Virtual Reality enhancing with Zoom Interaction Technique

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Abstract

This study introduces and evaluates a new zooming interaction technique in virtual reality (VR), and compares it to the commonly used teleportation technique. The zooming technique allows users to get a closer and more detailed view of a specific object or area in the virtual environment by using hand gestures. The comparison was conducted in an industrial setting scene, in which users were asked to perform tasks involving the manipulation of virtual machines.

1 Introduction

Virtual reality (VR) is an immersive technology that has the potential to revolutionize the way we interact with computers. However, for VR to be truly effective, it is essential that users have a natural and intuitive interaction with the virtual environment.

One of the challenges in VR is that the user may need to get a closer and more detailed view of a specific object or area in the virtual environment. The most commonly used method to achieve this is through teleportation, which allows users to instantly move to a different location in the virtual environment. However, teleportation can be disorienting and break the sense of immersion.

So what is the impact of adding the zoom as a feature on the user experience in a virtual reality (VR) environment? To answer this scientific question we implemented a new interaction technique of zooming, which allows users to get a closer and more detailed view of a specific object or area in the virtual environment by using hand gestures. The goal of this study is to evaluate the impact of adding this new feature on the user experience in a VR environment. We will investigate how the zooming interaction technique compares to the used alternative teleportation technique in terms of task completion time and user satisfaction.

2 Related Work

The field of Virtual Reality knows a significant amount of research on the design and evaluation of VR interactions. In particular, several studies have investigated the use of different interaction techniques in VR, such as hand gestures, body movements, and voice commands.

Teleportation is a commonly used technique in VR to allow users to move around the virtual environment. Studies have shown that teleportation can be an effective way to navigate large virtual environments, but it can also be disorienting and break the sense of immersion (e.g. Peterson, Wells, Furness 1998 , Swaan, Gabbard and Hix 2003). To overcome this limitation, researchers have proposed alternative navigation methods such as joystick,

gamepad, or mouse.

Zooming is another interaction technique that allows users to get a closer and more detailed view of a specific object or area in the virtual environment. Studies have shown that zooming can be a natural and intuitive way of interacting with virtual objects and environments (e.g. Lee, Bai, Billinghurst 2012, Bellarbi, Othmane, Zenati. 2017).

These studies have also shown that zooming can be implemented using different modalities such as hand gestures, head movements, or gaze tracking, and that it can be used to navigate large virtual environments. However, it is important to consider how the size and duration of the zooming step affect the user's experience.

Overall, the related work suggests that teleportation and zooming are both promising techniques for navigation in VR, but they have different trade-offs in terms of user experience and performance. This study aims to contribute to the existing literature by evaluating the effectiveness of the zooming interaction technique in an industrial VR setting and comparing it to the commonly used teleportation technique.

3 Approach

The experiment was conducted using the HTC Vive Pro VR headset and the Unity game engine. A virtual industrial environment was created, consisting of a room surrounded by a series of virtual machines that the users were asked to manipulate them using a UI board with a set position in the same room.

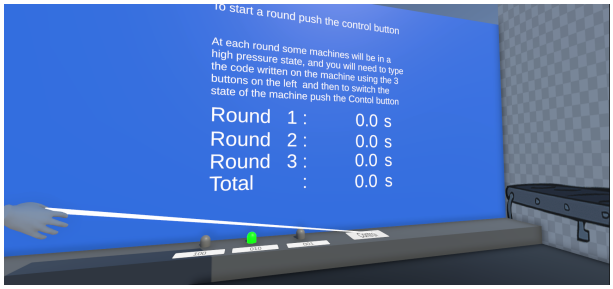

Figure 1: The UI board with the interaction ray linked to the left controller.

Two versions of the environment were used for the sake of comparison, one featuring teleportation as the primary interaction technique and the other featuring our zooming technique which can be used by the trigger in the right controller while the left controller is using ray casting to allow the interaction with the UI buttons.

