A Demonstration of ShareVR: Co-Located Experiences for Virtual Reality between HMD and Non-HMD Users

Jan Gugenheimer* Ulm University, Germany
Evgeny Stemasov † Ulm University, Germany
Julian Frommel‡ Ulm University, Germany
Enrico Rukzio§ Ulm University, Germany

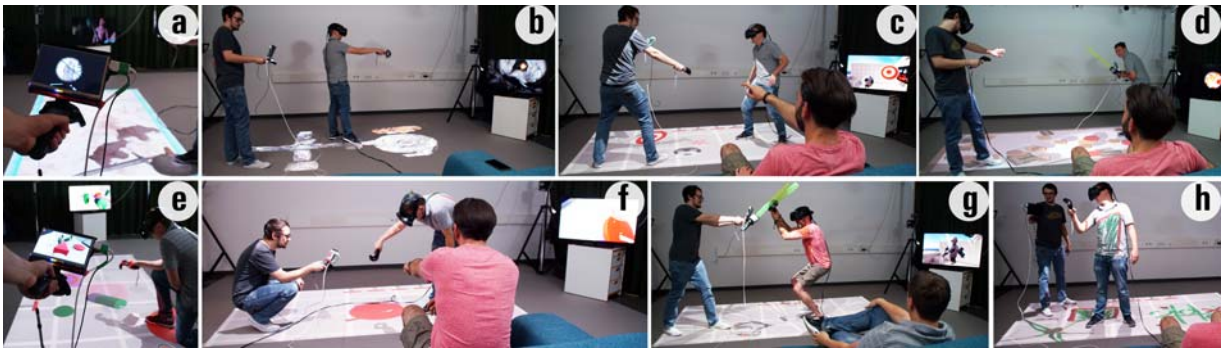

Figure 1: ShareVR enables co-located asymmetric interaction between users wearing an HMD and users without an HMD. ShareVR uses a tracked display (a, e) as a window into the virtual world and a floor projection to visualize the virtual environment to all Non-HMD users. It enables collaborative experiences such as exploring a dungeon together (b), drawing (h), sports (c) or solving puzzles (e, f) as well as competitive experiences such as "Statues" (d) or a swordfight (g). ShareVR facilitates a shared physical and virtual space, increasing the presence and enjoyment for both HMD and Non-HMD users.

ABSTRACT

Most current virtual reality (VR) head-mounted displays (HMD) create a highly immersive experience and are currently becoming part of the living room entertainment (e.g. PSVR). However, current VR systems focus mainly on increasing the immersion and enjoyment for the user wearing the HMD (*HMD* user). This results in all the bystanders (*Non-HMD* users) in the living room being excluded from the experience and degraded to mainly observing the *HMD* user. In this demonstration we show *ShareVR*, a VR system using floor projection and mobile displays in combination with positional tracking to visualize the virtual world for the *Non-HMD* user, enabling them to interact with the *HMD* user and become part of the VR experience. Additionally, we implemented several experiences for the asymmetric nature of *ShareVR*, exploring its design space.

Index Terms: Human-centered computing—Visualization—Visualization techniques—Treemaps; Human-centered computing—Visualization—Visualization design and evaluation methods

1 INTRODUCTION

Current virtual Reality (VR) head-mounted displays (HMD) are gradually becoming part of the home entertainment environment (e.g. Oculus Rift, HTC Vive, PlayStation VR and Windows Mixed Reality). All the devices and experiences currently available are mainly tailored towards a highly immersive but isolated experience from all the other people sharing the living room. However, Alladi Venkatesh describes the living room as a highly social environment where people experience content together and interact through technology [6]. Since the level of engagement may vary between members of the household (e.g. some want to watch, some want to have some form of interaction and some want to be fully part of the experience), a VR system has to cover a wide bandwidth of engagement [7]. Solely observing participants would benefit from a more spatial representation of the virtual world such as the approach of Valve, which uses a green screen in combination with a tracked camera to create a mixed reality video for the observer [5]. We argue that for VR to become part of this social living room environment, a way of interaction between users with an HMD and without an HMD is essential. Therefore, the focus of our work was on including the *Non-HMD* users into the VR experience and enhancing their way to interact with the *HMD* user.

