the next section we confront these categories with existing applications.

3 Analysis of Existing Applications

We describe here an overview of current web services for Incident Reporting. The user interface (UI) components of these services were analyzed using the categories described in the previous section.

3.1 Overview of Current Web Services for Public Incident Reporting

We conducted an analysis of UI components of 23 *e/m-services* for incident reporting in urban context. We focused on the front office (i.e. reporter tools) and not on the back office (i.e. officer tools). The state of the art covers international and national incident reporting services (covering: US, Canada, UK, Netherlands, Australia, New-Zeeland, Norway, South-Korea, Spain and India) and eight city services (covering: NYC, Vienna, Copenhagen, Lisbon, and four French towns or neighborhoods). Our sample includes different technological platforms resulting in eight services that are *Web only* based (i.e. can be used only on standard computers), three services that are optimized for *Webmobile* (i.e. can be used both on smartphones and standard computers), 10 mixed *web and smartphone applications*, and two services that are based on *smartphone apps only*.

3.2 Results

Current web services make different design choices to fit the urban incident declaration activity. All these choices fit the categories we identified in section 2.2. Hereafter we list some examples of what we usually found during this overview (see section 2.2 for the caption of abbreviations).

- **[IS]** About the incident scope, *e/m services* usually focus on one or few types of incidents. We found only one *e-service* where citizens can report freely any urban incident. But this same *e-service* requests, at the same time, one of the strongest citizens identification of your sample [PI] (surely to prevent from fake report or spam) and additionally did not provide incident reports openly [IO + PO] (surely to ensure the respect of reporter's privacy). We can consider that e-services that allow citizen to post suggestions that ultimately might improve the quality of life and preventing incidents, for example place a street lamp in a shadow place.
- **[II]** Incident declarations are usually guided by incident categories, and provide a blank comment field and a picture upload. Agents or other citizens moderate usually incident reports. More rarely reporters of an incident can apply a qualification to the incident such as its dangerousness, its evolution, or its mobility (e.g. a straying dog), …
- **[IO]** Incident reports that are provided openly, usually show the report date, a ticket management, the reporter's description or comments, the incident localization, a picture, the incident category and the identification of which service is in charge to solve the reported incident. Incident videos are rarely available and solely via Youtube.

- **[PI]** Few *e/m-services* allow anonymous reports. Those that allow this type of reporting are usually not directly related to government services, but instead they expect to encourage or to watch the governments activities and in some cases governments corruption. To balance the mandatory identifications, *e/m services* usually provide to users a strict and open privacy statement.
- **[PO]** Usually reporter's privacy is respected by *e/m services*. We found only one *e-service* that openly provides the name of reporters. But this *e-service* focuses on crowd sourcing, mixing individual and institutional radiation measurements. There reporters play the role of a "watchmen" that is real and socially valuable.
- **[LT]** Localization techniques strongly depend on mobile techniques. The only UI component we found in all cases is the interactive map. For all mobile applications GPS and/or WIFI location are available and usually configurable between automatic or manual localization. Some services allow to give *Non geographical information* or *Data about geographical information*, especially when you report an incident in a public garden, along a river or when you suggest an idea for an urban plan.
- **[SC]** Social activities and crowd sourcing are largely used by *e/m-services*. But these activities strongly depend on the open availability of incident reports.

4 Emerging UI patterns

This section explores how patterns candidates can raise from the combination of categories involved in the *mobile incident reporting in urban context* activity. Despite their specificities of the 23 applications surveyed, we can observe some trends in the type of tasks supported by the user interfaces. Hereafter we list several dimensions that we envision to use to identify UI patterns candidates for mobile incident reporting. In the parenthesis we point the number of applications that implemented every concern:

- Management of citizens' relations
    - Prevent spam, denouncement and fake report (83%, N: 19)
    - Respect of reporter privacy (95%, N: 22)
- Management of Incident ontogenesis in space and time
    - Prevent incidents (e.g. management of ideas, environment measurements)
    - Alert (e.g. incident reporting activities)
    - Solve / Cure (feedback to citizens)
    - Localization techniques
        - Interactive map (95%, N: 22)
        - GPS (48%, N: 11)
        - Non geographical information (22%, N: 5)
- Management of citizens social network and crowd sourcing
    - Vote (26%, N: 6)
    - Watch area (26%, N: 6)
    - Cross comments (48%, N: 11)

- Users guidance
    - User manual (83%, N: 19)
    - Demo video (13%, N: 3)

5 Conclusion and future works

This paper has introduced the application domain of incident reporting systems using mobile technology. We also have discussed several concerns that should be taken into account when designing the user interface. Our results are very preliminary but they raise several challenging questions of both scientific and practical significance: what are the users needs for reporting incidents in urban contexts of use? What are the dimensions and how do they affect the user experience when reporting incidents? How to incite users to declare incidents wisely? How to reduce training with the user interface for reporting incidents and still provide accurate description of problems? How to handle localization issues on urban context of issues? How to cope with temporal constraints related to the occurrence of the incident and the time of reporting it? What is the minimal information for identifying incidents? What is the role of social networking activities in policing incident reports? How mobile technology might increase civic attitudes towards the neighbors and administrations? Our ultimate goal with this paper is discuss some of these questions during the workshop.

The present work is a first step forwards the identification of best (and bad) practices for the design of user interface of critical incidents. Most of the analysis held in the current paper is based on user requirements and analysis of user tasks. Our future work will include the following activities:

- Increase the number of requirements interviews with end users to have a better coverage of scenarios;
- Identification of UI patterns candidates and proper description of patterns candidates identified. This activity is focused on the description of emerging solutions as they are implemented by existing applications. It will also require a kind of validation by the community of designers and developers to certify that solutions are effectively suitable design patterns for a given problem. The second aspect of this question concerns the analysis of existing categories of incidents. We expect to identify families of incidents that could be used to create categories that can be extremely used not only to classify design patterns but also to envisage new user interfaces allowing users to browse categories to identify the form that best suits for reporting a specific incident.
- Validation of the dimensions of the information space with more real case studies. The goal is to make sure that none dimension necessary to characterize the information space was let out.
- Compare our domain space with other currently available on the domains of Air Traffic Management and Health.

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