Exploring the Visual Interaction Design for Eurasia University Library's Digital Twin Model under the Metaverse study

Xuan Li*, Yunfei Zhao

Xi'an Eurasia University, Xi'an, China
*Corresponding author

Abstract: This paper explores the development and application of digital twin technology and metaverse in the field of libraries. Digital twin technology blends physical entities with virtual models, allowing for real-time data synchronization, while metaverse creates a new virtual world, providing an immersive and highly interactive online environment. The purpose of this study is to investigate the potential application of metaverse in library services, to enhance their quality and convenience, and to introduce relevant concepts and technologies of digital twin models and metaverse. The design scheme emphasizes the importance of creating virtual library scenarios and designing interactive interfaces. The technical implementation involves the construction of digital twin models and the integration of metaverse platforms, as well as the application of scenarios and case studies, such as online guidance and resource retrieval, and virtual academic activities. This research contributes to the innovative development of the library field, providing new directions and insights for future library services.

1. Introduction

1.1 Background

1.1.1 The development of digital twin technology and metaverse

Driven by the rapid advancement of technology, digital twin technology has gained widespread adoption in various fields. It is a technology that blends physical entities with virtual models to achieve real-time data synchronization. Concurrently, the metaverse, as a novel virtual world, has gradually emerged and garnered broad attention. By offering an immersive and highly interactive online environment, the metaverse provides users with opportunities to engage in diverse activities, including learning, working, and entertainment.

1.2.2 The trends towards digitization and virtualization of libraries

In recent years, the trends of digitization and virtualization have become increasingly apparent in

library settings. Traditional libraries have gradually shifted towards offering digital resources and services to meet the demands of modern society. Digital libraries not only make resource acquisition more convenient, but also provide personalized learning and research support to users. Moreover, through incorporating metaverse technology, the level of service in libraries can be elevated, and their functions and service scope can be expanded.

1.2 Research purpose and significance

1.2.1 Elevating the quality and convenience of library services

By applying digital twin technology to the field of libraries, a highly realistic virtual library can be built, providing users with richer and more convenient services[1]. Through the use of metaverse platforms, users can access library resources, participate in academic activities, engage with others in discussions anytime and anywhere, and thereby elevate the quality and convenience of library services.

1.2.2 Exploring the application of metaverse in the field of libraries

The purpose of this study is to explore the potential applications of metaverse in the field of libraries. By combining digital twin technology and metaverse, a visual and interactive virtual library environment can be constructed to meet users' demands in information acquisition, academic communication, and social interaction. This research will help drive innovation and development in the library field and provide new directions and ideas for future library services [2].

2. Related Concepts and Technologies

2.1 Digital twin model

2.1.1 Definition and characteristics

Digital twin is a technology that combines physical entities with their virtual counterparts to achieve a real-time synchronization of data between the physical world and the virtual world [3], characterized by high-fidelity simulation, real-time updating, and bidirectional interaction. Through digital twin technology, physical entities can be monitored, analyzed, and optimized in real-time, improving efficiency and reducing costs.

2.1.2 Applications

The technology of digital twin has found widespread adoption in numerous domains, including manufacturing, aerospace, construction, energy, and healthcare. In manufacturing, digital twin techniques are harnessed to optimize production processes, drive increased efficiency and quality outcomes. Similarly, in construction, digital twins hold promise as a tool for intelligent building management and maintenance. And in the energy sector, they can be applied to facilitate the identification of means for improving energy utilization efficiency and reducing environmental impact.

2.2 Metaverse

2.2.1 Concept and characteristics

Metaverse represents a novel network space composed of multiple interconnected virtual worlds

that can be accessed by users around the world [4]. In this digital realm, individuals are afforded the capability to create custom, virtual characters and engage in various online activities, including learning, working, and entertainment pursuits. Key attributes of Metaverse include its immersive nature, a high degree of interactivity, scalability, and cross-platform compatibility. With its capacity to provide users with a highly personalized online space, Metaverse presents a promising avenue for future internet development and growth.

2.2.2 Application scenarios

Metaverse has vast potential for application in diverse domains, including education, entertainment, commerce, and social interaction. In education, Metaverse can provide students with an immersive learning environment that enhances their learning experiences [5]. In entertainment, Metaverse offers opportunities for novel and more enriched gaming and entertainment experiences. In commerce, Metaverse generates new business models and marketing channels for enterprises. In social interaction, Metaverse provides users with entirely new means of socializing and facilitates interpersonal communication and information dissemination [6].

2.3 Design philosophy

2.3.1 User-centered design

User-centeredness is critical in the design process of the Eurasia University Library digital twin model. To provide personalized and efficient services that meet user expectations, a comprehensive understanding of user needs and habits is necessary. Throughout the design process, a focus on user experience is vital in order to improve operational flow and reduce the difficulty of usage.

2.3.2 Enhanced interactivity and immersion

Enhanced interactivity and immersion are core advantages of Metaverse. In the design process, it is crucial to fully utilize the unique features of Metaverse to enhance user interaction and immersion within the virtual library. This includes the use of high-quality 3D models, dynamic scene design, and enriched interactive elements.

3. Design Scheme

3.1 Construction of virtual library scene

To realize the Eurasia University Library digital twin model, the first step is to construct a virtual library scene. The construction of this scene should reference the actual layout and design of the library to create a highly realistic virtual environment. Various functional areas should be included in the scene, such as reading rooms, library resource retrieval areas, and online academic activity areas. Attention should be paid to detail in the scene design to facilitate smooth navigation and use of all functions within the virtual library for users.

