



User Experience Design of Digital Display of San Jiang Dong wooden Building Construction Skills based on Unreal Engine Technology

Shen Song^{1*}, Dahlan Bin Abdul Ghani²

¹City Graduate School, City University Malaysia

²Malaysian Institute of Information Technology

Corresponding Author: Shen Song; Email: 81203540@qq.com

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ABSTRACT

This study aims to explore the user experience design of digitized presentation of the craftsmanship of Dong ethnic wooden architecture in San Jiang County, Guangxi, using the Unreal Engine technology. By extracting the interactive features of Unreal Engine, the characteristics of Dong ethnic wooden architecture, and user experience elements, and analyzing empirical cases, this research investigates the digitization and user experience from the perspectives of immersive experience, interactive experience, and imaginative experience. The results indicate that Unreal Engine technology creates realistic digital scenes, enhancing users' perception and engagement with wooden architecture. The multi-modal interactive design provides a more immersive learning experience, while the internalization of emotional experience fosters an emotional connection between users and the cultural heritage of Dong ethnic wooden architecture. This study provides a feasible reference for the application of Unreal Engine technology in the digitized presentation and preservation of intangible cultural heritage.

INTRODUCTION

Intangible cultural heritage is the crystallization of human wisdom and creativity, representing the unique cultural traditions and values of various nations. However, with the continuous advancement of modernization, many

traditional cultures are facing the threat of disappearance and loss (Ch 'ng et al., 2017). To protect and inherit this precious intangible cultural heritage, scholars actively seek innovative ways and technical means.

Unreal Engine is a powerful digital authoring tool, which has been widely used in game development, virtual reality, and other fields (Mack & Ruud, 2019a). (Fig. 1) The continuous development of Unreal Engine technology provides new possibilities for the protection and inheritance of intangible cultural heritage. With Unreal Engine technology, we can create virtual scenes that make the audience feel as if they are in them and experience the charm of traditional culture (Deng et al., 2021).



Figure. 1 Virtual scenes in the Unreal Engine

Although Unreal Engine technology has great potential in the protection and inheritance of intangible cultural heritage, it still faces some challenges in the application process (Zhang et al., 2023). For example, how to use Unreal Engine technology to effectively display the characteristics and connotations of intangible cultural heritage? What are the specific application ways and methods of unreal Engine technology in intangible cultural heritage protection? How does the application of Unreal Engine technology affect user experience and perception?

This study aims to explore the digital display and user experience design of intangible cultural heritage based on Unreal Engine technology. By analyzing the interactive characteristics of Unreal Engine technology, the display characteristics of intangible cultural heritage and the elements of user experience, this study tries to deeply study the effectiveness of digital display and user experience in the protection and inheritance of intangible cultural heritage.

This study is of great significance for the protection and inheritance of intangible cultural heritage. By studying the application of Unreal engine technology in intangible cultural heritage display, new ideas and methods can be provided for the digital protection and communication of intangible cultural heritage (Zhang et al., 2023). At the same time, the research results will help enhance the audience's cognition and understanding of intangible cultural heritage and promote the inheritance and development of intangible cultural heritage in modern society (Chen et al., 2021).

This paper aims to deeply explore the effectiveness of digital display and its impact on audience through the research of Unreal engine technology applied to digital display and user experience of intangible cultural heritage. Through the research of scientific perspective, the feasibility reference of unreal engine technology in the protection and inheritance of intangible cultural heritage is provided, and useful enlightenment is provided for scholars and practitioners in the field of cultural heritage.

METHODS

This chapter will detail the methods and steps adopted in this study, including the selection of research tools, the data collection process, the data analysis process, and the data display process.

Unreal Engine is a powerful and flexible digital authoring tool, which plays an important role in this research. Unreal engine is widely used in game development, virtual reality, and other fields. Its openness and customizability make it an ideal choice for exploring the protection and inheritance of intangible cultural heritage. In this study, the use of Unreal Engine mainly includes the following aspects:

Virtual scene modeling and presentation: Unreal Engine can create

highly realistic virtual scenes through modeling tools, which includes the digital presentation of wooden buildings of Dong ethnic group in San Jiang. Through the virtual scene, the audience can feel as if they are in it and experience the charm of traditional culture in person (Wang & Hu, 2020). The realistic graphics and lighting effects of Unreal Engine can make the audience feel the reality and beauty of intangible cultural heritage.

