*Advances in Social Science, Education and Humanities Research, volume 416*
**4th International Conference on Culture, Education and Economic Development of Modern Society (ICCESE 2020)**

# Research on Library Reader Service Application and Innovation Based on VR

Wei Luo
Zhuhai College of Jilin University
Zhuhai, China

***Abstract*—The current application of VR technology in the digital library virtual space is mainly manifested in the online library roaming of the digital library. The author analyzes the current situation of virtual reality technology and its application, and discusses how college libraries use virtual reality technology in the era of big data to integrate two-dimensional planar images and three-dimensional scenes to break the constraints of space and time, and carry out the collection of literature resources and innovation of reader services, bringing readers a new reading experience and a new service method.**

***Keywords: library, virtual reality, reader service***

## I. INTRODUCTION

Virtual Reality (hereinafter referred to as VR) was first proposed by American Jaron Lanier in 1989, which caused the scientific community to pay attention to it and carry out research. VR is a computer simulation system that can create and experience a virtual world. It uses a computer to generate a simulation environment. It is a multi-source information fusion, interactive three-dimensional dynamic scene and physical behavior system simulation that immerse users into that environment. VR includes simulation environment, perception, natural skills and sensing equipment. In addition to the three-dimensional, realistic images generated by computer graphics technology, there are a variety of perceptions such as hearing, touch, force, motion, and even smell and taste. The generation of virtual reality needs to solve three main problems: how to make the observer's sensory organs feel the vision, touch and smell that are the same as the actual existence; how to make the active and dynamic operations of the observer immersive, and how to let the feelers get a realistic sense of reality. VR technology is a multi-disciplinary, multi-field comprehensive technology, and it is the three key technologies in the 21st century alongside the Internet and multimedia technology.

## II. VR APPLICATION STATUS

Technology changes life. In recent years, interactive media technologies such as VR have revolutionized technology and art, such as virtual driving, virtual bicycles, virtual rowing boats, virtual sailing boats, virtual flying, virtual football, virtual fighting, virtual shooting, virtual percussion and so on. The core of VR is modeling and simulation. The technology has been applied in various industries in China and foreign countries: real estate roaming, free walking and viewing in VR system, customers can virtually see the surrounding facilities and environment in the future through virtual real estate; virtual prototype room, allowing customers to experience multiple decoration designs for the same apartment type, so as to choose the style that best suits them; urban planning, widely used in various areas of urban planning, such as road and bridge simulation, urban greening, old district reconstruction and so on; venue simulation, showing the real appearance of the venues; preservation and reproduction of cultural relics, such as the roaming of the Mogao Caves, digital archiving of national historical relics, etc.; education, mainly reflected in supporting the creation of a learning environment, supporting skills training, supporting language learning, and supporting special children's education; industrial simulation systems, enterprises combine user business layers and databases to achieve the purpose of managing factories, controlling production and equipment operation.

At present, the national-level virtual simulation experimental teaching center includes the "Engineering Practice Virtual Simulation Teaching Center" of Xi'an University of Technology, the "Cultural Heritage Digital Protection Virtual Simulation Experimental Teaching Center" of Northwest University, and the "ICT Virtual Simulation Experiment Teaching Center" of Xi'an University of Posts and Telecommunications, "Civil Engineering Virtual Simulation Experiment Teaching Center "of Xi'an University of Architecture and Technology, "Mine Construction Engineering Virtual Simulation Experiment Teaching Center" of Xi'an University of Science and Technology, etc.

## III. APPLICATION STATUS OF VR TECHNOLOGY IN LIBRARY

VR library is a virtual reality library. The definition of library experts includes three levels of meaning: first, VR library is a comprehensive technology, which integrates multi-disciplinary technology and research results; second, VR library is a technology that uses computer technology as the basic platform to carry out work; third, VR library is a direction for the application of computer operational

CLC number: G250

 

technology with multi-dimensional space and all-round perception.