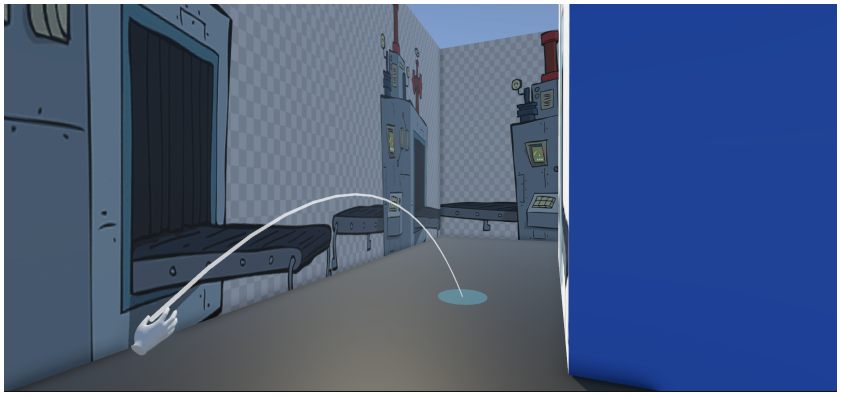

Figure 2: Teleportation ray

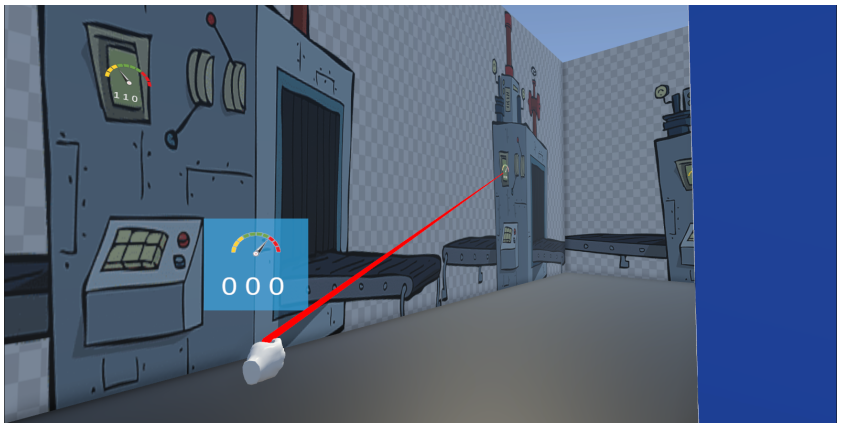

Figure 3: Zoom technique

The figure 2 above represent the teleportation ray that was used in the teleportation condition and the figure 3 shows the used prototype of the zooming capability.

The experiment consisted of two parts, one using the teleportation and the other was using the zoom technique, and both parts consisted of asking the user in three rounds to search in the room for the machines that are in what we call a "High Risk Pressure" situation when the needle is pointing to the red color, and should be turned off, in order to do that we need to copy the machine code and type it in the UI board and control its state. Each round ends when the user successfully switched all the machines to a safe state which means all the needles are pointing to either a green or yellow color.

The participants were given a brief training period to familiarize themselves with the environment and the interaction technique. User feedback was collected through a questionnaire administered after each experiment.
23

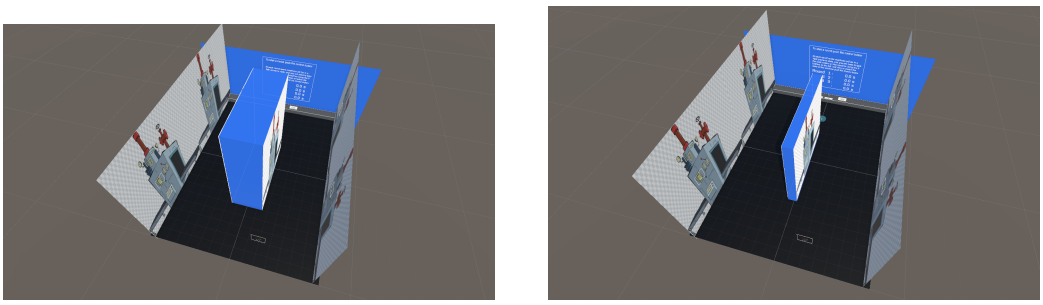

Figure 4: The scene before (on the left) and after (on the right) the scaling changes.

