

Study of Interaction Concepts in 3D Virtual Environment

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Abstract. This paper describes what could be understood by interaction techniques and interaction concepts. In this work we focus in particular the second screen applications. Research of interaction techniques and concepts in this case investigates how to design interaction concepts with tablet as second screen, by remote connection with virtual environment on a primary screen. However, the actual samples used in this research are summarized by interactions like selection, manipulation and navigation aspects.

Keywords: Human computer interaction, second screen, manipulation, navigation on virtual environment in virtual reality, interaction technique, interaction concept, gestures.

1 Introduction

Interaction is a central term to the following study, especially the in the context of interaction concepts as well as interaction techniques. The focus is on interaction concepts between second screen as a remote control device and virtual environment (VE) that will be represented on a large primary screen. The next section gives a very brief introduction what belongs to the second screen. Furthermore, to show different interaction techniques and concepts and to apply this in the matter of second screen, that was the motivation. The distinction drawn in the literature between interaction technique and interaction concepts is not clear defined, so that we will show how to separate this.

There are currently no consistent standards in the field of interaction in 3D VE, as is the case when interacting with computers in 2D, working with windows, icons, menus and pointers interfaces. 3D interaction in a 3D space should facilitate the feeling of a complete immersion. That means that people who interacting with virtual reality to completely forget of their environment. Interactions accord of expectations of behavior.

Due to the additional third dimension, there is much greater variety of interaction techniques coupled with the different drafts of interaction concepts for selection, manipulation and object manipulation as soon as navigation in 3D VE. Therefore and as a first step, we focus on current interaction concepts, particularly dealing with object manipulation in 3D space using selected input devices.

Results from this reflection might yield to more or less established quasi-standards. The appropriate use of concepts are proven by detailed research and existing user

studies. The results provide suggestions for further scientific work. Are there revealing gaps with urgent need for further scientific research?

2 Related Work

Nowadays a broad variety of media has expanded, but on the constellations of end-use, too. Several years ago we use a mobile phone for only making calls, today is possible much more actions with just one device. Therefore, it is no surprise that in the use of mobile phones like tablets were combined or mixed with another media [1].

Second screen concept will be used in the context of social network, thereby to exchanging the information with friends of current TV program [2]. The second screen trend is from using of a mobile device for additional information of current program. A typical example of second screen functionality as a TV shown describes the FANFEEDS application [3]. A next one changing development is NextShare^{Mobile} an integrated second screen application for Apple iOS devices [4]. With NextShare^{Mobile} it is possible to wind a video forward and back from the comfort of your sofa using included remote control.



Fig. 1. Second screen in application

The concept of second screen we take up an issue and integrate this in a simulation system. A tablet device is the remote control for interactions on virtual environment. This realization system includes tasks to interact with construction of factory environment, definition of task what worker has to do through to simulation and valuation of simulated working process. In this work we analyze interaction concepts build on the example of NextShare^{Mobile}.

Second screen shall be limited to interact with both hands. The left hand hold on the device and only right hand can interact with the touchscreen. Therefore, we able to find out interaction concepts only for one hand or for a few fingers. In normal practice occurs interaction in virtual environments with virtual hand, space mouse, specific glasses, joystick or game controller (Wii, PlayStation). These examples of trackers are too expensive.

The high-performance smartphones have good sensors, accelerometer, such as digital compass, and gyro on the market today, so we can work with and use these mobile devices as an alternative by the said trackers. The interaction can be classified as selection, manipulation and navigation.

In search of definition term for interactive technique and interactive concepts no results were found. Here is what we think of. Interaction techniques are techniques describes how information with the input device, touch sequence or sensing enter into a computer. Under interaction technique is one part consists of hardware and part of software elements. For example virtual hand is one hardware technique and button on the screen is one software technique element. But what is about demarcation of interaction concept? The combination of different interaction techniques and specific chronology of interaction techniques with a device makes an interaction concept.

3 Interaction Concepts

The directed manipulation in 3D space is the most natural technique, because it is intuitive for people to act on physical objects. The second screen applies a semi-immersive interaction with a virtual environment because it is a remote interaction. But doesn't have to be necessarily a negative there are methods to obliterate the differences. This will happen by following concepts.

