
Evaluating the User Experience of Tangible Interface Prototypes

Jorick Vissers

CUO|Social Spaces, iMinds – KU
Leuven
Parkstraat 45 bus 3605 - 3000
Leuven - Belgium
Jorick.vissers@soc.kuleuven.be

David Geerts

CUO|Social Spaces, iMinds – KU
Leuven
Parkstraat 45 bus 3605 - 3000
Leuven - Belgium
David.geerts@soc.kuleuven.be

Abstract

In order to choose the right method to evaluate the user experience (UX) of products, several UX dimensions need to be taken into account. The choice of a method for evaluating these dimensions also depends on other factors such as development phase, time constraints or available expertise. We present an adapted method for qualitatively evaluating tangible user interface (TUI) prototypes based on three existing methods (the explicitation interview, Open Profiling of Quality and the Repertory Grid Technique), which can be used for evaluating physical characteristics of TUIs. Two case studies are presented which will be used to further refine and validate the adapted method.

Author Keywords

TUI; user experience; evaluation; prototyping

ACM Classification Keywords

H.5.2. User Interfaces: Evaluation/methodology

Introduction

The last decade has seen a shift in emphasis from usability towards user experience (UX) in both industry and academia, which has led to a central focus in product design on creating specific methods for evaluating UX. As each product is different, used in a specified context by specified users with specified goals

[3], selecting the right method is crucial to ensure that the right user experience can be evaluated. Moreover, user experience is a very broad concept, encompassing different dimensions that can be evaluated (e.g. enjoyability, usability, engagement, etc.) [3]. An important step in selecting the right evaluation method is therefore choosing which dimensions are relevant for the product to be evaluated. However, when choosing a method there are other aspects that also need to be considered, such as the development phase, available time, or expertise of the researchers, which have an impact on the characteristics of the method.

In this paper, we are interested in an evaluation method that can be used in the earlier phases of the design process, for iteratively designing and evaluating early prototypes of tangible user interfaces (TUIs). In this formative stage, evaluations are needed that can provide detailed qualitative information on how to improve the TUI prototypes in a short time frame. Although there are several evaluation methods for evaluating tangible user interfaces similar to those used for other user interfaces, so far no evaluation methods specific to TUIs have been developed [15]. While many of these methods, such as user testing, can easily be used to test various UX aspects, none of these focus on the 'Tangible Magic' [19] that TUIs should offer. The aim of this paper is therefore to take the first step in creating a qualitative method for iteratively evaluating the UX of tangible user interface prototypes.

We start by discussing related work on user experience and its dimensions, as well as work on evaluating tangible interfaces. Then we present the adapted method, which is based on a combination of UX evaluation methods. In future work, we describe two

case studies in which we will apply this adaptation of methods so we can report on the suitability for the purpose of our research.

User Experience Dimensions

Despite the growing interest in user experience (UX), it has been hard to gain a consensual definition of UX and which aspects it consists of [9,3]. A definition that seems to be getting some stronghold in the UX community is the ISO9241-210 definition [1], which defines user experience (UX) as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". This includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use. However, this definition is very broad, offering little concrete guidance on which aspects of UX should be evaluated.

Several authors have tried to identify the different dimensions that UX encompasses. As there are a large number of different approaches, we will present here some recent papers that offer a synthesis of earlier work. Provost and Robert [13] present ten dimensions that can be used to characterize both positive and negative aspects of UX. Five aspects are related to the product itself (functional, usability, physical characteristics, informational and external characteristics), the other five aspects are related to its users (perceptual, cognitive, psychological, social and physical). Fuchsberger et al. [6] developed an approach for combining value- and user-centered design with factors (or dimensions) related to usability, user experience and user-acceptance, leading to the Values in Action (ViA) model. This model describes several

values, clustered in the following main categories: functional value (e.g. efficiency), social value (e.g. social image), emotional value (e.g. engagement), interpersonal value (e.g. social connectedness), epistemic value (e.g. learning) and conditional value (situational context). Although the model is quite extensive, covering many UX aspects also described by other authors, it is presented as an open approach explicitly stating that other factors or values might be appropriate for different projects or user groups [6].

Because of the increased focus on user experience, Bargas-Avila and Hornbaek [3] performed an integrated review of UX, looking for similarities within products, dimensions of experience, and methodologies across a systematically selected sample of 51 publications from 2005-2009 representing a total of 66 empirical studies. They state that 'which experiential dimensions to assess?' still remains a key question in UX. The dimensions of UX that were most frequently assessed within the scope of studies were: 'generic UX', 'emotions and affect', 'enjoyment', 'aesthetics', and 'hedonic quality'. In addition to this, several authors included in their review proposed new dimensions for understanding UX: enchantment, engagement, tangible magic, aesthetics of interaction, and relevance. Their general conclusion is that "although multidimensionality is a key tenet of UX, surprisingly few studies describe multiple aspects of UX and their interrelation", [3] which is something we will have to address when evaluating the UX of tangible user interface prototypes.

