

Virtual Exhibition as a Portal to Authentic Art Experiences: Exploring the Immersive Reproduction of Exhibition in Practice

Yuanyuan Yin*

Lian Pan†

Xiao Wei‡

Ruohan Tang#

Christopher O'Connor§

University of Southampton

University of Southampton

University of Southampton

University of Southampton

University of Southampton

Guangxi Normal University

ABSTRACT

Exhibitions are traditionally constrained by fixed times and locations, limiting access for a wider audience. Immersive reproduction, leveraging 3D reconstruction and virtual reality technologies, offers a way to transcend these temporal and spatial limitations. While previous research has largely focused on integrating mixed-reality elements within physical museum spaces, treating VR as a supplementary tool, our research positions VR as the primary “portal” to authentic artistic experiences. This demo showcases the complete process of immersive reproduction for *Following the Fish*, an exhibition featured at the 18th Venice International Architecture Biennale in 2023, offering valuable insights and references for future digital archiving and immersive reproduction of exhibitions.

Index terms: Virtual Reality, Immersive Reproduction, Digital Archive, High-Precision 3D Reconstruction, Virtual Exhibitions, Virtual Tour.

1 INTRODUCTION

The rapid development of immersive technologies has transformed how people engage with cultural participation, offering interactive and sensory-rich experiences across fields like cultural preservation, interaction and accessibility [1]. While many museums and art galleries now offer virtual tours, they often rely on presenting fictional artistic spaces or static photography to create 360-degree panoramic displays, which fail to recreate the original artistic environments required for a true sense of spatial presence and immersion. Increasingly, researchers and practitioners are integrating mixed-reality technologies to enhance museum and gallery displays and interactions [2,3]. However, their efforts are primarily focused on integrating virtual and augmented reality into existing physical exhibition spaces. Our project, by contrast, emphasises the immersive reproduction of entire exhibitions, including venues, artworks, installations, and the authentic artistic experiences they evoke. We created a high-precision immersive reproduction of *Following the Fish*, an exhibition from the 2023 Venice Architecture Biennale curated in part by Dr. Daniel Cid Moragas, Associate Professor of Design Studies at WSA of University of Southampton. Viewed by over

26,000 visitors, it became the Biennale’s most visited architecture exhibition, allowing visitors to rethink architecture from the perspective of an African immigrant. The reproduced immersive exhibition was constructed at a 1:1 original scale of the physical exhibition. When the available space permits (i.e., when the space is equal to or larger than the original venue), visitors can walk through the virtual environment, recreating an authentic artistic experience.

The demo¹ provides a detailed overview of the reproduction process, encompassing 3D scanning of the exhibition venue and displayed art installations, high-precision 3D modelling, immersive environment setup, and VR integration and testing. It demonstrates how emerging technologies can be efficiently and precisely utilised to authentically recreate an exhibition and its associated experiences, making them accessible to distant audiences and preserving them for future generations. A usability testing of the immersive virtual exhibition was conducted using Meta Quest 3 after reproduction. In addition to the immersive virtual exhibition, a 360° panoramic virtual tour version [4] of the exhibition was also produced, accessible on smartphones and computers. This dual approach allows researchers and audiences to compare different digital archiving methods and virtual exhibition experiences, offering valuable insights for future studies on digital art archiving and immersive exhibition reproduction.

2 REPRODUCING AN IMMERSIVE VIRTUAL REALITY EXHIBITION

Our project explores the immersive virtual reproduction of exhibition. This demo illustrates the steps from high-precision 3D scanning to immersive scene creation.

2.1 Environmental Data Collection

To comprehensively document the exhibition environment, we collected both visual and auditory data using a variety of devices and techniques. Drones, smartphones, and DSLR cameras were employed for 3D spatial mapping and scanning, accurately capturing the exhibition’s spatial layout and structure, which served as the foundation for creating a rough model of the entire exhibition.

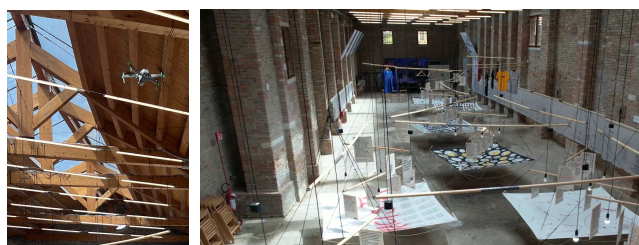


Figure-1 Scanning the Exhibition Venue from above by Drone

* e-mail: y.yin@soton.ac.uk

† e-mail: lian.pan@soton.ac.uk

‡ e-mail: xiao.wei@soton.ac.uk

e-mail: ruohan.tang@soton.ac.uk

§ e-mail: c.s.oconnor@soton.ac.uk

¹ Demo Link: https://youtu.be/ku_HTQo0ruI

High-resolution material textures were captured using DSLR cameras to preserve intricate surface details of the art installations and architectural elements. Additionally, Insta360 cameras were used to record 360-degree photos and videos, serving as reference documentation for the virtual reconstruction and as the basis for creating a 360° panoramic virtual tour to enable cross-media experience comparisons. Auditory data, including natural environmental sounds, ambient venue noise, and artistic sound elements, was also recorded to construct a realistic soundscape for the virtual environment. Together, these materials provided a comprehensive dataset of the exhibition's physical and auditory environment, forming a solid foundation for high-precision 3D reconstruction and immersive scene creation.

