Mediascape XR: A Cultural Heritage Experience in Social VR

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Figure 1: The user journey of the Mediascape XR application. In the *Museum* scene the users are able to navigate in a replicated version of the Netherlands Institute of Sound and Vision Museum and explore a famous costume in Dutch culture. Then, the users move to the *Musical Hall* scene, where they recreate a historical show from the music program Toppop played in 1979.

ABSTRACT

Social virtual reality (VR) allows multiple remote users to interact in a shared space, unveiling new possibilities for communication in immersive environments. Mediascape XR presents a social VR experience that teleports 3D representations of remote users, using volumetric video, to a virtual museum. It enables visitors to interact with cultural heritage artifacts while allowing social interactions in real time between them. The application is designed following a human-centered approach, enabling an interactive, educating, and entertaining experience.

CCS CONCEPTS

• **Information systems** → **Multimedia streaming**; • **Human-centered computing** → **Virtual reality**.

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KEYWORDS

Social Virtual Reality, Cultural Heritage, Real-time Volumetric Capture, 3D, Point Clouds

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1 INTRODUCTION

Museums are not just a safe storage space for heritage artefacts, but a place for discussion, collaborative learning, and group outing for families and friends. However, it is not always easy for geographically separated friends or family members to visit museums together. Therefore, many museums have explored how digital technologies such as websites and streaming videos [2] or immersive capture techniques [7] can facilitate remote access to their collections. These solutions mainly focus on the digitization of the content, and not on the immersive shared experience of visiting

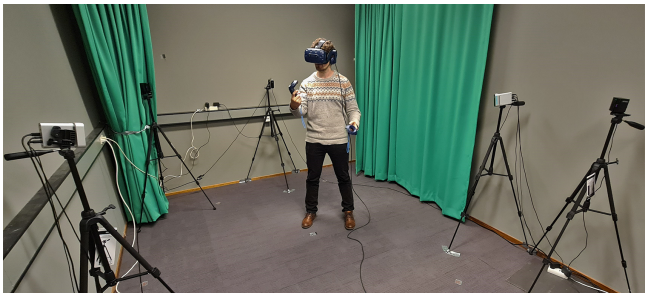

Figure 2: Example of the physical space where the user is being captured by three Azure Kinect sensors

the museum together with others [9]. Moreover, 2D screens limit the possibilities for co-presence and interaction between users [8].

In the domain of cultural heritage, the way of presenting artefacts to the visitors is gradually shifting from mobile devices or websites to more immersive environments in VR [9, 11]. Thanks to its advanced 3D visualization technology and commercially affordable hardware, VR technology has recently evolved into a suitable solution for displaying cultural objects, supporting interactive exhibits and sharing knowledge in playful representations. Moreover, VR is transforming from an isolated digital experience into a social medium [1, 5]. Social VR offers enriched communication using social cues like eye and head orientation and highly realistic interaction capabilities [4].

This demo showcases a novel social VR museum experience, allowing remote audiences to visit a virtual museum and to explore cultural heritage artefacts together. In particular, we provide a virtual replica of the Netherlands Institute of Sound and Vision museum[1] offering navigation within the museum and interaction with some cultural heritage artefacts, beyond what one can do in the physical space. The experience is tailor-made for one specific cultural artefact: the costume that Jerney Kaagman, lead singer of the rock band Earth and Fire, wore in the music program Toppop in 1979[2]. In the virtual environment, visitors can freely interact with a high-quality 3D model of the costume, enjoy a curated tour through this model, and recreate the Toppop show with other remote visitors. The work followed a human-centered methodology, involving museum curators and other experts (focus groups, co-creative sessions, evaluations).

2 TECHNOLOGY

MediaScape XR is a SocialVR application, build on top of the VRTogether platform [3], which allows the co-presence of multiple users in the same virtual space, a museum in this case. The application is developed in Unity3D. The users are captured as dynamic point clouds in real time, using the cwipc framework [10]. This is a set of libraries and tools that provide a volumetric video-conferencing pipeline between multiple clients, and support capturing, encoding, transmission, decoding and rendering of point clouds in real time [6]. Figure 2 shows an example of the capturing setup. In this case the user is surrounded by three Microsoft Azure Kinect sensors and wears an HTC Vive Pro headset and controllers in order to navigate and interact with the virtual space. Two machines

[1]https://www.beeldengeluid.nl/en
[2]https://youtu.be/CP1bPNG2BxE

Figure 3: Two visitors (left and right) experiencing Mediascape XR demo at VRDays 2021, with two operators (middle)

are needed to run the demo, one for each user; additionally, other machines might be used to join the experience, e.g., to control a virtual camera in order to show to the audience what is happening inside the VR world. The application runs on Windows 10 OS, in machines equipped with a i7@4.2 GHz CPU, 32GB RAM, and a Nvidia GeForce GTX 1080Ti GPU.