This research demo presents *ShareVR* (Fig.1), a proof-of-concept prototype enabling *Non-HMD* users to be part of the VR experience and interact with the *HMD* user and the virtual environment. The system is based around an HMD, a tracked display and a floor projection to visualize the virtual space for the *Non-HMD* user (Fig.1 a,e) and potential bystanders. Prior work showed that this physical interaction can potentially increase enjoyment, social interaction and has cognitive benefits [1, 2, 4]

2 SHAREVR SYSTEM

ShareVR was built using an HTC Vive, two oppositely positioned short throw BenQ W1080ST projectors to visualize the tracking space and a 7 inch display attached to one of the HTC Vive controllers serving as a "window into the virtual world" for the *Non-HMD* user (Fig.2). We additionally added a TV which mirrored the view of the *HMD* user. The whole software was implemented using Unity© engine and is running on an i7 machine with an Nvidia GTX 970.

The main goal for *ShareVR* was to enable enabling *Non-HMD* users to become a part of the virtual experience of the *HMD* user and enable them to interact and explore the environment together. Additionally, we tried to enable all the *Non-HMD* users in the surrounding to be able to understand all the actions that happen inside the virtual environment and also to be able to interact with the *HMD* and *Non-HMD* user.

*e-mail: jan.gugenheimer@uni-ulm.de
†e-mail: evgeny.stemasov@uni-ulm.de
‡e-mail: julian.frommel@uni-ulm.de
§e-mail: enrico.rukzio@uni-ulm.de

2018 IEEE Conference on Virtual Reality and 3D User Interfaces
18-22 March, Reutlingen, Germany
978-1-5386-3365-6/18/$31.00 ©2018 IEEE

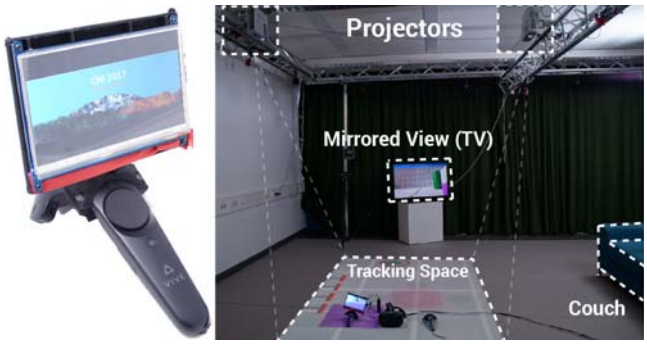

Figure 2: Left: Display mounted on the controller of the *Non-HMD* user. Right: Physical setup of *ShareVR*, replicating a living-room layout

3 Demo Application

We implemented a variety of applications for the *ShareVR* exploring different aspects of the asymmetry and measure their impact on immersion, enjoyment and social interaction [4]. In this demonstration we will focus on *SneakyBoxes* a competitive application for two user (*HMD* user and *Non-HMD* user) to play against each other.

SneakyBoxes is based on a popular children's game [8] which has different names through the world (e.g. RedLight, GreenLight in the US). *SneakyBoxes* is further highly inspired by Ruckus Ridge VR Party [3] which is one of few currently available co-located asymmetric VR games. The *HMD* user is positioned at the edge of the tracking space and uses one controller which represents a "marker" which can shoot projectiles. When looking into the tracking space the *HMD* user sees randomly positioned boxes, chests and barrels (Fig.3). The *Non-HMD* user is visualized as one of those boxes and is positioned inside the tracking space holding one controller which is mainly used for tracking his location. The goal of the *HMD* user is to find and "mark" the box which represents the *Non-HMD* user, whereby the *Non-HMD* user has to look through all the other boxes and find a randomly placed gem. All boxes are fixed in the scene and only the *Non-HMD* users' box moves when he physically moves his controller. This allows the *HMD* user to distinguish and tag the *Non-HMD* user.