2.2 High-Precision 3D Reconstruction

High-precision 3D reconstruction aims to recreate the exhibition environment and details through a multi-phase modelling process. Initially, point cloud data was generated using footage from drones and smartphones processed through *Reality Capture*. This point cloud data accurately mapped the architectural structures and locations of art installations, which were then imported into *Maya* to create a rough model of the exhibition. Then, using DSLR and Insta360 camera footage as references, along with rough models as guides, we created high-precision and clean 3D models in *Maya*. The high-precision models were then imported into *Unreal Engine* (see Figure-2).



Figure-2 From point cloud to High-precision model

In UE, we reconstructed the materials for the art installations based on curatorial materials and on-site documentation (see Figure-3). These included exhibit surfaces, posters, and scene textures such as walls, floors, ceilings, beams, and structural details like wood grain patterns.

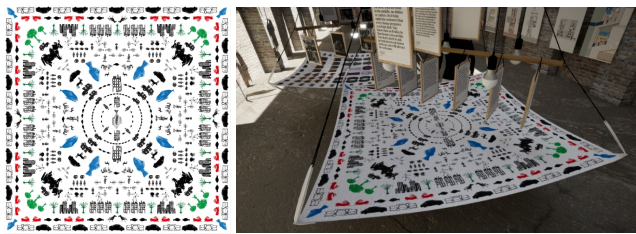


Figure-3 Texturing the Art Installation Model in UE

Lighting reconstruction was another critical component. Both natural and artificial lighting conditions were simulated based on recorded footage to replicate the authentic lighting atmosphere of the exhibition. Finally, we developed a VR-compatible version of the exhibition, which underwent iterative testing with curators and team members to refine and perfect the virtual environment.

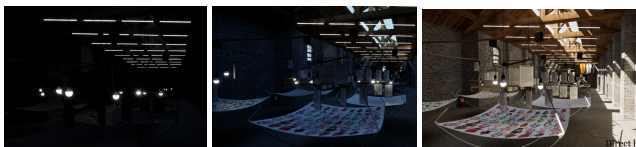


Figure-4 Reconstructing Lighting in UE

2.3 Interaction Design

The interactive design and user experience phase aims to integrate interactive features into the virtual exhibition to enhance user engagement and immersion. Sound and video triggers were implemented to automatically play specific audio and visual content when users approach designated areas in the virtual space. This includes recreating the exhibition's soundscape with ambient noise and curated background music, further enriching the immersive experience. Two primary navigation modes were designed for the virtual tour: 1) Free Exploration Mode: Visitors can freely navigate the VR exhibition at their own pace, exploring the space without restrictions. 2) Guided Auto-Tour Mode: Visitors follow a predefined path led by a virtual guide, receiving step-by-step navigation and commentary to complete the tour. Additionally, a "pop-up information" feature was introduced, providing detailed explanations and background information for each art installation, allowing visitors to gain a deeper understanding of the exhibition content. These interactive elements collectively enhance the usability and experiential depth of the virtual exhibition, ensuring a meaningful and engaging experience for all users.

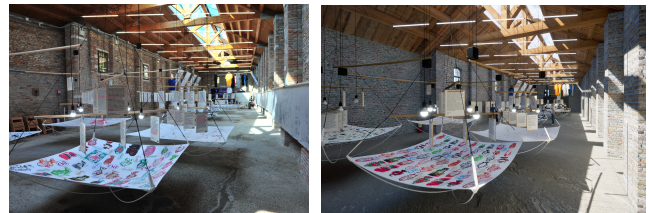


Figure-5 Original Exhibition (Left) vs. High-Precision Reconstructed Virtual Exhibition (Right)

3 CONCLUSION

Exhibitions are traditionally limited by fixed times and locations, restricting access for those unable to travel. Virtual reality exhibitions overcome these barriers by enabling remote cultural participation. Through immersive virtual reproduction, exhibitions can be "transported" across time and space, allowing individuals to experience and connect with art from the comfort of their own space. This process not only archives art works and cultural heritage, but also enhances their public accessibilities, transforming the "unreachable" into the "accessible". Immersive virtual exhibitions exemplify the potential of emerging technologies to transcend physical boundaries, foster inclusivity, and create meaningful cultural experiences, while offering valuable insights for future archival, exhibition and VR application practices.

REFERENCES

- [1] Bekele, Mafkereseb Kassahun, Roberto Pierdicca, Emanuele Fronton i, Eva Savina Malinverni, and James Gain. "A Survey of Augmented , Virtual, and Mixed Reality for Cultural Heritage." *Journal on Computing and Cultural Heritage* 11, no. 2 (March 22, 2018): 1–36. <https://doi.org/10.1145/3145534>.
- [2] Trunfio, Mariapina, Maria Della Lucia, Salvatore Campana, and Ade le Magnelli. 2021. "Innovating the Cultural Heritage Museum Service Model through Virtual Reality and Augmented Reality: The Effect s on the Overall Visitor Experience and Satisfaction." *Journal of Heritage Tourism* 17 (1): 1–19. doi:10.1080/1743873X.2020.1850742.
- [3] Barbieri, Loris, Fabio Bruno, and Maurizio Muzzupappa. "User-Cent ered Design of a Virtual Reality Exhibit for Archaeological Museum s." *International Journal on Interactive Design and Manufacturing (IJIDeM)* 12, no. 2 (June 5, 2017): 561–71. <https://doi.org/10.1007/s12008-017-0414-z>.
- [4] The 360° panoramic virtual tour can be accessed through: <https://storage-net-fs.com/hosting/7909817/3/>