

Conceptual Design of Virtual Sightseeing Application Based on Panoramic Video on Virtual Reality All-in-one Headset

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Abstract—Based on the analysis and Research on the current situation of virtual reality application, in this thesis, the author investigates and analyzes the relevant needs of target users and the process of users using virtual reality products. Considering the function realization and interaction comfort of virtual tourism application, the author analyzes and puts forward the design points of VR all-in-one virtual tourism application, and then analyzes the overall framework, interaction mode Put forward specific design schemes for function realization. Finally, use Unreal Engine 4 to realize the production of main application function prototypes, and preliminarily build a virtual sightseeing platform based on panoramic video resources.

Keywords-virtual reality; virtual sightseeing; interactive design

1 INTRODUCTION

1.1 Introduction to Virtual Reality Technology

Virtual reality is a digital environment that is highly similar to a certain range of real environments in terms of visual, auditory, tactile, and other aspects, with computer technology as the core and relevant scientific technologies combined. Users can interact and interact with objects in the digital environment with necessary equipment, and can experience the corresponding real environment firsthand. [1] Virtual reality technology mainly includes aspects such as simulating the environment, perception, natural skills, and sensing devices [2], which can give people a strong sense of immersion. With the development of society, traditional two-dimensional representation technologies are gradually unable to meet people's needs for immersive experiences, and the demand for virtual reality technology in various industries is gradually emerging. At present, the application scope of virtual reality technology is expanding day by day, and it has been applied in many fields. It is considered one of the important technologies that will affect people's lives currently and, in the future [3]. From the

first proposal of virtual reality ideas in 1960 to the detonation of the concept of "metaverse" in 2021, virtual reality has entered a new era of development.

1.2 Background of the development of the tourism industry

According to the data of the National Bureau of Statistics, the number of domestic tourism trips and domestic tourism revenue in 2022 will be 2.53 billion and 2040 billion yuan respectively [4], which is lower than before the COVID-19 epidemic, but the market is still broad. Traditional travel usually requires a high cost of money and time, and sometimes due to geographical limitations and natural resource protection, travel to specific destinations may not be achievable. Driven by the epidemic, technological innovation and digital transformation in the tourism industry are accelerating, deeply integrating with life and production. [5] While the tourism industry is thriving, the innovation of domestic tourism and cultural products is relatively poor, mainly consisting of toys, clothing, and postcards. The homogenization of scenic souvenirs is severe. Virtual reality devices, through their strong immersion and presence, enable users to generate vivid mental images and aspirations for travel destination scenes [6], perfectly fulfilling the mission of tourism and cultural products. Therefore, virtual reality devices that can provide low-cost immersive experiences have great potential in the tourism industry, especially in tourism cultural products.

1.3 Current status of virtual travel products

With the rapid development of virtual reality technology, network communication technology, and destination informatization, virtual travel has become an emerging hot topic. High quality virtual travel content has a positive impact on individuals, tourist attractions, and society. In terms of integrating panoramic technology with the tourism industry, a large number of high-quality travel-related virtual reality apps emerged from 2015 to 2022. Among them, in terms of VR virtual tourism content, the presentation of virtual tourism content is mainly divided into two categories: 3D digital model content and real scene shooting content, with 3D digital models and static panoramic images occupying the main seats. Due to the high production cost and difficulty, as well as the lack of effective integration of high-quality content on all-in-one devices, 360° panoramic videos, which are both real-life shooting content, have varying quality on various platforms and do not occupy the advantageous position they should have in the virtual tourism market. Meanwhile, in this regard, China's domestic ecology is poor, and most of the existing software relies on a specific scenic spot. Attractions exist in isolation, and the integration between attractions is a direction worth considering. If effective integration of high-quality 360° panoramic videos can be achieved, its market prospects will be considerable.

2 RESEARCHES AND ANALYSIS ON TARGET USERS

2.1 Determination of target users

This design will use VR all-in-one device as the main target hardware device, and Oculus Quest 2 shown in Figure 1 is the selected device for this design.



Figure 1 Oculus Quest 2 VR headset and Touch controllers

Considering the actual situation and user age, the target users of this VR integrated virtual tourism application based on panoramic video are mainly middle-aged and middle-aged people with a certain level of education. As a group in a period of struggle and exploration in life, the young and middle-aged group has a high level of acceptance of external emerging things, sufficient curiosity and execution ability, and a strong desire to travel and explore the outside world. Meanwhile, due to the fact that virtual reality technology is mainly used for leisure and entertainment in the civilian field, it has a strong attraction for the group that needs spiritual support.

2.2 Research design

In order to form a clear and intuitive concept of the needs of target users, in this article, user research was mainly conducted through survey questionnaires and interviews to determine user needs.

Before this design, survey questionnaires were distributed online to understand the basic needs of users. The questionnaire mainly involves two main aspects: virtual reality and tourism, collecting the target users' understanding of virtual reality applications, their main expectations for virtual reality technology, the frequency of tourism in the past three years, tourism willingness, and the biggest real obstacles to tourism.