3 USER EXPERIENCE

The experience is sketched in Figure 1. It begins in the training zone (1) of the *Museum* scene, where users meet each other and learn how to navigate the virtual space and interact with it (teleport, grab, click) but also between them (by using voice communication and passing props to each other). Then they are invited to freely explore the museum exhibition together. On the way to the main artefact of the exhibition, they find a mirror (2) where they can check their photo-realistic representations. Next they find the main artefact, the costume (3). Users are able to read its history and characteristics on the information panels, but also to interact with it, change size and rotate it. To enhance the learning experience, the exhibition offers the users the possibility to travel back in time to the main stage where the costume was used (4). In the *Musical Hall* scene, users are represented as cartoon-type avatars and they are wearing the famous dress. At the beginning, users are guided through the experience using numbered floor markings, to properly learn how to interact with all the objects around. For instance, they learn how to grab a camera and take a selfie (5), to see their reflection in mirrors (6), to watch a small fragment of the opening of the show that was broadcast in 1979 (7), and to play multiple instruments like a guitar or drums (8). Once they learned how to use all the props, the guidance elements disappear and the show starts, so users can freely recreate this historical moment together (8).

4 CONCLUSION

The application has been already showcased in the VRDays Europe 2021[3]. Figure 3 shows the specific setup used for that event.

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[3]https://www.cwi.nl/front-page-content/cwi-and-the-netherlands-institute-for-sound-vision-gave-a-sneek-peek-into-the-future-of-cultural-heritage

REFERENCES

[1] Elena Dzardanova, Vlasios Kasapakis, and Damianos Gavalas. 2018. On the effect of social context in virtual reality: An examination of the determinants of human behavior in shared immersive virtual environments. *IEEE Consumer Electronics Magazine* 7, 4 (2018), 44–52.

[2] Eva Hornecker and Luigina Ciolfi. 2019. Human-computer interactions in museums. *Synthesis lectures on human-centered informatics* 12, 2 (2019), i–171.

[3] Jack Jansen, Shishir Subramanyam, Romain Bouqueau, Gianluca Cernigliaro, Marc Martos Cabré, Fernando Pérez, and Pablo Cesar. 2020. A Pipeline for Multiparty Volumetric Video Conferencing: Transmission of Point Clouds over Low Latency DASH. In *Proceedings of the 11th ACM Multimedia Systems Conference* (Istanbul, Turkey) *(MMSys '20)*. Association for Computing Machinery, New York, NY, USA, 341–344. https://doi.org/10.1145/3339825.3393578

[4] Jie Li, Yiping Kong, Thomas Röggla, Francesca De Simone, Swamy Ananthanarayan, Huib de Ridder, Abdallah El Ali, and Pablo Cesar. 2019. Measuring and Understanding Photo Sharing Experiences in Social Virtual Reality. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300897

[5] Jie Li, Vinoba Vinayagamoorthy, Julie Williamson, David A. Shamma, and Pablo Cesar. 2021. Social VR: A New Medium for Remote Communication and Collaboration. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI EA '21)*. Association for Computing Machinery, New York, NY, USA, Article 81, 6 pages. https://doi.org/10.1145/3411763.3441346

[6] Rufael Mekuria, Kees Blom, and Pablo Cesar. 2017. Design, Implementation, and Evaluation of a Point Cloud Codec for Tele-Immersive Video. *IEEE Transactions on Circuits and Systems for Video Technology* 27, 4 (2017), 828–842. https://doi.org/10.1109/TCSVT.2016.2543039

[7] Tobias Nöll, Johannes Köhler, Gerd Reis, and Didier Stricker. 2015. Fully Automatic, Omnidirectional Acquisition of Geometry and Appearance in the Context of Cultural Heritage Preservation. *ACM Journal on Computing and Cultural Heritage* 8, 1 (2015), 2:1–2:28. https://doi.org/10.1145/2629693

[8] Andrew J Pekarik, Zahava D Doering, and David A Karns. 1999. Exploring satisfying experiences in museums. *Curator: The Museum Journal* 42, 2 (1999), 152–173.

[9] Panagiotis Petridis, Ian Dunwell, Fotis Liarokapis, George Constantinou, Sylvester Arnab, Sara De Freitas, and Maurice Hendrix. 2013. The herbert virtual museum. *Journal of Electrical and Computer Engineering* 2013 (2013).

[10] Ignacio Reimat, Evangelos Alexiou, Jack Jansen, Irene Viola, Shishir Subramanyam, and Pablo Cesar. 2021. CWIPC-SXR: Point Cloud Dynamic Human Dataset for Social XR. In *Proceedings of the 12th ACM Multimedia Systems Conference* (Istanbul, Turkey) *(MMSys '21)*. Association for Computing Machinery, New York, NY, USA, 300–306. https://doi.org/10.1145/3458305.3478452

[11] Reimar Tausch, Matevz Domajnko, Martin Ritz, Martin Knuth, Pedro Santos, and Dieter Fellner. 2020. Towards 3D Digitization in the GLAM (Galleries, Libraries, Archives, and Museums) Sector - Lessons Learned and Future Outlook. *IPSI Transactions on Internet Research* 16, 1 (2020), 45–53. http://publica.fraunhofer.de/documents/N-578457.html.