To create a bigger challenge for the *HMD* user, the lights in the scene go out after approximately 10 seconds. To turn the lights back on, the *HMD* user has to turn away from the tracking space and hit a floating target behind him. This gives the *Non-HMD* user time to reposition himself and look through some of the boxes. To further exploit the physical proximity we attached an inflatable sword on the controller of the *Non-HMD* user. By hitting the *HMD* user with the inflatable sword, the lights inside the scene can be "hit out" every 15 seconds, forcing the *HMD* user to turn around and turn the lights back on. The handheld display is used as a "window" into the virtual world and the projection visualizes the tracking space (top down view of all boxes).

In our own experience the game is something participants quickly understand and are able to quickly jump in and out of the game. Additionally, its an entertaining experience for all other bystanders that are currently not part of the experience. The application therefore includes not only the *Non-HMD* but could also engage the audience in cheering for one of the party (*HMD* user or *Non-HMD* user). This application nicely demonstrates the ability of *ShareVR* to include the *Non-HMD* user and everyone in the environment and make them part of the VR experience.

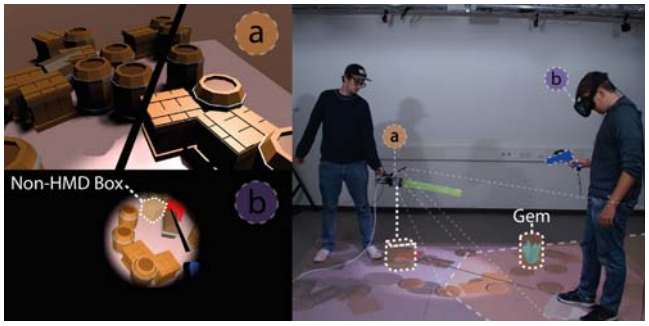

Figure 3: Two users playing SneakyBoxes and their individual views: (a) handheld (b) inside the HMD. Note that the HMD user (b) can not distinguish between a regular box and the Non-HMD box.

4 Conclusion

In this demo of *ShareVR*, we present a proof-of-concept prototype using floor projection and mobile displays in combination with positional tracking to visualize the virtual world for *Non-HMD* users and enable them to interact with the *HMD* user and become part of the VR experience. We designed and implemented *ShareVR* using off the shelf hardware and explored the design space through several applications. With this demo we want to push the concept of asymmetric co-located interaction for virtual reality and want to engage with the participants of the conference in a discussion about the future direction of consumer virtual reality. We argue that in the future VR HMDs should not only be designed for the *HMD* user but also start to include people in the environment to increase social acceptance and help increase the distribution of VR technology in regular housholds.

References

[1] L.-P. Cheng, P. Lühne, P. Lopes, C. Sterz, and P. Baudisch. Haptic turk: A motion platform based on people. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 3463–3472. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557101

[2] L.-P. Cheng, T. Roumen, H. Rantzsch, S. Köhler, P. Schmidt, R. Kovacs, J. Jasper, J. Kemper, and P. Baudisch. Turkdeck: Physical virtual reality based on people. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology*, UIST '15, pp. 417–426. ACM, New York, NY, USA, 2015. doi: 10.1145/2807442.2807463

[3] Foreign VR. *Ruckus Ridge VR Party*. Game [HTC Vive], 2016. Foreign VR, Palo Alto, USA.

[4] J. Gugenheimer, E. Stemasov, J. Frommel, and E. Rukzio. Sharevr: Enabling co-located experiences for virtual reality between hmd and non-hmd users. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 4021–4033. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025683

[5] VALVE. Virtual reality - steamvr featuring the htc vive. `https://www.youtube.com/watch?v=qYfNzhLXYGc`, 2016. Accessed: 2016-09-07.

[6] A. Venkatesh, E. Kruse, and E. C.-F. Shih. The networked home: an analysis of current developments and future trends. *Cognition, Technology & Work*, 5(1):23–32, 2003. doi: 10.1007/s10111-002-0113-8

[7] A. Voida and S. Greenberg. Wii all play: the console game as a computational meeting place. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1559–1568. ACM, 2009.

[8] Wikipedia. Statues (game). `https://en.wikipedia.org/wiki/Statues_(game)`, 2016. Accessed: 2016-09-07.