3.2 Interactive interface design

The interactive interface design is a core component of the virtual library that determines how users interact with the virtual library. The interface design should be simple and easy to use, with consideration given to user operational habits. When designing the interface, different devices and platforms must be taken into account to ensure cross-platform compatibility. In addition, the interface

design should include real-time feedback and prompts, allowing users to understand their operating status and results. By optimizing the interactive interface design, user operational efficiency and satisfaction can be improved within the virtual library.

4. Technology Implementation

4.1 Construction of digital twin 3D model

Utilizing processed data, three-dimensional modeling software such as 3ds Max, Blender etc. can be used to create the digital twin model of the Eurasia University Library. The model should accurately reflect the actual structure and layout of the library while exhibiting high levels of simulation. In the process of model creation, factors such as lighting, texture, and animation must be considered to enhance the realism and immersion of the model.

4.2 Integration of virtual metauniverse platform

4.2.1 Selecting an appropriate virtual metaverse platform

To implement the application of the digital twin model within a virtual metaverse, it is essential to select an appropriate virtual metaverse platform. The selection of such a platform should consider factors such as platform maturity, scalability, compatibility, and community support. For instance, virtual metaverse platforms such as Unity and Unreal Engine are prevalent in the current digital landscape.

4.2.2 API interface development and integration

Once a suitable virtual metaverse platform has been selected, the development of API interfaces is required to achieve integration between the digital twin model and the platform. The API interfaces should include functionalities such as data synchronization, user interaction, and resource retrieval. Through the API interfaces, the digital twin model can be embedded within the virtual metaverse platform, enabling users to access books, participate in activities, and communicate with others within the virtual library. Furthermore, the API interfaces must support real-time updates to ensure that any changes occurring within the actual library are reflected immediately within the virtual library.

5. Application Scenario and Case Analysis

5.1 Online guide and resource search

5.1.1 Virtual library guide

The digital twin model of the Eurasia University Library in the virtual metaverse platform can provide users with an online guide service. Users can freely navigate the library through their virtual avatars, familiarize themselves with the library layout and various functional areas. Additionally, the guide feature can offer personalized guide routes based on user needs, helping users quickly locate their desired areas.

5.1.2 Book search and recommendation

The virtual library provides a book search function, where users can quickly find their desired books or resources through simple keyword search or advanced search. Furthermore, the system can provide personalized book recommendations for users based on their search history and interest

preferences [7]. By improving search efficiency and accuracy, the user experience can be significantly enhanced.

5.2 Virtual exhibition and display

The virtual library can host a variety of virtual exhibition and display activities, such as art exhibitions and showcases of specialty books. With high-quality 3D models and animation effects, users can enjoy an immersive exhibition experience. Additionally, virtual exhibitions can be updated in real-time and expanded limitlessly, providing a flexible and efficient display platform for the library. Users can even customize their preferred avatars according to their preferences, and the instructors themselves may take the form of historical figures like Sima Qian or Albert Einstein [8].

6. Evaluation and Prospect

6.1 User experience satisfaction

To evaluate the success of the Eurasia University Library digital twin model in the virtual metaverse platform, user experience satisfaction must be a primary focus. User feedback and suggestions can be collected to evaluate the user experience within the virtual library. Evaluation metrics may include ease of use, immersion, interactivity, among others. In addition, user overall satisfaction and expectations of the virtual library can be assessed through methods such as surveys and interviews.

6.2 System performance and stability

In order to ensure the normal operation and excellent user experience of the virtual library, it is necessary to evaluate the system performance and stability. Evaluation metrics should include response speed, resource consumption, system crash rate, among other factors. The system can be assessed using performance testing tools and actual user experience data, and based on the results, optimizations and adjustments can be made to the system.

6.3 The wide application of virtual metaverse in the field of education

The metaverse possesses a strong social nature, enhancing the social attributes of libraries and establishing them as significant social spaces within the metaverse. Immersive social interaction takes place in virtual spaces where virtual avatars communicate and engage within the library [9]. As an emerging network space, virtual metaverse possesses considerable potential for development. In the field of education, virtual metaverse offers a more immersive and interactive learning environment for students, enhancing knowledge dissemination and academic exchanges [10]. In the future, it is anticipated that an increasing number of academic institutions and scholars will leverage virtual metaverse to conduct teaching, research, and collaboration, thereby driving innovation and development in the education sector.

7. Conclusions

This article explores the visual and interactive design of the digital twin model of the Eurasia University Library in the virtual metaverse, with a focus on interactivity and immersion, guided by a user-centered approach. We propose a design solution that integrates the digital twin model, including the construction of virtual library scenes, the design of interactive interfaces, and the implementation of model construction and virtual metaverse platform integration technologies. Through application

scenarios and case analyses, we discuss the practical implementation of features such as online navigation and resource retrieval, virtual academic events, and evaluate the model and provide insights into future trends and developments.

Through this study, we have discovered that the application of digital twin models in virtual metaverse platforms brings opportunities and innovation to the field of libraries. Virtual libraries can break through regional limitations and provide users with more convenient and efficient services, promoting the digital and intelligent development of libraries. Meanwhile, virtual metaverse platforms, as an emerging network space, provide vast development opportunities for the deep fusion of libraries and the education sector.

This study aims to provide reference and inspiration for the design and implementation of digital twin models in the field of libraries, and to promote the widespread application of virtual metaverse technology in the library and education sectors. In the future, we look forward to seeing more libraries and educational institutions leveraging virtual metaverse technology to achieve innovation and development, making greater contributions to society and the dissemination of human knowledge.

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