

Innovative Design for Interactive Display of Ancient Architectural and Cultural Heritage using UE5 Virtual Engine

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Abstract: This paper discusses the innovative application of UE5 illusory engine in the interactive display design of ancient architectural cultural heritage. The main features of UE5 illusory engine are introduced, including real-time rendering, global illumination, real physical simulation and interaction design. The main way of interactive display design of ancient architectural cultural heritage by using UE5 illusory engine is put forward: to show the visual charm of ancient architecture through highly realistic rendering effect; through rich interaction design, guide the audience to participate in the experience through virtual reality technology, the audience's immersive experience is realized. Through case analysis, the feasibility and effectiveness of the above design method are verified. The research results of this paper show that the UE5 illusory engine provides new possibilities for the interactive display design of ancient architectural cultural heritage, and enables the audience to better understand and feel the charm of ancient architectural cultural heritage.

Keywords: UE5 illusory engine, ancient architectural, cultural heritage, interactive display design, innovative application

1. Introduction

The cultural heritage of ancient buildings is a witness of history, carrying rich historical and cultural information, and is a precious wealth of mankind. However, due to the passage of time and the influence of the natural environment, many ancient buildings are facing the problem of protection and inheritance. How to make more people understand and get into contact with the cultural heritage of ancient buildings has become an important issue at present. The traditional way of displaying the cultural heritage of ancient buildings, such as truthfully visiting, picture display, text introduction, etc., is often difficult to attract the interest of the audience because of its single form and poor interaction, and it is also difficult to deeply spread the historical and cultural information of ancient buildings. Therefore, how to use modern scientific and technological means to innovate the display mode of an ancient architectural cultural heritage and improve its interactivity and interest has become an important research direction at present [1].

As an advanced game and virtual reality development tool, UE5 illusory engine provides new possibilities for the interactive display design of ancient architectural cultural heritage with its powerful rendering and interactive design functions. This article will discuss its innovative application in the interactive display design of ancient architectural cultural heritage from the perspective of the UE5 illusory engine, in order to provide new ideas and methods for the protection and inheritance of ancient architectural cultural heritage.

The cultural heritage of ancient buildings is closely related to digital display design. In the traditional display of ancient buildings, we are often limited by physical space and protection needs, often unable to fully demonstrate its historical, cultural and artistic value. Digital display design, especially interactive display design based on UE5 illusory engine, opens up new possibilities for us[2].

UE5 Unreal Engine is a powerful real-time rendering engine, its wide application in the game and film industry has proved its ability. UE5 has ultra-high graphics quality, strong interactivity and excellent cross-platform performance. It can create a very realistic virtual environment and interact with it, which is of great value in the digital display of ancient buildings.

The main goal of this paper is to explore how to use the UE5 illusory engine to design the interactive display of ancient architectural cultural heritage, and to explain its importance in promoting cultural heritage and increasing public participation. Our key point is that, with the help of the powerful function of the UE5 illusory engine, we can not only better protect and inherit the cultural heritage of ancient buildings, but also make more people understand, appreciate and love this intangible cultural heritage by providing more abundant and interactive display forms[3].

2. The present situation of interactive display design of ancient architectural cultural heritage

2.1 At present, the main methods and techniques of interactive display design of ancient architectural cultural heritage

At present, the interactive display design of ancient architectural cultural heritage mainly adopts a series of digital technologies, including virtual reality (VR), augmented reality (AR), 3D scanning, panoramic display, projection mapping, etc., so that the history and culture of ancient buildings are presented in a more attractive and participatory way.

1) Virtual Reality (VR). VR technology can create a new and immersive virtual environment for the audience, so that the audience can move and explore freely in the virtual ancient building environment. The application of VR in the display of ancient buildings can not only show the appearance of ancient buildings, but also reproduce the internal environment and historical scenes of ancient buildings. It can even simulate historical events related to ancient buildings and provide a rich story experience [4].

2) Augmented reality (AR). AR technology can superimpose digital information into a real environment, allowing viewers to obtain detailed information and background stories about ancient buildings while observing ancient buildings. For example, through AR technology, we can display historical pictures, structural drawings, related texts, etc. in the actual location of ancient buildings, providing rich interactive content for the audience.

3) 3D scanning. 3D scanning technology can accurately capture the appearance and internal structure of ancient buildings, which provides an important basis for the digitization of ancient buildings. Through 3D scanning, we can create high-quality ancient building models for VR and AR applications.

4) Panoramic display. Panoramic display technology can provide a 360-degree perspective for the audience, so that the audience can fully appreciate the beauty of ancient buildings. Panoramic display is usually carried out through photography and computer graphics technology and can be viewed on web pages or VR devices.