For example, the central area of Canada's Parliament Hill is one of the most representative buildings in the country, carrying the balance, discussion and protection of democratic symbols and national interests. To preserve this precious historical heritage and pass it on to future generations, the Central District has undergone a comprehensive renovation for the first time in its history. The HOK Architecture team responsible for building restoration adopted an Unreal Engine based building visualization process, capturing field data using Leica terrain scanners, HD cameras, and manual scanning hardware, and then reconstructing digital scene restoration of point clouds and mesh volumes using Unreal Engine (Shah et al., 2022). Through this complex digital process, the team was able to demonstrate the impact of design choices and iterations in real time, as well as the significant state of the building at each stage of the project's ten-year cycle, ensuring that all stakeholders had a complete picture of the progress and outcomes of the renovation. This digital display and visualization process based on Unreal engine provides a reliable tool and reference for long-term planning and preservation of historical heritage.

Interactive Experience Design: Unreal Engine supports multiple modes of interaction, such as touch, gestures, and VR controls, allowing viewers to actively participate in the experience in the virtual scene (Plowman, 2019). For example, in the virtual scene, the

audience can freely explore the architectural structure, learn the details of the craftsmanship of constructing wooden buildings, and interact with the virtual cultural heritage. This interactive experience can improve the user's sense of engagement and learning effect (Kong & Zhang, 2021).

User Experience Optimization: Unreal Engine can achieve immersive experience through virtual reality technology and enhance the emotional experience of users through sensory stimulation (Mack & Ruud, 2019b). For example, adding environmental sound effects, atmospheric music, and visual effects to virtual scenes can enhance users' perception and cognition of intangible cultural heritage and make users more engaged in the display experience.

The effectiveness of Unreal engine in the protection and inheritance of intangible cultural heritage has been proved by relevant cases. Many cultural institutions and museums have adopted Unreal Engine technology to realize the digital display and dissemination of intangible cultural heritage (Bevilacqua et al., 2022).

For example, the European Cultural Heritage Village project has used Unreal Engine technology to enable the digital display and interactive experience of multiple cultural heritage sites. Through virtual scenes, visitors can explore the historical and cultural connotation of various cultural heritage sites, while interacting with virtual guides to obtain deeper cultural cognition.

In addition, many famous museums in the world, such as the British Museum and the Metropolitan Museum of Art in New York, have also realized digital display and virtual visit with the help of Unreal engine technology. These virtual displays not only increase the audience's participation and sense of experience, but also provide a new display way for the protection and inheritance of cultural heritage.

Therefore, as the main tool of this research, the powerful digital creation function, and the effectiveness of wide application of Unreal engine will provide strong support for the research of intangible cultural heritage digital display and user experience design in this paper.

The data collection process for this study consisted of the following steps:

First, we will conduct a literature review to collect research literature related to Unreal Engine technology, intangible cultural heritage protection, and digital display. These literatures will provide information about the status and research results of the application of Unreal Engine technology in the field of cultural heritage.

Secondly, we will visit the actual heritage sites of Dong wooden architecture in San Jiang, such as museums and cultural villages, to collect architectural and cultural elements. At the same time, we will interview relevant experts and practitioners to obtain their insights and understanding on the construction skills of wooden architecture of the Dong nationality in San Jiang.

Then, we will create virtual scenes through Unreal Engine technology, including digital display and interactive experience of wooden architecture. In the virtual scene, the audience can visit, explore and interact with the virtual cultural heritage, thus gaining an in-depth understanding of the wooden architecture culture of the Dong people in San Jiang.

The data analysis process of this study mainly adopts the method of combining qualitative and quantitative analysis:

The data analysis process of this study primarily employs a mixed-method approach, combining qualitative and quantitative analyses. For the qualitative data, the researcher utilized content analysis to summarize and organize textual descriptions and

feedback on the virtual display and user experience of Dong wooden architecture. To gain deeper insights into users' perceptions and experiences of digital intangible cultural heritage display, we conducted interviews with 5 Dong wooden architecture craftsmen and 25 architecture students in San Jiang County. During these interviews, an application developed using Unreal Engine technology was employed to present Dong wooden architecture and facilitate interaction with users. Through meticulous analysis of interview content, it was observed that three master carpenters expressed high expectations for the interactive program based on Unreal Engine as they believed it could better protect, preserve, promote intangible cultural heritage while attracting younger generations towards traditional handicrafts. However, two carpenters expressed their disapproval for the app arguing that traditional crafts require authentic materials and environments to fully showcase their charm; hence digital displays might compromise authenticity. Simultaneously, most of the 25 participating architecture students displayed positive expectations towards the application since younger generations are generally more receptive to new technologies and willing to explore intangible cultural heritage through novel means. Consequently, they exhibited curiosity and anticipation in supporting the Dong wooden architecture interactive program created by Unreal Engine technology.

RESULTS AND DISCUSSION

This chapter will describe the results and findings of this study in full detail according to the research question and purpose and provide a comprehensive discussion of these findings in the light of theory, concepts, and previous related research.

