Preliminary Design Guidelines for 3D UIs on Tablet Devices Defined Based on User Experience Evaluations

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ABSTRACT
In this poster paper we present preliminary design guidelines for 3D user interfaces on touch screen tablet devices. These guidelines are defined based on the findings from two user experience evaluations conducted in the early phase of a 3D user interface development process.

Author Keywords
3D, design, UI, tablet device, touch screen, user experience

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Three dimensional (3D) user interfaces (UIs) have been studied for many decades with personal computers using several input devices [1, 3, 6, 11]. 3D UIs and applications on touch screen tablet computers are relatively new and there are a few studies from the user point of view [8]. Tablet computers have been studied, for example, from marketing, education, usability [2] and game playing [5] perspectives. ISO 9241-110:2010 defines user experience (UX) as: a person's perceptions and responses that results from the use and/or anticipated use of a product, system or service [4]. Therefore, UX should be evaluated before, during and after the use [9]. Although the interest in UX in industry and academy is high, there is still a lack of methods on how to evaluate user experience [9]. Especially, there is a need to develop and use low-cost methods for UX evaluation and utilize the collected information in the early phase of the development process [10]. The aim of UX studies is to help in selecting the best design solutions and to assess that the development is on the right track and if the final product meets the original UX targets [9]. In iterative and agile development processes, time- and cost-effective UX studies give important UX feedback for the design [10].

In this poster paper we present our preliminary design guidelines which were defined based on two different UX evaluations for our 3D UI concept designs and existing 3D applications in the early phase of our iterative development process. These guidelines can be useful for designers and developers who are working with topics such as 3D UIs, interactive objects in 3D virtual environments, 3D game development and touch screen tablet devices.

UX STUDIES AND DESIGN GUIDELINES FOR 3D UI
Study A. In the early phase of our development process we conducted 3D UI concept design and evaluation phases. In the concept design phase we made approximately 100 sketches of different 3D UI ideas from which we finally designed six 3D UI metaphor concepts for UX evaluation: 'Room', 'Shelves', 'Pie', 'Keyring', 'Keyring in Square mode' and 'Contact ball' with file searching and sharing use cases. The concepts were shown as a virtual prototype on a tablet and on a laptop. We also created a self-expression template for users to express their ideas about the 3D UI on a touch screen tablet. We had 20 pair evaluation sessions with a total of 40 participants (age varied from 23 to 52, while the average was 35). Users were interviewed and observed during the evaluation. This study elicited a lot of information of how users perceived the visual aspects of 3D UIs on tablets. Based on the first findings we proposed six design recommendations for interactive 3D objects in 3D UI on tablet device [7].

Study B. In parallel with our concept design phase we conducted a separate UX evaluation for 3D UIs with existing map application and games on tablets. The games were selected because they had an overlay UI (layer where 2D control widgets and icons are found). They also had interactive 3D objects embedded into a 3D game space. The map application was selected because it did not have a 2D overlay UI. In this study we had 12 participants, whose age varied from 23 to 34 years. We used observation, interviews, user tests, adjective selections and an online post-discussion forum. This study elicited how users interact with both 2D overlaid UI and embedded 3D UI. A large amount of 2D overlaid widgets decreased the interaction with 3D objects and space. Based on this study we proposed design guidelines for hybrid 2D/3D UIs. [8]

This poster paper presents preliminary design guidelines for 3D UIs on touch screen tablet devices. These guidelines take into account 3D space (e.g. virtual environment), 3D UIs (e.g. menus and icons), touch screen device (e.g. touch gestures while holding the device) and customization.
**Design 3D space based on target use**

- Design the visual appearance of the 3D space to support targeted use context (e.g., home, work, leisure, game, map). The use context shown in the 3D space influences on how important users perceive the service for them. (Study A, B)
- Design realistic physics in space and objects when the visual appearance of the space refers to real world context (Study A)
- Take privacy and security issues into account when designing 3D UI in a realistic looking virtual space (users must know what others can see from users’ own or shared 3D UI components or space and in which situations). This is especially critical when some part of the content shown on the screen is publicly shared and the other part is private (user’s own device content). (Study A)

**Design interactive 3D objects and icons for 3D space**

- Design icons as 3D icons from the beginning with unique characteristics and appearance (level of detail and distinct enough from each other) [7]
- Design 3Dness for the 3D objects by using different depth cues so that they stand out from the background [7]
- Design clear and consistent cues for interactive 3D objects. [7]

**Design touch screen gestures for device context**

- Design touch-gesture-based user interaction with 3D objects and 3D space [7]
- Design proper hit zones for objects and visual feedback to the user of an object’s selection [7, 8]
- Design location of interactive elements by taking ergonomics into account. [7, 8]

**Design customizable 3D UI for touch screen (Study A)**

- Give a user a possibility to change UI’s and objects’ location, position and size (users have different preferences for UI appearance) (Study A, B)
- Give a user a possibility to personalize the 3D UI on a touch screen tablet device (customization is relatively easy and fast with touch gestures) (Study A)
- Give a user a possibility to select different 3D UI metaphors for different menu hierarchy levels (3D UI needs new UI paradigms which supports users’ own mental models and preferences for UI layout). (Study A)

Traditionally interaction design does not recommend giving too much freedom for users to customize the UI. However, modern touch screen devices (e.g., touch phones, tablets) can change this attitude towards more personalized UI design. Based on our observations, user customization is one key topic which should be taken into consideration when designing touch-gesture-based UIs.

**CONCLUSION**

In this poster paper we present preliminary design guidelines for 3D user interfaces on touch screen tablet devices. This set of guidelines was defined based on our two early phase UX evaluations, which strengthen that UX studies can bring valuable information for design in early development phase. The guidelines are meant for designers and developers who are working with 3D UIs, interactive objects in 3D virtual environments, 3D game development and touch screen tablet devices. In the future we will develop 3D UIs based on these guidelines and validate them.

**REFERENCES**