5) Projection mapping. Projection mapping technology can project dynamic images onto the surface of ancient buildings, making ancient buildings a dynamic and visually attractive display platform. Through projection mapping, we can give new life to ancient buildings and tell the history and story of ancient buildings.

The above five technologies have their own characteristics and have different advantages in different application scenarios. They provide a powerful tool for the interactive display design of ancient buildings, enabling us to display and disseminate the cultural heritage of ancient buildings in a more vivid and interesting way.

2.2 The advantages and limitations of existing interactive display methods and technologies

The current interactive display methods and technologies have undoubtedly greatly enriched the display methods of ancient architectural cultural heritage, enabling people to understand and experience ancient architectural culture in various novel and attractive ways. However, these methods and techniques also have their advantages and limitations [5].

1) Advantages of existing interactive presentation methods and technologies.

Enhance the sense of experience. Such as virtual reality (VR) and augmented reality (AR) can create an immersive experience, so that the audience,, as if in the scene of an ancient building, feel its history and culture.

Rich information transmission. The digital display can provide rich information. For example, AR

can provide detailed historical background and related knowledge while viewing ancient buildings.

Facilitate sharing and dissemination. The digital models of modelled buildings can be shared and disseminated through the Internet, so that more people can appreciate and understand the cultural heritage of ancient buildings.

2) Limitations of existing interactive display methods and technologies.

High (technical threshold. Creating high-quality virtual environments and augmented reality experiences requires complex technologies and a lot of resources, which can be a challenge for some small cultural institutions.

Experiential device limitations. Virtual reality and augmented reality experiences often require specific devices (such as VR helmets and AR glasses), which may limit the experience for some viewers[6].

Lack of realism. Although existing technologies can create realistic virtual environments, they may lack some subtle texture and atmosphere compared to real ancient buildings.

The depth and breadth of knowledge dissemination. Although digital display can provide rich information, it may not be comparable to professional tour guides or educational activities, and can not provide in-depth historical and cultural analysis.

Therefore, we need to properly select and use these interactive display methods and technologies according to specific situations and objectives, so as to better display and disseminate the cultural heritage of ancient buildings.

3. The characteristics of UE5 illusory engine and its application in interaction design

3.1 The main features and functions of UE5 illusory engine

Unreal Engine 5 (UE5) is the latest game engine developed by Epic Games. It has a wide range of applications in games, film and television production, architectural visualization and many other fields [7]. UE5 brings many innovative technologies and features. Here are some of them:

1) Nano-polygon technology (Nanite). This new technology makes it possible to create and present extremely detailed and complex scenarios while maintaining efficient running performance. Nanite can handle polygons up to tens of billions of levels without worrying about loss of detail or overburdening.

2) Global Light System (Lumen). Lumen is a new global lighting system, which can generate extremely realistic lighting effects in real time without pre-computation or special settings. Lumen can handle a variety of lighting conditions, including sunlight, indoor light, reflection and so on.

3) Ultra-high quality sound system (MetaSounds). MetaSounds is a new sound system in UE5 that gives back control of the audio processing process to the developer so that it can be fine-tuned as needed.

4) Animation system (Control Rig). Control Rig allows developers to create and edit complex character and object animations directly in the engine without the need for external tools.

5) Cloud services. UE5 provides a series of powerful cloud services, including online collaboration, version control, cloud rendering, etc., to help the development team improve work efficiency.

6) Cross-platform compatibility. UE5 supports a variety of platforms, including mainstream game consoles, PCs, mobile devices, and even emerging VR and AR devices.

With its powerful function and flexibility, UE5 illusory engine provides endless possibilities for various projects, which undoubtedly includes the interactive display design of ancient architectural cultural heritage.

3.2 Discuss the specific application examples of UE5 in interaction design

The multiple characteristics of UE5 make it an ideal tool for displaying and reproducing the cultural heritage of ancient buildings[8]. The following are two specific application examples of UE5 in the interaction design of ancient buildings:

1) Create and interactively access virtual reproductions of ancient buildings. With the help of UE5's Nanite technology, ancient building models that are accurate to the millimeter level can be created. For example, archaeologists can import ancient building models obtained by 3D scanning technology into UE5, and then use Nanite technology to further refine and optimize the model. In the virtual environment, the audience can freely browse and explore these ancient buildings, and even walk inside the building to observe its fine architectural decoration and structural details. In addition, the powerful interactive function of UE5 can be used to add various interactive elements, such as information prompts, background stories, historical scene reproduction, etc., to enrich the audience's visit experience.