Through qualitative and quantitative data analysis, we deeply explore the

application effect of unreal engine technology in the digital display of Dong wooden building construction skills in San Jiang. Unreal Engine technology creates realistic digital scenes that make viewers feel as if they are inside traditional buildings, providing a highly immersive experience. Users' perception and experience of digital display is mostly positive, and their cognition and understanding of intangible cultural heritage has been significantly improved. Unreal Engine technology plays an active role in displaying the essence and values of intangible cultural heritage.

Several related studies also support our findings. For example, some researchers (Fonseca et al., 2018) have explored the application of virtual reality technology in the digital display of cultural heritage in their research and found that virtual reality technology can effectively enhance users' perception and experience of cultural heritage.

This study further analyzed the impact of interactive experience in Unreal Engine technology on user engagement. Through Unreal Engine's dynamic customer presentation, users can see the impact of design choices and iterations in real time, thereby enhancing user engagement and commitment. Multimodal interaction design enables users to learn and experience traditional culture more deeply, and further deepen their emotional resonance of intangible cultural heritage.

In previous related studies, some researchers (Matovu et al., 2022) have studied the impact of interactive experiences in virtual reality on user engagement, and the results show that enhanced interactive experiences can significantly improve user engagement and satisfaction.

From a theoretical and conceptual point of view, we discuss the importance of digital display for the protection and inheritance of intangible cultural heritage. Unreal Engine technology provides an innovative way for

intangible cultural heritage to be displayed and transmitted digitally, thus effectively protecting, and inheriting these precious cultural traditions and values. Digital display provides a new way for the sustainable development and inheritance of intangible cultural heritage, so that these cultural treasures can be preserved in future generations. In addition, the study of Liu et al. (2023) also emphasizes the importance of digital display in the protection and inheritance of cultural heritage, which enables cultural heritage to be widely disseminated and shared.

During the discussion, we also realized that Unreal Engine technology still faces some challenges in the protection and inheritance of intangible cultural heritage. The application of unreal engine technology needs professional technical personnel and a lot of resource investment. In addition, although digital display can improve user cognition and understanding, it may also bring problems such as information overload and perception fatigue. Future research can focus on solving these challenges and further optimize the application of Unreal Engine technology in the protection and inheritance of intangible cultural heritage.

In summary, this chapter describes in detail the findings of Unreal Engine technology in the digital presentation and user experience of intangible cultural heritage and provides a comprehensive discussion of these findings in terms of theory, concepts, and previous related research. We recognize that Unreal Engine technology provides new possibilities for the protection and inheritance of intangible cultural heritage, but also realize that there are still challenges in the application of the technology. These research results are of great significance to scholars and practitioners in the field of intangible cultural heritage protection and inheritance.

CONCLUSION

This study aims to explore the digital display and user experience design of intangible cultural heritage based on Unreal Engine technology, to improve the understanding and perception of intangible cultural heritage characteristics and cultural spirit. Through the research on the application effect of unreal engine technology in the digital display of wooden construction skills of Dong nationality in San Jiang, we draw the following conclusions:

Firstly, Unreal engine technology provides a powerful tool and platform for the digital display of intangible cultural heritage. Through the realization of virtual scenes, users can experience the charm of traditional culture in person and enhance the perception and participation of intangible cultural heritage.

Secondly, the impact of interactive experience on user engagement is significant. Multimodal interaction design enables users to learn and experience traditional culture more deeply and increases their emotional resonance of intangible cultural heritage.

Third, digital display is of great significance to the protection and inheritance of intangible cultural heritage. Unreal Engine technology provides a new way for the sustainable development and inheritance of intangible cultural heritage, so that these precious cultural traditions and values can be preserved in future generations.

However, there are some challenges in the application of Unreal Engine technology. Technology application requires professional technical personnel and a large amount of resource investment, and digital display may bring problems such as information overload and perception fatigue. Therefore, future research can focus on solving these challenges and further optimize the application of Unreal Engine technology in the protection and

inheritance of intangible cultural heritage.

In the follow-up research and practical improvement, we suggest to focus on the development of the following aspects: 1) in-depth study of the application of Unreal Engine technology in other fields of intangible cultural heritage, and explore more innovative display forms; 2) Strengthen the cooperation with non-traditional craftsmen and combine their professional knowledge with Unreal Engine technology to create more realistic and accurate digital display; 3) Further study the psychological factors of user experience and perception, and optimize the user experience of unreal engine technology in the digital display of intangible cultural heritage.

In summary, this study provides useful insights and experiences for the application of Unreal Engine technology in the digital display and inheritance of intangible cultural heritage. The application of Unreal engine technology opens a new way for the protection and inheritance of intangible cultural heritage and is expected to promote the inheritance and development of intangible cultural culture in modern society. We expect that the results of this study can provide useful reference for scholars and practitioners in the field of cultural heritage and make more positive contributions to the protection and inheritance of intangible cultural heritage.

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