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# Cultural Windows: Towards Immersive Journeys into Global Living Spaces

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## ABSTRACT

“Cultural Windows” is a research initiative aimed at enhancing cross-cultural understanding through immersive extended reality (XR) experiences. The project deploys AR and VR platforms to allow users to explore diverse living spaces, bridging the gap between preconceived notions and the actual appearance of these spaces. By using 3D scanning to create accurate models of culturally significant objects and integrating them into immersive systems, the project provides insights into the use of immersive technologies in cultural education, promoting engagement with global living designs.

## KEYWORDS

Cross-Cultural Visualization, Extended Reality (XR), Cultural Awareness in Design

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## 1 INTRODUCTION

Immersive technology has increasingly enabled users to virtually experience distant and unknown places. While many VR applications focus on visiting landmarks or landscapes, they rarely allow users to explore how locals live within these cultures. “Cultural Windows” addresses this gap by using XR to recreate and explore living spaces from various cultural contexts. By immersing participants in these virtual environments, the project aims to foster cultural appreciation and reduce biases, offering a nuanced understanding of global domestic aesthetics.

This project stands out by balancing cultural exploration with privacy considerations, using non-photorealistic models and generic objects when necessary (Figure 1). The goal is to create immersive experiences that are both educational and respectful of cultural sensitivities, providing an engaging platform for both learners and professionals in fields like design and architecture.

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Figure 1: “Cultural Windows” workflow for immersive global interiors: (a) 3D scanning unique design elements, (b) Ensuring privacy with generic, non-photorealistic models, (c) Incorporating 3D models with original textures, and (d) Finalizing the scene for VR.

## 2 BACKGROUND

Media, particularly visual media like photography, plays a crucial role in shaping public perceptions of ethnic and cultural groups by enhancing cross-cultural empathy and awareness. Projects such as Peter Menzel’s “Material World” [5] and the “Dollar Street” initiative by Gapminder [2] provide compelling narratives that emphasize cultural diversity in everyday life.

Technological advancements in XR have furthered this by immersing users in diverse cultural perspectives. Described as an “empathy machine,” VR has been particularly effective in educational contexts to enhance engagement and understanding of cultural education [6, 7].

However, XR technologies face challenges such as access to XR hardware and achieving realism in virtual environments [1, 8]. Although 3D scanning is widely used in cultural heritage preservation [4], integrating it into XR in the context of “Cultural Windows” presents challenges in ensuring cultural accuracy and sensitivity, which are critical to avoid misrepresentations and reinforce cultural inequalities [3].

## 3 METHODOLOGY

In “Cultural Windows” photogrammetry and LiDAR scanning are employed to capture the textures and geometries of detailed models of selected living spaces, with a focus on preserving cultural authenticity while addressing privacy concerns. The collected data is processed using tools like Rhino 3D and Autodesk Recap Photo to create error-free, realistic 3D models (see Figure 2). The models of these living spaces are then integrated into VR and AR environments, allowing users to interact with and explore the cultural

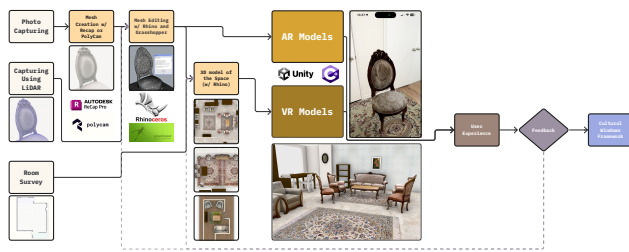


Figure 2: Methodology diagram of “Cultural Windows.”



Figure 3: Final reconstructed 3D models of the living spaces, ready for VR integration: (a) Room No. 1 in Tehran, (b) Room No. 2 in Tabriz, (c) and (d) Room No. 3 in Tehran.

design elements in an immersive setting. Figure 3 illustrates final reconstructed 3D models of the living spaces used for this project.

#### 4 OBSERVATIONS AND FEEDBACK

In a preliminary informal study, 4 participants (two men and two women, each from different cultural environments) with backgrounds in interior design and architecture engaged with the VR and AR experiences developed through this workflow. Initial feedback highlighted the project’s potential to enhance cultural understanding and appreciation. However, participants emphasized the need for collaboration with cultural experts to ensure accuracy and sensitivity in the representations. They also suggested including more contextual information and a broader range of cultural scenarios to enhance the educational value of the experiences.

#### 5 DISCUSSION AND LIMITATIONS

This project explores the potential of immersive technologies like VR and AR in fostering cultural understanding through interactive and visually rich experiences. The preliminary findings suggest that these tools can deepen users’ engagement with cultural content by bridging the gap between abstract knowledge and experiential understanding. However, it is crucial to continue refining the methodology and ensure the inclusion of culturally sensitive content to avoid oversimplifications or misrepresentations.

The preliminary study was limited by a small sample size and a focus on specific cultural contexts, which may not fully capture the diversity and complexity of global cultural designs. Additionally, technological constraints such as the resolution of 3D models and the usability of VR and AR systems posed challenges that could affect user engagement and the overall effectiveness of the immersive experiences. These limitations suggest the need for broader studies and more advanced technological solutions.

Future research should aim to expand the cultural contexts represented in the “Cultural Windows” project by including diverse socio-economic classes and geographical regions. Additionally, there is a need to integrate more sophisticated XR technologies that offer enhanced realism and interactivity. Collaborating with cultural experts throughout the content creation process will be essential to ensure accuracy and sensitivity, while also exploring automated methods for collecting and processing cultural data to broaden the scope and impact of the project.

#### 6 CONCLUSION

By introducing a workflow to create immersive cultural experiences, we contribute a mechanism to use immersive technologies to foster cross-cultural understanding. In our preliminary study, most participants noted the practical applications of projects like “Cultural Windows” in their professional fields and the educational value of such immersive experiences. By further embracing collaborative contributions and advancing technological solutions, future work can transform how we experience, understand, and appreciate global cultures through immersive technologies.

#### SUPPLEMENTAL MATERIALS

All supplemental materials are available on OSF (<https://t.ly/D2K3A>). The repository includes the Creative Commons version of all figures in this article, the descriptions provided by participants in the first phase, and the questionnaire used during the debriefing phase after the immersive experience.

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