Bauhaus-Universität Weimar
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Jumping for Guided Navigation in Immersive Virtual Environments

Master's Thesis

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Declaration of Authorship

I hereby declare that I have written this thesis without the use of documents and aids other than those stated in the references, that I have mentioned all sources used and that I have cited them correctly according to established academic citation rules, and that the topic or parts of it are not already the object of any work or examination of another study programme.

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Abstract

This is the abstract...

Contents

1 | Introduction

Many navigation techniques exist for both Desktop and Immersive Virtual Environments (VE) that define how users moves around these VEs. The goals of navigation are to move towards a target location and orientation to explore the environment. Navigation should facilitate way finding in the VE, which means allowing the user to know where they are, where they will go next and how they will get there. This also means that the user should have a good perception of the VE and path that they took. Navigation techniques have to ensure that there is minimal motion sickness, sufficient environmental awareness which means that while navigating the user knows where they are in an environment compared to where they were before and that it is easy to reach important places in the environment. Two common metaphors for navigation are steering and teleportation.

Steering navigation is a technique where there is continuous movement in a direction indicated either by gaze, pointing or use of a physical device. In some cases an additional action can be added to specify the velocity. With steering navigation spatial awareness is generally good but can cause motion sickness. Teleportation navigation is a target based metaphor for where the goal position is specified discretely by pointing or choosing a location and orientation to be moved towards. This form of navigation minimises motion sickness but results in less environmental awareness as compared to the steering metaphor. Some techniques try to reconcile these two metaphors to minimise motion sickness while still maintaining a good environmental awareness. One example is the jumping metaphor presented by Weissker et al. which *'only allows to teleport to locations in the currently visible part of the scene'* which makes it a short range version of the teleportation metaphor [1].

Navigation techniques can be active such that the user is controlling their own movement; passive such that the user is being automatically moved around the environment; or they can be a mix of active and passive. Guided navigation techniques such as the river analogy presented by Galyean which guides *'the user's continuous and direct input within both space and time allowing a more narrative presentation'* and uses steering for guided navigation [2].

These kinds of techniques allow for the addition of a narrative structure to a VE. In this work we will explore guided navigation using the jumping metaphor instead of a steering one and investigate the benefits of an automatic approach over a user controlled one for a museum setting.

This thesis will discuss work related to navigation techniques and guiding in VEs on Head-Mounted Displays (HMD)s in Chapter 2.

2 | Related Work

As mentioned in Chapter 1, this thesis aims to investigate a technique for automated guided navigation using the jumping metaphor. To understand where the concept for this technique comes from we will take a look at different navigation metaphors for HMDs and see what the advantages of jumping navigation are. We will then see what the purpose of guiding in VEs is and why it can be useful for navigation to be guided. Based on this we will then show the motivation for bringing together jumping and guiding into one navigation technique.

2.1 Navigation

Navigation

2.2 Guiding

2.3 Conclusion

3 | Guided Jumping Scenarios

In this chapter we will look at use cases where navigation in a VE is required. These scenarios will be used to demonstrate the motivation for automated guided jumping for navigation which will be introduced in Chapter -.

3.1 Museum Tours

3.2 Storytelling

3.3 Conclusion

4 | Automated Guided Jumping for Navigation

5 | Design and Procedure of the User Study

5.1 Research Questions

In Chapter 4 we looked at a technique for automated guided navigation using the jumping metaphor and in Chapter **??** we saw how the jumps in this technique could be made comprehensible so that the user would know when and where they will jump. The motivations and scenarios that might require such a technique were discussed in Chapter 3. Keeping in mind the motivation to have a virtual museum that novice VR users are able to explore, we introduced the following research questions:

RQ$_1$: How can guided navigation techniques facilitate the acquisition of relevant knowledge of the scene while avoiding motion sickness?

RQ$_2$: How can we maximize the comprehensibility of a sequence of automated jumps?

RQ$_3$: Will having guided jumping improve comfort and reduce task load compared to free jumping with visual guidance?

To study the developed technique with regards to these research questions we decided to design a study that would compare automated jumping with user controlled (free) jumping. It was important to have a controlled study designs such that there would be no other influencing variables besides the automation.

6 | Evaluation of the User Study

7 | Conclusion and Future Work

This is the conclusion...

Bibliography

[1] T. Weissker, A. Kunert, B. Froehlich, and A. Kulik, "Spatial updating and simulator sickness during steering and jumping in immersive virtual environments," in *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 97–104, 2018.

[2] T. A. Galyean, "Guided navigation of virtual environments," in *Proceedings of the 1995 Symposium on Interactive 3D Graphics*, I3D '95, (New York, NY, USA), p. 103–ff., Association for Computing Machinery, 1995.

A | Appendix

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