Among the top 50 university libraries in the world, among the 48 foreign universities except Tsinghua University and Peking University, more than 11 university libraries such as the National University of Singapore, Oxford University Library St Edmund Hall Branch and Harvard University Library are using VR technology to provide services on the library's website, and VR technology is most widely used in the library community in the United States. According to data, as early as the beginning of the 21st century, American libraries have begun to provide certain services with the help of virtual technology. In 2003, Linden Lab launched a network virtual platform, of which Second Life is the most typical. Many libraries in the United States built their own virtual libraries on this platform. VR technology has been widely used in colleges and public halls in the United States. VR technology is applied to the construction of scenes such as Stanford University, Oregon State University Books, North Carolina State University Library, etc. VR technology is applied to the construction of digital resources such as the Virginia Beach Public Library, the Downtown Houston Library, the Sliver Greek Middle School Library, and the Binghamton University Library. VR technology is used in information retrieval systems such as the University of Illinois at Urbana Champaign Library, etc., and VR technology used in intelligent navigation is the University of Miami Library and so on. In 2008, an online bookstore named Zoomii also adopted VR technology. The virtual bookstore was clicked to enter. The reader seemed to walk into the physical bookstore. The book wall was displayed according to the classification. The mouse was used to zoom in and zoom out. Just like in the physical bookstore, you can click on the cover to watch and decide whether to buy.

In September 2008, the National Library's "Virtual Reality System" was officially launched. It is China's first set of interactive virtual digital library systems, which marks the beginning of the use of VR in Chinese libraries. The National Library has carried out VR projects such as "Virtual Navigation in the Lobby", "Network Virtual Navigation", and "Virtual Reality Reading Station" through virtual reality equipment, links and other application forms, bringing readers a convenient and fresh reading experience. At least 9 colleges and universities and public halls have applied VR technology to scene construction, resource construction, interactive experience and reader training, such as the virtual "Virtualized Navigation System" and "Collection Map" of the Tsinghua University Library, the "Virtual Library" of the Sichuan University library, the "3D Roaming Library" of the Wuhan University library, and the "Somatosensory Interactive Experience" of Shanghai Jiaotong University library, Sun Yat-sen University Library's "Talking Electronic Reading Materials" and "New Technology Experience Zone", Shandong University Library's "Reader Entry Guide", etc. Taking University of Electronic Science and Technology of China as an example, the library entrance uses face recognition, VR reading booths, 360 degree all-round experience, VR interactive games, etc. Readers can also relax while looking for resources to learn.

## IV. VR APPLICATION AND INNOVATION STRATEGY IN LIBRARY READER SERVICE

VR technology can further innovate reader service methods and service contents, improve the way of information spreading and transmission, enrich the connotation of information resources, and enhance the reader's interactive experience.

VR technology requires a lot of investment, technology and manpower. Among them, research and development of hardware, stereo projection, helmets, VR glasses, VR gloves and other equipment, as well as intellectual property rights, require a large amount of investment. Each library can reasonably allocate VR products and services according to its own business needs and funding. If the funding is sufficient, you can develop or equip your own equipment to carry out a comprehensive VR experience-based service; if the funding is limited, you can use desktop virtual roaming services, or carry out business cooperation and introduce booksellers and other supporting services.

### *A. Using VR to realize library space navigation and roaming*

Modern libraries are constantly improving their digitalization, their functions are becoming more diversified, and their space construction is integrated. The ultimate goal of such an open and multifunctional comprehensive service space is to provide readers with fast and high-quality services. Through the scene construction of VR, readers can be provided with the guide and reading function of the venue.

