Improving UX and Productivity through TUIs in Work Environments

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Abstract

This paper presents research in progress and describes the prototype and evaluation of an RFID-based tangible user interface with the target of enhancing user experience and productivity while working with a complex product management system of a sporting goods manufacturer. While results do not show significant improvements of the user experience criteria, it is possible to achieve a significant decrease in time required to complete given tasks.

1 Introduction

One approach in Human-Computer Interaction research is the application of physical objects to access and manipulate digital information through Tangible User Interfaces (TUIs) (Ishii & Ullmer 1997). As a concept of ubiquitous computing, they make use of the user`s real-life skills, pushing the computer (partly) into the background by making elements of the system invisible (Diekmann 2007). However, research focusing on the affective effects of ubiquitous computing are relatively new (Tan et al. 2013). This work presents the prototype and evaluation of a TUI-based interaction concept implemented to enhance productivity (e.g., time savings) and User Experience (e.g., usability and fun during use) in a selected working environment.

2 Prototype and Interaction Concept

The system enhanced through a TUI is the range planning platform of a large sporting goods company. It was implemented to reduce the number of expensive physical samples and contains images of all of the company's past and future products. It is mainly used for design approvals and various other process steps in the product creation process which comprises

Veröffentlicht durch die Gesellschaft für Informatik e.V. 2016 in
S. Franken, U. Schroeder, T. Kuhlen (Hrsg.):
Mensch und Computer 2016 – Kurzbeiträge, 4. - 7. September 2016, Aachen.

http://dx.doi.org/10.18420/muc2016-mci-0228

thousands of products per season and has a strong focus on a quick “time to market” (Zagel & Löffler 2010). For these tasks a dedicated meeting room was set up, containing a 16 full-hd display video wall for being able to show a large amount of products at once or if required, to present selected items in real-life size. In it’s current setup the system is controlled via mouse and keyboard. Nevertheless, employees using the tool are traditionally used to work with physical elements (e.g., t-shirts, shoes, garment samples) instead of virtual product representations. Especially for designers and product managers haptics, color variations, and the detailled structure of fabrics are important decision criteria. Nevertheless, these aspects cannot be transferred to a virtual environment, yet (e.g., due du a limited color specturm of computer displays). The system is very complex and contains hundreds of filtering options due to the large variety of products, seasons, and subbrands. This leads to complicated queries and requires an intensive learning process.

In order to bridge the gap between physical environment and virtual content as well as to ease the process of navigating through the filter options a TUI based on Radio Frequency Identification (RFID) was implemented. It uses RFID Tags embedded into physical cards (e.g., to filter for gender, season, price point or article type) as well as sewed into garment samples (to filter for colors and fabrics). This allows the users to experience the haptics of the material as well as the real-life representation of the gament’s color without any restrictions of the color spectrum. The interaction is handled through a RFID reader integrated into a dedicated pedestal (Figure 1). On top of the pedestal simple instructions and filter possibilities are shown. Nevertheless, tags can be detected all over its surface.