In order to further understand the target users in detail, we invite some of them to participate in the experience of watching panoramic scenery videos through a virtual reality all-in-one headset and conducting interviews. The age distribution of the participants in the survey is between 16 and 48 years old. The hardware used in the experiment is Oculus Quest 2, Oculus Touch controller, and the software is Sky Box player. The video content is an angel waterfall aerial panoramic video that is similar to the panoramic video content used in the design after.

2.3 Analysis of questionnaire results

In this questionnaire survey, a total of 51 responses were collected. After excluding unqualified responses set by users who do not meet the expected age, there are 49 valid responses remaining.

From the questionnaire results, it can be seen that there is currently a strong willingness to travel among the target group, but due to various practical reasons, it is difficult to achieve travel. At the same time, the target group has good attention and high expectations for virtual reality technology, which means that virtual reality applications have good market attention, and the sale and promotion of such applications may be possible. In terms of application

functions, in traditional travel, users pay more attention to scenery and social interaction, and also look forward to introductions about travel's cultural history, customs, and traditions. Therefore, simple travel and sightseeing may not fully meet users' requirements for tourism. If these two functions can be implemented in virtual applications, it will be more in line with users' psychological expectations.

2.4 Analysis of interview results

We invited 19 users in batches to participate in the experience of watching panoramic scenery videos through a VR all-in-one headset. The age distribution of the participants in the survey is 16-48 years old. The hardware used in the experiment is Oculus Quest 2, Oculus Touch controller, and the software is Sky Box player. The video content is an aerial panoramic video of Angel Waterfall produced by AirPano, which lasts for 4 minutes and 13 seconds, and is similar to the panoramic video content used in this design.

After watching the video, an interview was conducted with the user. Among the 19 users, 13 have no previous experience using VR devices; 18 people expressed surprise, and the experimenter exclaimed that "you can look around", "you can look down", etc. The 4 minutes and 13 seconds of the video were still full of meaning; Four people expressed confusion and encountered issues such as "there is always a progress bar in view" and "I don't know how to start playing"; 17 people reported feeling dizzy, especially when the camera was moving up and down; 16 people reported feeling 'very empty' or afraid of heights when looking down, with 9 people indicating relief when sitting down or holding onto stable supports.

From the interview, it can be seen that the current popularity of VR is not very high, so guiding design, such as tutorials when starting the application for the first time, cannot be ignored in application design; Meanwhile, thanks to the limited popularity of VR devices, the viewing of VR panoramic videos has great appeal to users, and the production and dissemination prospects of panoramic videos are broad; Due to the significant difference between three-dimensional interaction and two-dimensional interaction, users usually bring real-world habits into virtual reality, such as preferring to grab objects rather than aiming and clicking. Therefore, in this application design considering new VR users, attention should be paid to the implementation of such interaction; The source of fear of heights may be that the user is located in the center of the video sphere, with no obstruction on the soles of their feet, and the movement of the camera position can easily trigger the user's "sense of instability"; "Motion sickness", which refers to feeling dizzy during translation, is a known problem with VR devices. Due to conflicts between visual and vestibular sensations, users experience motor or positional hallucinations [7], and there is no solution yet.

3 DETERMINATION OF KEY POINTS IN DESIGN

Virtual reality has the characteristics of strong immersion and presence, while tourism has design gaps. Combining virtual reality with sightseeing tourism to design corresponding applications is conducive to leveraging their respective advantages. Based on the above research and user research and analysis, the following design points have been identified:

3.1 Combining 3D modeling with panoramic video to achieve highly interactive scenes

The high interactivity brought by modeling compensates for the shortcomings of traditional panoramic video players with low interactivity, enhances the user's sense of participation and presence during the sightseeing process, improves the richness of the application, and thus optimizes the user's experience while watching panoramic videos.

3.2 Combining sightseeing and socializing

Adding a social module to the application allows users to not only watch panoramic videos alone, but also travel and sightseeing with family, friends, and even strangers, sharing the scenery and joy of the journey, making virtual sightseeing travel a good assistant for enhancing relationships. At the same time, benefiting from the virtual characteristics of virtual reality, users can visit together no matter where they are, breaking geographical restrictions and providing new good places for socializing.

3.3 Implementing partial screenshots and screenshot display of panoramic videos

Add the most popular photo taking segment of tourists to virtual reality applications, restore the real travel experience, record the scenery in front of you at any time, and share and display it to enrich the user experience.

4 CONCEPTUAL DESIGN OF VIRTUAL SIGHTSEEING APPLICATION

4.1 Proposal of the overall application plan

Considering both user and functional aspects, combining video viewing with social interaction ensures the fun of the application while still focusing on panoramic video playback. After comprehensive comparison of multiple solutions, we have selected the final solution as follows:

We use spacecraft as the carrier for panoramic video playback, connecting the concept of "watching panoramic videos" with the concept of "spacecraft navigation", so that video playback is not hard anymore. Instead, we combine the content of panoramic landscape videos to cleverly replace the behavior of watching videos with the behavior of virtual travel. The behavior of "users choosing videos" is mapped to "users choosing flight routes", further implying the setting of virtual tourism to users to enhance their immersion. In order to enhance user stickiness, social attributes are added, and users can invite other users to enjoy panoramic videos, turn on microphone communication, and achieve achievements together. In order to enhance the fun of the application, a small number of motivational games are added to the panoramic video viewing process.