2) Virtual restoration and reproduction of ancient buildings. Some ancient buildings have been severely damaged or disappeared due to historical reasons, leaving only a small amount of relics or records. UE5 can help us to restore and reproduce these ancient buildings in a virtual environment. For example, you can use UE5 to create 3D models of ancient buildings based on historical documents and relics, and then use Lumen's global lighting system to simulate realistic lighting and atmosphere. The audience can enjoy the whole picture of these lost ancient buildings in the virtual environment and experience the former style.

These two examples show that UE5 can not only bring new possibilities for the display of ancient buildings, but also provide a powerful tool for the protection and inheritance of cultural heritage.

4. The application of UE5 illusory engine in the interactive display design of ancient architectural cultural heritage

4.1 Fantasy engine digital heights interactive program

The Interactive Program of Digital Mountain Villa is a VR display project with the theme of ancient Chinese architecture, which is created by UE5 illusory engine technology. It makes full use of the powerful rendering ability and interactive design function of UE5 engine, and presents an antique Chinese villa to the audience in a new way[8].

In the development process of the interactive program of the illusory engine digital villa, the developer first obtains the accurate model of the villa through 3D scanning technology, and then imports the UE5 illusory engine for rendering processing. The global lighting function, which is used for the first time, solves the problem of real-time lighting, so that the villa building can show natural light and shadow effects at any time point. Under the illumination of light and shadow, each brick and each tile shows a realistic texture, reflecting the unique charm of ancient buildings.

In interaction design, developers use the powerful interactive design tools of UE5 illusory engine to design rich interaction links. Users can not only walk and fly freely in a virtual environment, but also touch buildings, read ancient books, unlock organs, and even make an ancient sword by hand. These fun-filled interactive ways enable the audience to have a deeper understanding of ancient buildings, and also increase the fun of the display.

The successful application of this project shows the great potential of UE5 illusory engine in the interactive display design of ancient architectural cultural heritage. It can not only improve the visual effect of the display, but also activate the ancient building, make it a 'living cultural heritage' that can be touched and experienced, and deepen the audience's understanding and perception of the cultural heritage of ancient buildings. As is shown in Figure 1 and Figure 2.

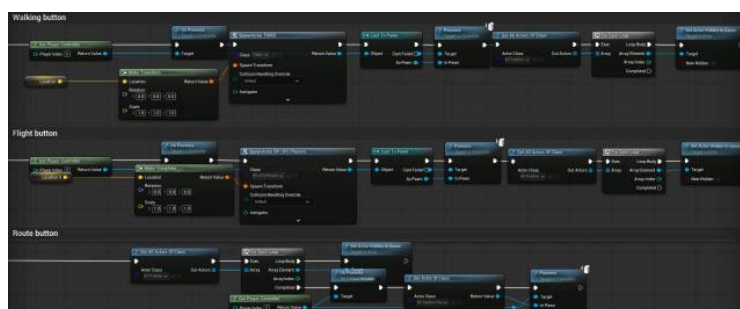


Figure 1: Blueprint - Flying / Walking

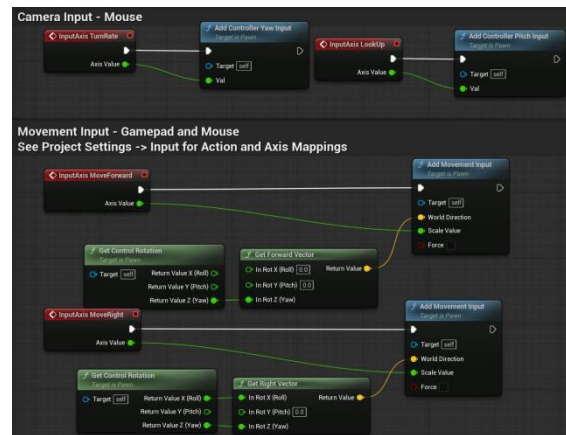


Figure 2: Blueprint - Motion input

4.2 Analyze the effect and influence of these application cases

1) More intuitive visual effects. Through the high-quality real-time rendering of UE5 illusory engine, it brings users a realistic visual experience, so that all the details of ancient buildings can be fully presented, which greatly improves the user's cognitive depth of ancient buildings.

2) Richer interactive experience. Through virtual reality technology, users can freely explore and interact in the virtual villa from the first-person perspective, which enhances the user's participation and fun, and also enables users to have a deeper understanding of ancient buildings.

3) Broader communication impact. The interactive program of digital villa can not only run on virtual reality equipment, but also be shared online, so that more people can experience the charm of ancient buildings and realize the wide spread of cultural heritage of ancient buildings.

4) More profound cultural perception. Through the interactive experience of users' personal participation, it not only inherits the material form of ancient buildings, but also helps to spread and understand the history and culture behind ancient buildings, and achieves deep cultural perception.