Moreover, there seems to be little agreement on universal UX dimensions, and they are different for each study [7]. While this could be partly contributed to a lack of consensus on what UX is, Gross & Bongartz

emphasize that the type of product needs to be taken into account when evaluating the experience of a user with a product. They argue that the relevance of UX components differs between different product types [7]. Although this will also be the case for products with tangible user interfaces, we propose that a common focus is needed within the domain of tangible interfaces, related to the physical aspects of a product.

UX Dimensions of Tangible User Interfaces

As has become apparent in the previous paragraphs, some UX dimensions are of specific interest to tangible user interfaces. The ten dimensions of Provost and Robert listed above include physical characteristics of the product as well as the physical experiences of users, two dimensions that are of specific relevance for tangible interfaces and should be part of evaluating their user experience. Xu et al. [19] are even more specific and talk about a quality that is inherent in tangible interfaces called "tangible magic", which they describe as a combination of the novelty of using objects for doing unexpected things and the pleasure we gain from handling physical objects.

We argue that any evaluation method that will be used for evaluating tangible user interfaces should focus on this 'tangible magic', or the physical dimensions of the user experience. Of course, as mentioned earlier, multidimensionality is a key tenet of UX and in order to evaluate tangible user interfaces with users we do not only need a method that focuses on these physical components, but also evaluates other dimensions that are relevant for the user experience of a specific product.

Evaluating Physical UX Dimensions

Now that we have defined the physical aspects of interaction as the common UX dimension for evaluating tangible user interfaces, we can identify the methods that are able to evaluate this dimension. As we stated at the start of this paper, we are interested in a method for iteratively evaluating prototypes in an early design phase, and thus would need a qualitative method that can be performed in a short time frame.

Given the requirement for a qualitative approach we would need a method that allows users to talk about their physical experiences with the presented prototypes. Obrist et al. point out the limited ability of participants to verbalize their tactile experiences [4,12]. During an experiment with users they used the explication interview technique for stimulating verbal responses to different tactile stimuli, leading to 14 categories of tactile experiences. However, the technique is not specifically used for evaluating UX. As a similar approach, but used for evaluation, Strohmeier et al. [16] present Open Profiling of Quality (OPQ) as a method for building a deeper understanding of subjective quality. This method consists of a combination of both quantitative and qualitative data gathering to construct a link between preferences and quality attributes by letting the participants develop their own attributes that characterize their quality perception of different stimuli (objects). The test procedure of the OPQ method contains four subtasks. First, an introductory task is given to help participants understand the nature of the descriptive evaluation task. The second task is meant to elicit attributes by means of the Free Choice Profiling Method [18], in which participants write down attributes of a product without limitations. Within the third task, participants

are asked to refine their attributes by identifying the strongest ones, and create a scale for them labeled with "min" and "max". Finally, in the fourth task, participants are presented with stimuli (products), which they have to assess by marking them on each attribute scale. As we're only interested in the qualitative part, we will not discuss these steps in further detail.

Another method that is used to elicit people's experiences and meanings in relation to a product is the Repertory Grid Technique (RGT). Fallman et al. regard this technique as a methodological extension of Kelly's Personal Construct Theory [2], which states that we tend to model everything around us according to a number of personal bipolar constructs. According to Kelly, a 'construct' is a single dimension of meaning for a person allowing two phenomena to be seen as similar and thereby different from a third [2]. The RGT uses an elicitation session in which users are presented with three objects at a time and asked to explain how they differ from each other, in order to generate these bipolar constructs. This is especially relevant for us as we could ask the participants to describe the differences between the various prototypes that are being designed in the early prototyping phase.

Adapting the Methods

By borrowing from different methods (the explication interview, Open Profiling of Quality and Repertory Grid Technique), we can create an adapted method that lets us evaluate the physical aspects of tangible interface prototypes in a qualitative way. When evaluating the case studies described below, we will present the users with various TUI prototypes. We will then elicit verbal responses by asking users to differentiate between the

products, with a focus on physical experiences in their own words. Using the resulting vocabulary, we will ask users to evaluate each of the prototypes on these aspects using rich, qualitative comments. This can inform the design of the next iteration of prototypes.

Future work

In order to validate and refine our adapted evaluation method, we will apply the method in two case studies where two different products are being designed. The common aspect however, is that they both have a tangible user interface. As argued in this paper, we will first have to identify the specific UX dimensions for each product, but the 'tangible magic' is already one that will need to be evaluated. In order to identify the appropriate dimensions for the different case studies, we conducted a workshop with 10 UX researchers. They were asked in a free-form exercise to write down as much general UX dimensions as they could think of. These were then merged with the UX dimensions identified from earlier studies [3,6,9,13,14,19]. After presenting each of the cases, we asked the UX researchers to match the relevant UX dimensions with each of the cases and to discuss how each of these dimensions could be evaluated.