3.1 Manipulation of Objects with Remote Controller

Represented Example. A represented example for this research is a work of [5]. The focus of this work are to design "...on the 3D object manipulation similar to the traditional virtual hand researches". The communication between primary screen and mobile device is done over Wi-Fi. The placement of cursor on virtual environment is happened unanimously by moving of second screen device in all directions of axes. This describes continuous commands in the table 1. The interactions on the z axis doing by sweeping up and down the screen with a finger on the screen or by moving the mobile device by stretching the arm holding the device (object scaling).

Event-based command is for example to select an object. The placement of cursor in 3D VE should be for the object and then interact with finger by double tap (this is the grasp state). For rotation command you tap triple in grasp state. However, move device and the rotation on object in 3D is following. The conform behavior with the virtual object through device appeals in the hands for real object [6].

Table 1. Overview of the Commands. Source[5]

Continuous Command [Ⓟ]	
<i>3D Hand Placement</i> [Ⓟ]	Moving the virtual hand by moving the mobile device [Ⓟ]
<i>Object Translation</i> [Ⓟ]	Moving the object in the virtual hand by moving the mobile device [Ⓟ]
<i>Object Scaling</i> [Ⓟ]	Scaling the object by sweeping on the mobile device's screen [Ⓟ]
<i>Object Rotation</i> [Ⓟ]	Rotating the object by tilting the mobile device [Ⓟ]
Event-based Command [Ⓟ]	
<i>Grasp</i> [Ⓟ]	By double tap [Ⓟ]
<i>Release</i> [Ⓟ]	By tap [Ⓟ]
<i>Scaling Mode</i> [Ⓟ]	By double tap in grasp state [Ⓟ]
<i>Rotation Mode</i> [Ⓟ]	By triple tap in grasp state [Ⓟ]

Bimanual Surface. Here investigate another example [7]. This work shows an agreement between gestures for choice of sensory, multi-touch and dual-surface input with bimanual touch- and motionabled concept. There is a difference to the represented example. If an interaction is to translate the object that would be interesting for the z axis direction (Figure 2).

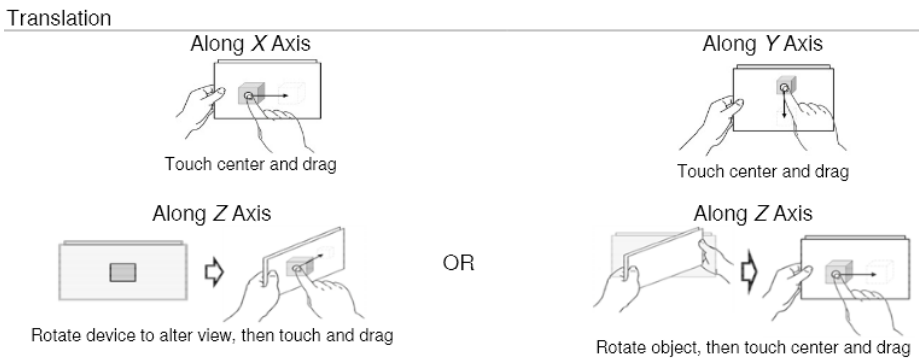


Fig. 2. Translation on z axis is a combination of gesture and a using device sensor [7]

The manipulation is happened direct on the touch screen. Gestures parameter should be transfer on primary screen. In this case we use a metaphor of 3D object from primary screen on second screen. The metaphor means an object on second screen that represent the object of VE, so can interactive with the object remote.

Definition of Detection Gestures

Another idea is define and create own detection gestures, one that describes interactions with finger. For example to select an object this will happen by five-finger-pinch [8]. It would be possible to define interactions for undo and redo operations. The problem of this detection is, there must be made unique association between gesture, object and the situation. Another aspect is the definition of new gestures needs to be learned. Is that attempt intuitive for everybody?

Points Tap

On the base of [9] [10] there are another attempt to interactive with mobile device. The interaction concepts are scheduled for two hand interaction, but this can transferred to one hand interaction. In which the points to determine on a metaphor object in second screen and then performed an interaction gesture with the finger (Figure 3). This approach to solve the interaction on z axis for 2D interactions without changing the direction or the perspective for interaction.