Through the application of VR technology, the venue's external facilities and internal space layout are shot in real-time, a 360-degree virtual roaming space is built, and the various functional areas of the library are displayed in a three-dimensional environment using three-dimensional modeling. Taking the library of Zhuhai College of Jilin University as an example, in the virtual space, you can follow the road signs to enter the library door. Readers can see the general service desk on the first floor, self-check-out equipment, cafes, and self-study areas. When you enter the second floor, you can see the science book reading area, new book reading area, western language reading area, and so on. Readers can see the functional areas of each floor of the library during space roaming, the books on the bookshelves, shelf labels and ground signs, etc.Readers are not limited by space and region. They only need to scan the QR code or click on the URL link to enter the physical library. They can intuitively understand the distribution of various functional areas within the library, the classification and organization of the library's literature information, and the corresponding service content within the shortest time, which can meet the needs of readers to the greatest extent and optimize the user experience.

While realizing space navigation and roaming, VR can fully integrate the RFID book positioning and other systems

currently used by the majority of libraries, and combine the three-dimensional modeling function of VR to change the way the collection resources are displayed. VR presents the contents of the literature to the readers in a virtual scene, which brings a strong sensory impact to readers. While the reader is roaming in the space, the reader can combine positioning and virtual panorama to realize the reader's positioning of books on the shelf in the virtual space and simple browsing of book content. When locating books under a certain category, you can also combine links to related resources such as e-books, periodicals, etc., so that readers can briefly browse the relevant content of literature resources when browsing in space to optimize the user experience.

### *B. Using VR to realize the integration, sharing and stereoscopic display of resources*

The information resources of college libraries are diverse and rich in content, including paper books, audio, video, and databases. Traditional paper documents have some deficiencies due to their own characteristics, such as inconvenience to carry, inconvenient circulation, and time and place constraints. The best solution is to scientifically match the ratio of paper and electronic documents, and establish a multi-database based on the characteristics of each library. As the name suggests, VR is a technology that combines virtual and reality. It integrates traditional libraries with virtual libraries, and finally forms a complete library simulation system, so that readers are not restricted by time and space and can browse and consult at any time.

On the one hand, paper documents can be digitally virtualized, and text, voice, or pictures and videos can be added. When users roam, they can combine Web3D and two-dimensional networks, so that they are not restricted by time, space and place. They can search collection resources, browse, screen and obtain required document resources from mobile phones, PAD and other terminals whenever and wherever possible. On the other hand, the virtual resource collection can be used as a supplement to the literature of the actual collection resource, the digital resources accessible on the network can be integrated, and the network technology can be used to unify the search path for readers. With the help of the 3D modeling function of VR technology, the library's paper and digital document resources are integrated, and the collection resources are displayed in front of the reader in three dimensions, instead of being a monotonous title content introduction. While realizing space roaming, users can obtain the entire contents of the literature through virtual scenes, and get a rich sense of impact.

Through the network, it is also convenient to establish libraries alliance in the same or different regions. It will coordinate and combine professional literature resources in 13 universities and colleges, and establish a systematic, scientific, and comprehensive literature resource system to satisfy users in different disciplines and scientific research fields through a unified path for comprehensive literature retrieval. Users no longer need to go to different libraries or resource libraries to find the required resources in different categories. In the true sense, it will realize the co-construction and sharing of library literature resources in a larger scope, and more conveniently carry out interlending, resource sharing, and substituting retrieval and waiting and other service work.

### *C. Using VR to realize the second protection of ancient books, cultural relics and the construction of special collection literature*

In traditional libraries, precious cultural relics, calligraphy and painting, ancient books, documents and other resources are kept under extremely strict conditions. In order to avoid damage to cultural relics, they are usually not open to readers. Without sufficient protection, it is difficult for these precious cultural and historical materials to make intimate contact with readers. At this time, the function of collecting and using appear more or less conflict. With the use of virtual reality technology, precious ancient books can be virtualized. Readers can leaf through and browse in a three-dimensional mode in the virtual venue to see the true content of the treasure. Readers can mark and extract at the same time of virtual reading, which is to protect the ancient books a second time and to ensure that the readers use resources fairly, without being restricted by time and space.