With these small changes in the scene, no more report where were received from the users about the ability to complete the tasks and the experiments started to go in more fluidity.

The experiment was then run again with 12 more participants, and it had a complete different result. This time after eliminating the external factors of room size and physical obstacles that allowed users to get a view on further machines with just couple of steps and peaking, the mean task completion time for the zooming condition was more than 20% faster than the teleportation condition, as for the zoom technique the mean of the users was 47.8s and for the teleportation it was 57.6s. In addition to result of the feedback that was conclusive.

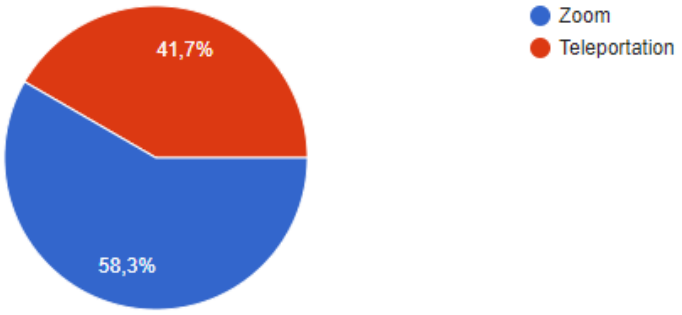

Figure 5: User Feedback on what method they preferred more.

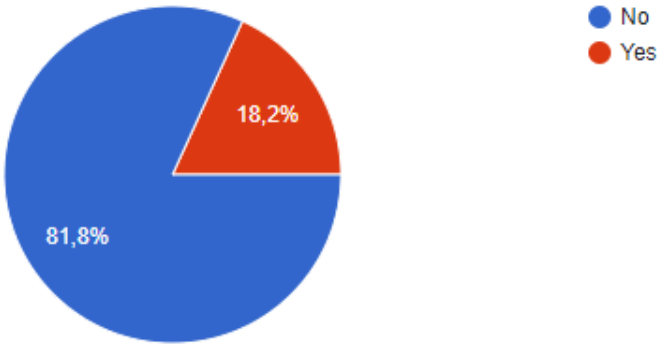

Figure 6: Report on whether teleportation caused dizziness, discomfort or not.

These results were collected after experiencing both conditions, and they were discussed with the users that indicated that the zooming technique felt more natural and did not cause dizziness, unlike teleportation which was reported to cause discomfort for some users.

These findings suggest that the zooming technique may be a more effective and comfortable alternative to teleportation for enabling seamless and natural navigation and manipulation in VR environments.

4 Discussion

The results of our study support the hypothesis that the zooming technique is a promising alternative to teleportation for VR interaction. The improved performance and user satisfaction observed with the zooming technique may be due to its ability to enable more detailed inspection and manipulation of virtual objects, as well as its ability to preserve spatial awareness and reduce discomfort.

In addition, the naturalness of the zooming technique may make it more intuitive and enjoyable for users, particularly in comparison to the disorienting effect of teleportation.

However, it should be noted that the specific context and requirements of different VR environments may affect the performance, exactly how we discussed in the result section before and after the changes made into the scene. Ultimately, the choice of an interaction type between the teleportation or the zoom techniques will always depend on the specific characteristics of the tasks and the environment.

5 Conclusion

In summary, our study introduced and evaluated a new zooming interaction technique in VR, and compared it to the commonly used teleportation technique.

The results showed that the zooming technique had significantly better task completion times and user satisfaction ratings compared to teleportation. In addition, user feedback indicated that the zooming technique felt more natural and did not cause dizziness, unlike teleportation which was reported to cause discomfort in some users.

These findings have implications for the design of VR interfaces and suggest that the zooming technique may be a promising alternative to teleportation for enabling seamless and comfortable navigation and manipulation in VR environments. The naturalness of the zooming technique may also make it more intuitive and enjoyable for users.

Finally, different applications of this technique could further explore the use of it in different types of VR environments and tasks, and compare its performance to other interaction techniques, which may lead us to an enhanced and efficient Human-Computer interaction.

6 References

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