5. Interactive display design innovation of ancient architectural cultural heritage: from the perspective of UE5 illusory engine

5.1 Specific suggestions for UE5 illusory engine to realize the interactive display design innovation of ancient architectural cultural heritage

1) Accurate reproduction and simulation. Using UE5 's Nanite technology, we can create fine ancient building models, and even accurately simulate the materials and textures of ancient buildings. In addition, the Lumen global illumination system of UE5 can be used to simulate the realistic illumination effect and reproduce the real scene of ancient buildings under different time and weather conditions[9].

2) Enhancing interactive experience. Through the powerful interactive function of UE5, we can add various interactive elements, such as information prompt, tour route, historical scene reproduction and so on. Some game elements can be designed, such as puzzles, adventures, etc., so that the audience can learn and understand the history and culture of ancient buildings in the process of the game.

3) Invirtual recovery and reproduction. For some ancient buildings that have been seriously damaged or disappeared, we can use UE5 to virtually restore and reproduce them. This can help the audience to better understand the original appearance and historical background of ancient buildings.

4) Multi-platform support. UE5 supports a variety of platforms, including mainstream game consoles, PCs, mobile devices, and even emerging VR and AR devices. This means that we can provide a variety of visiting experiences for different audiences.

5) An online and offline integration. Using the AR technology of UE5, the visit experience of online and offline integration is designed. For example, while visiting ancient buildings in the field, viewers can see virtual information tips, 3D models, historical scene reproduction, etc. through AR

glasses or mobile phones.

6) Community interaction. UE5 provides rich community functions, such as online discussion, sharing models, and creative competitions. We can use these functions to encourage the audience to participate in the protection and research of ancient buildings, so that the display of the cultural heritage of ancient buildings becomes more vivid and participatory.

In general, the UE5 illusory engine has brought new possibilities and innovations to the interactive display design of ancient buildings. We need to make full use of its powerful functions to design novel, interesting and educational display methods, so that the cultural heritage of ancient buildings can be better inherited and developed.

5.2 The potential impact of UE5 in the interactive display design of ancient architectural cultural heritage in the future

1) Richer ways of experiencing things. Through UE5, the future display of ancient buildings will not only be limited to static pictures or videos, but also provide a richer immersive experience. The audience can freely explore ancient buildings in a virtual environment through virtual reality (VR) technology, and can even participate in the restoration and protection of ancient buildings by themselves.

2) Be deeper in. With the powerful interactive ability of UE5, various educational activities and games can be designed, so that the audience can learn the history, culture, art and other knowledge of ancient buildings in the process of games.

3) No more extensive dissemination. UE5 supports a variety of platforms, including mainstream game consoles, PCs, mobile devices, and even emerging VR and AR devices. This means that the virtual display of ancient buildings can easily spread to all corners of the world, so that more people have the opportunity to understand and appreciate the cultural heritage of ancient buildings.

4) Better protection. UE5 can help us create realistic models of ancient buildings, and even simulate the materials and textures of ancient buildings. This is of great significance for the protection of ancient buildings, such as the restoration and restoration of ancient buildings, and the long-term preservation and recording of ancient buildings.

5) Higher accessibility. For some remote or inaccessible ancient buildings, we can create a virtual model through UE5, so that the audience can visit these ancient buildings in a virtual environment. This will greatly improve the accessibility of ancient buildings, so that more people have the opportunity to contact and understand the cultural heritage of ancient buildings.

In general, the UE5 illusory engine will greatly promote the development of interactive display design of ancient architectural cultural heritage, and provide more possibilities and opportunities for the protection and dissemination of ancient architectural cultural heritage.

6. Conclusion

This paper deeply studies the application and value of Unreal Engine 5 (UE5) in the interactive display design of ancient architectural cultural heritage, expounds the main characteristics of UE5, such as Nanite technology and Lumen global lighting system, and provides specific application examples. Possible future developments and potential impacts are discussed.

We found that the powerful function and flexibility of UE5 can not only bring new possibilities for the display of ancient buildings, but also provide a powerful tool for the protection and inheritance of cultural heritage. Through UE5, we can create elaborate models of ancient buildings, provide immersive visit experience, design interesting and educational display methods, and enable the cultural heritage of ancient buildings to be better inherited and developed.

At the same time, the cross-platform compatibility and cloud services of UE5 make the virtual display of ancient buildings easily spread to all corners of the world, improve the accessibility of ancient buildings, and give more people the opportunity to understand and appreciate the cultural heritage of ancient buildings. Therefore, UE5 will greatly promote the development of interactive display design of ancient architectural cultural heritage, and provide more possibilities and opportunities for the protection and dissemination of ancient architectural cultural heritage.

In general, the UE5 illusory engine has great potential in the interactive display design of ancient architectural cultural heritage and is a tool worthy of further research and utilization.

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