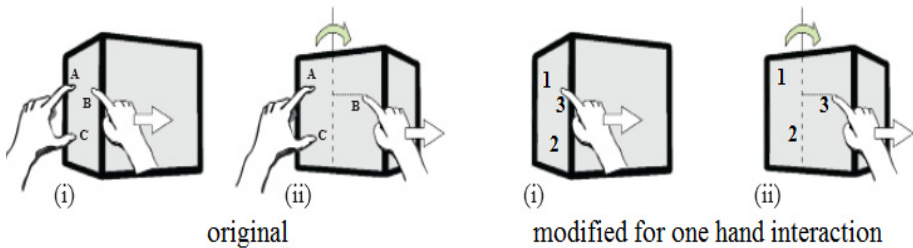


Fig. 3. On the left side is the original interaction and on the right side is the modified interaction for one hand [9].

Instead of A,C points for left hand like in original (i), can tap with the right hand on the points 1,2 and the third one is to move gesture (ii). Principal can so be manipulated all points in all axes in different situations.

This would be a selection of interaction concepts. In this case is a combination of the hardware techniques and sensors of tablet are for rude interactions and gestures techniques on touchscreen are for detailed indications from the manipulative object.

3.2 Discussion

For some of discussed concepts is to have a metaphor on second screen a requirement. However, here is another thing that should be considered. One problem stays, how to define an interaction for undo operation on mobile device?

4 Results

Is that a standard set for interaction techniques and interaction concepts in virtual environments/ virtual reality? Advantage of second screen application is the mobility of remote control. You can use the efficient sensors for more intuitive interaction and visualization of 3D EV is limited only by the screen size. Simulations and demonstration are showed by a large screen. In the other hand the disadvantages are to interact with one hand. Interaction would maybe only by 2D touchscreen and limited visualization on the second screen size.

5 Future Work

To design an interaction concept as a second screen application hosts some interaction restrictions. But this is the most interesting thing on development. We want to evaluate our user study of interactions with second screen application. To consider of an undo interaction concept is for future work, too.

What is a clear definition of interaction technique and interaction concept? Where are the differences? To design interactions with second screen interaction is a challenge.

References

1. Courtois, C., D'heer, E.: IBBT-MICT-Ghent University: Second Screen Applications and Tablet Users: Constellation, Awareness, Experience, and Interest. In: EuroITV, Berlin, Germany. ACM (2012)
2. Lochrie, M., Coulton, P.: School of Computing and Communications, Lancaster University: Mobile Phones as Second Screen for TV, enabling Inter-Audience Interaction. In: ACE, Lisbon, Portugal. ACM (2011)
3. Basapur, S., Mandalia, H., Chaysinh, S., Lee, Y., Venkitaraman, N., Metcalf, C.: Interactive Media User Research: FANFEEDS: Evaluation of Socially Generated Information Feed on Second Screen as a TV Show Companion. In: EuroITV, Berlin, Germany. ACM (2012)
4. Knowles, W., Mu, M., Bamford, W., Race, N., Needham, C.: Demo: Introducing NextShare^{Mobile}, An Interactive Second Screen Application. In: MobiSys, Low Wood Bay, Lake District, UK. ACM (2012)
5. Lee, D., Kim, G.J., Hwang, J.-I., Ahn, S.C.: 3D Interaction Using Mobile Device on 3D Environments with Large Screen. In: MobileCHI, Stockholm, Sweden. ACM (2012)
6. Daiber, F., Li, L., Krüger, A.: Designing Gestures for Mobile 3D Gaming. In: MUM, Ulm, Germany. ACM (2012)
7. Liang, H.-N., Williams, C., Semegen, M., Stuerzlinger, W., Irani, P.: User-defined Surface+Motion Gestures for 3D Manipulation of Objects at a Distance through a Mobile Device. In: APCHI, Matsue-city, Shimane, Japan. ACM (2012)
8. Lü, H., Li, Y.: Gesture Coder: A Tool for Programming Multi-Touch Gestures by Demonstration. In: CHI, Austin, Texas, USA. ACM (2012)
9. Reisman, J.L., Davidson, P.L., Han, J.Y.: A Screen-Space Formulation for 2D and 3D Direct Manipulation. In: UIST, Victoria, British Columbia, Canada. ACM (2009)
10. Bollensdorff, B., Hahne, U., Alexa, M.: TU Berlin: The Effect Perspective Projection in Multi-Touch 3D Interaction. In: Graphics Interface Conference Toronto, Ontario, Canada. ACM (2012)