CASE 1: TANGIBLE INTERACTION WITH A TELEVISION

With this case we aim to discover an innovative way to interact with television or radio by using everyday or new tangible objects. One example is using an electronic dice for playing along with a game show or for controlling the content. During the workshop the following UX dimensions were identified as important for this case: pragmatic aspects, sociability, emotional value, findability, frustration, tangible magic, and material aspects.

CASE 2: SKWEEZEES

The goal in this case study is to create a soft squeezable object (Skweezee [17]), that allows a remote tangible user experience. It is a soft and stretchy product filled with conductive wool and electrodes, able to recognize specific squeeze-patterns. Users can change the shape of the object in order to turn it into a specific input device. During the workshop the following UX dimensions were identified as important for this case: physical experience, responsiveness, material, usability, and pleasure.

Although a very limited sample, the results from the discussion about relevant UX dimensions for both case studies show that tangible magic, material aspects and physical experiences are common traits of TUIs to be evaluated. Our next steps will consist of using our adapted method to address these aspects explicitly.

References

- [1] 9241-210, I. (2008). Human-centred design for interactive systems. *Ergonomics of human system interaction-Part 210* .
- [2] Bannister, D., & Fransella, F. (2002). *Inquiring Man: Theory of Personal Constructs*. Taylor & Francis.
- [3] Bargas-Avila, J., & Hornbaek, K. (2011). Old Wine in New Bottles or Novel Challenges? A critical Analysis of Empirical Studies of User Experience. *2011 annual conf. on Human factors in computing systems CHI*, (pp. 2689-2698).
- [4] Dagman, J., Karlsson, M., & Wikström, L. (2010). Investigating the haptic aspects of verbalised product experiences. *Int. Journal of Design*, 4(3) , 15-27.

- [5] Fallman, D., & Waterworth, J. (2005). Dealing with User Experience and Affective Evaluation in HCI Design: A Repertory Grid Approach. *CHI'05 Workshop on Evaluating Affective Interfaces*. Portland.
- [6] Fuchsberger, V., Moser, C., & Tscheligi, M. (2012). Values in Action (ViA) - Combining Usability, User Experience and User Acceptance. In Proc. *CHI'12* (pp. 1793-1798). Austin: ACM.
- [7] Gross, A., & Bongartz, S. (2012). Why do I like it?: Investigating the product-specificity of user experience. *7th Nordic Conf. on HCI: Making sense Through Design*, (pp. 322-330).
- [8] Hassenzahl, M., & Tractinsky, N. (2006). User Experience - a research agenda [Editorial]. *Behavior & Information Technology*, 25(2) , 91-97.
- [9] Law, E., Roto, V., Hassenzahl, M., Vermeeren, A., & Kort, J. (2009). Understanding, scoping and defining user experience: a survey approach. *CHI '09* (pp. 719-728). ACM.
- [10] Lawless, H., & Heymann, H. (1999). *Sensory Evaluation of Food: Principles and Practices*. New York, USA: Chapman & Hall.
- [11] Obrist, M., Seah, S., & Subramanian, S. (2013). Talking about tactile experiences. In Proc. *CHI '13* (pp. 1659-1668). ACM.
- [12] O'Sullivan, C., & Chang, A. (2006). An Activity Classification for Vibrotactile Phenomena. In Proc. *HAID '06*, (pp. 145-156).
- [13] Provost, G., & Robert, J. (2013). The dimensions of positive and negative user experiences with interactive products. *2nd conference on Design, User Experience, and Usability: design philosophy, methods, and tools, I*, pp. 399-408.
- [14] Robert, J.-M., & Lesage, A. (2011). From usability to user experience with user interfaces. In G. A. Boy, *Handbook of HCI: A Human Centered Design Approach* (pp. 303-332). Ashgate, UK.
- [15] Shaer, O., & Hornecker, E. (2009). Tangible User Interfaces: Past, Present, and Future directions. *Human-Computer Interaction* , 3, 1-137.
- [16] Strohmeier, D., Jumisko-Pyykkö, S., & Kunze, K. (2010, January). Open profiling of quality: a mixed method approach to understanding multimodal quality perception. *Advances in Multimedia* .
- [17] Vanderloock, K., Vanden Abeele, V., Suyskens, J. A., & Geurts, L. (2013). The skweezee system: enabling the design and the programming of squeeze interactions . *UIST'13* (pp. 521-530). New York: ACM.
- [18] Williams, A., & Langron, S. (1984). The use of free-choice profiling for the evaluation of commercial ports. *Journal of Science of Food Agriculture* , 35, 558-568.
- [19] Xu, D., Read, J., & Sheehan, R. (2008). In search of tangible magic. *the 22nd British CHI Group Annual Conf. on HCI 2008: Culture, Creativity, Interaction*, (pp. 01-05). Liverpool.