4.2 Application specific functional framework design

This is a virtual reality experience application based on panoramic video content that integrates social entertainment in a relaxed and lively style. This application mainly has four functional

modules, namely panoramic video appreciation, social interaction, entertainment, and personalized display. The specific function settings are shown in Figure 2.

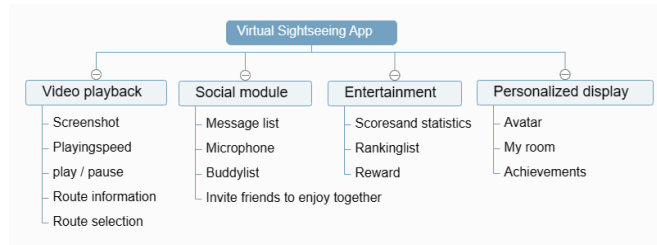


Figure 2 Application specific functional framework

4.3 Interactive design

In order to achieve functions in the four directions of panoramic video appreciation, social interaction, entertainment, and personalized display, we have adopted a design that combines 3D object interaction with traditional 2D flat UI in terms of interaction methods. In order to avoid user visual illusions caused by binocular occlusion conflicts in the virtual reality world [8], this design will not use too much traditional 2D plane interaction, but will appropriately incorporate traditional interface design into the interaction as a supplement to 3D interaction. In this design, in most cases, users can directly interact with objects in the scene. This type of interaction is easy to understand and conforms to normal behavioral logic, but it is not sufficient to meet all, especially more refined interaction requirements in this application.

As a supplement to the 3D interaction mode within the application, the design of the user's wrist menu has been added in this design. When the user raises their left hand, a wrist function bar is displayed on their wrist. There are four main buttons on the function bar, namely "Camera", "Expression", "Voice", and "My", which correspond to the four main functions of "Take a photo", "Select to display an expression", "Environment volume and microphone volume control", and "My information". In three-dimensional space, when the user's left hand naturally droops, the menu is hidden, and the user can start interacting with the interface of the wrist function bar by raising their wrist. A screenshot of the user perspective of the wrist menu is shown in Figure 3. By pressing the button with the right hand, the corresponding function can be triggered.



Figure 3 Screenshot of the user's wrist menu

4.4 Social Mode Design

In terms of social methods, we combine two social modes: acquaintance socializing and stranger socializing. After logging in to the application, users will first appear in the lobby, which is a public social space for multiple people. Users can meet strangers from the main scene lobby and take a boat ride on the selected route for sightseeing. For users who wish to travel with friends, they can create their own flying boats and independently decide on their sightseeing routes, inviting friends to travel together.

4.5 Virtual Sightseeing Design

The virtual sightseeing function is the core function of this application, which is related to whether the design significance of the application can be realized. In this design, virtual sightseeing refers to the user's ability to watch panoramic videos through interactive actions, which surround the user 360 degrees. Due to the immersion brought by VR, the user experiences being sightseeing and sightseeing.

A 360° panoramic video is shot and assembled by multiple cameras and played on a single screen. However, due to technical issues, the top and bottom of the assembled video may experience slight deformation, resulting in poor visual effects. Therefore, this design allows users to be in the center of the ball screen and project a panoramic video on the inner surface of the outer shell model, as shown in Figure 4.

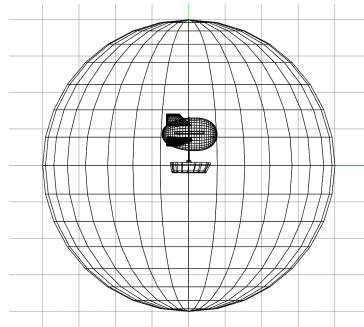


Figure 4 Model of panoramic video playback scene

The top and bottom of the main sightseeing scene "airship" will limit users' visibility, while the roaming mode controls users to stay in place, allowing users to only view panoramic videos from around. Although it may waste some video resources, it was found during the testing process that it can effectively reduce users' dizziness.

4.6 Establishment of function prototype

We will import the prepared model and materials into Unreal Engine and use blueprint programming tools to prototype and develop the basic functions applied in this design, achieving the goal of initially experiencing the main basic functions of the application. The final effect of the user riding the flying boat is shown in Figure 5.



Figure 5 Screenshot of a user watching panoramic videos

5 CONCLUSIONS

With the upsurge of "Metaverse" and the vigorous development of the tourism industry, the combination of virtual reality technology and tourism industry, the study of the application of virtual reality technology in tourism, and the development of relevant software are conducive to enriching the travel experience of users, and also have a positive impact on the tourism industry. This article focuses on the virtual sightseeing application of VR all-in-one headset based on panoramic video. Based on background research and user analysis, the design points have been determined. In the later work, the author will continue the research and conduct further design based on this.

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