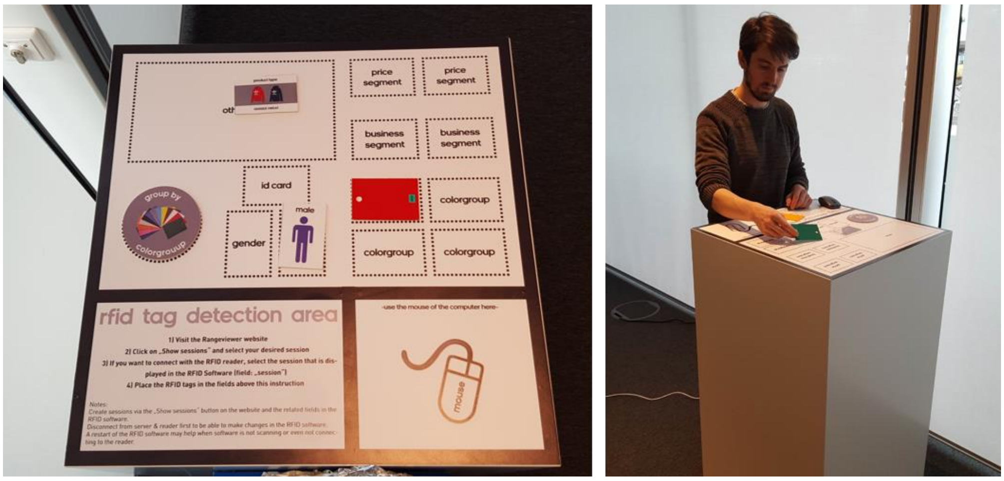

Figure 1: TUI Interaction Pedestal

3 Evaluation

The goal of the evaluation was to assess the effects of using the TUI instead of the traditional filter functions set through mouse and keyboard. Therefore, we conducted a laboratory experiment amongst 11 subjects (6 female, 5 male), aged between 19 and 45 (M = 29.7; SD = 8.22). Within the first part of the survey they were asked about their general Technology Readiness (Raub 1981) as well as about their Geek Score, reflecting their fascination for new technology (Zagel et al. 2015).

The experiment itself consisted of two parts: each of the participants was given a set of four typical tasks that are usually performed when working with the system (e.g., sorting by product division, marketing division, season, product group, color group). Each of the participants was asked to perform the tasks applying the traditional as well as the enhanced TUI-based interaction process. After each step they had to complete an identical survey assessing the aspects Perceived Usefulness (Davis 1989), Perceived Ease of Use (Davis 1989), Service Fascination (Zagel 2016), Reliability (Bailey and Pearson 1983), as well as Timeliness (Bailey and Pearson 1983). All items were answered on a 7-point Likert-type scale labeled at the end points (1 = I completely disagree, 7 = I fully agree).

Table 1 shows the evaluation results. Next to means, standard deviations, and absolute differences the effects were analyzed using the Wilcoxon test for paired samples (Wilcoxon 1949) as well as Cohen’s d effect sizes (Cohen 1998). Effect sizes are important for experimental and quasi-experimental research and used to describe the practical relevance of evaluation results in addition to significances (McGrath et al. 2006). Values of 0.2 describe small, values of 0.5 medium, and values of 0.8 large effects (Cohen 1998). All item sets exceeded the required Cronbach`s alpha value of 0.7.

Dimension	**General**	**TR**	**TUI**	**Δ**	**p**	**d**
TR (α=.750)	6.00(0.85)					
GF (α=.923)	5.36(1.22)					
PU (α=.936/.966)		5.45(1.44)	5.57(1.48)	0,12	.235	0.082
PEOU (α=.745/.903)		5.41(1.02)	5.98(1.14)	0,57	.210	**0.527**
SF (α=.802/.844)		5.68(1.27)	5.84(1.21)	0,16	.171	0.134
REL (α=.979/.950)		5.36(1.40)	5.97(0.94)	0,61	.210	**0.512**
TIM (α=.878/.768)		5.00(1.42)	4.76(1.10)	-0,24	.506	-0.189

Table 1: Evaluation Results, Mean and StdDev (TR= Technology Readiness, GF= Geek Factor, PU= Perceived Usefulness, PEOU= Perceived Ease of Use, SF= Service Fascination, REL= Reliability, TIM= Timeliness)

Overall the participants showed a high Technology Readiness and also a large interest in new technologies (Geek Factor). Except the Timeliness criteria, the TUI was able to improve the perception of all aspects observed, while none of the changes is significant. However the criteria Perceived Ease of Use as well as Reliability show medium effects, indicating a trend towards practical relevance.

Interestingly, the participants rated the time aspect slightly worse when assessing the enhanced system. Nevertheless, time measurements conducted during the experiment prove the opposite: while completing the given tasks using the traditional process on average took 7 minutes and 28 seconds (Min: 04:30, Max 09:34), the TUI was able to speed up task completion by almost 30% (Avg: 05:15, Min: 03:13, Max: 06:08).

4 Conclusion and Outlook

Within this work we observed improvements of User Experiences in work environments through the implementation of a TUI into a product planning system. While the interaction process was able to realize time savings of almost 30%, no significant changes in the user experience criteria were observed. The study is limited by the small and technology savvy group of participants. The relatively small changes in perception may result from the fact that already the traditional system was perceived very positive. Future studies with a larger number of participants are planned, additionally assessing advantages in decision making when working with physical elements that allow a judgement based on the real color and structure of the textile. These studies will additionally include qualitative evaluation criteria in the form of interviews and open questions in order to better understand the discrepancy between time effectively spent and the subjective perception of the time component. The combination with additional technologies like touch tables might be able to further increase productivity and User Experience. Furthermore it is planned to include causal attribution measurements in future research, since there is evidence that causal attributions influence system evaluations in usability tests (Niels et al. 2016).

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