On May 1, 2016, the Dunhuang Academy China officially released the high-definition digital content and panoramic roaming of 30 classic caves in Dunhuang for the first time to the world. The "Digital Dunhuang" resource platform is to use modern digital technology to capture, scan, acquire, and store the cultural relic information of the Dunhuang Grottoes. Through the establishment of a diversified and integrated digital Dunhuang database, digital asset management system, and permanent preservation system of digital resources, the permanent preservation of Dunhuang cultural and artistic resources can be realized while providing unlimited possibilities for academic research and multiple uses. The "Digital Dunhuang" project in Mogao Grottoes in Dunhuang perfectly blends virtual reality technology with Dunhuang mural art. Sitting in the exhibition hall, the author seemed to have walked into each cave and listened to the stories told by the ancient people on the frescoes, which brought not only a visual feast, but also the wisdom crystallization of the ancient working people. The application of VR to the construction of data resources is also an important means for the permanent preservation and sustainable use of cultural heritage. It is necessary to permanently preserve precious documents and even cultural relics resources, break through regional restrictions, make more readers familiar, and continuously and efficiently exert heavy academic and artistic values in academic, education, art, tourism and other fields.

The China Academic Digital Associative Library (CADAL) project is a successful case of applying VR to the construction of digital resources. The first phase of the project completed the digitization of 1 million books and the second phase added 1.5 million books to digitization, providing a globally accessible browsing service. After 2013, the project has entered the operation and maintenance

guarantee period. In addition to contemporary Chinese and foreign language books, the database contains various documents such as ancient books, Republic of China books, Republic of China periodicals, Manchurian Railways and overseas Chinese approval. At the same time, it also established special collections such as the Encyclopedia of the Republic of China Culture, Oracle Digital Old Photos, etc. The digital integration of document resources by advanced means can not only close protect the ancient books on paper, but also fully display them to users and readers through one-stop search.

*D. Using VR to realize one-stop literature search service*

Using VR technology combined with RFID book positioning system, a "Real-time Virtual Bookshelf" simulation system can be constructed. When the reader searches, the area where the book is located will be indicated on the OPAC system. When the user clicks the "Book Positioning" tab, the specific rack of the book will be displayed, and the system can display related information about books near that book at the same time. By controlling the buttons, users can browse more nearby books. According to relevant data, at present, three Chinese university libraries are using VR to provide readers with retrieval services: the real-time virtual bookshelf of the Nanjing Normal University Library, the Shanghai Jiaotong University Library and the Nankai University Library's book positioning and navigation system. However, currently, there are still some technical difficulties in implementing VR for document retrieval services. It still needs continuous refinement, deepening and exploration so as to strive to be more popular and expand the scope of use.

*E. Reader education and librarian education with VR*

Through VR technology, it is possible to better play the educational function of the library, say goodbye to the traditional boring and tedious traditional curriculum model, and give the educated a novel and unique experience. Web-based VR combined with the animation platform can be an innovative reader's learning platform and model. It can use methods such as setting checkpoints and accomplishing stage clear through learning to increase the fun, diversity, affinity, and interaction of learning, making teaching fun and improving the effectiveness of education.

Fujian Agriculture and Forestry University Library introduced a virtual awareness system in 2015 and applied it to freshman education. Freshmen are required to log in to this system while receiving admission notices, conduct simulated visits through role-playing and scene roaming, self-study the facilities, regional functions, collection distribution, digital resources and rules and regulations, and complete the opening of campus card related permissions and functions by themselves on the Internet.

Librarians also need a solid business foundation and superb computer technology in the process of applying VR to reader education and reader services. In the process of participating in the design, implementation, and application of VR systems, librarians have also promoted and improved their technical level and comprehensive business literacy, and their innovation capabilities, organizational capabilities, and coordination capabilities have also been greatly improved. It also plays a role in promoting the learning and re-education of librarians.

*F. Using VR to realize social service functions*

The library is not only an important position for talent training in universities, but also a local cultural and information dissemination center. Both university libraries and public libraries should assume social functions such as cultural promotion, literacy education, and cultural poverty alleviation, and carry out targeted social service work.

By using VR technology to actively carry out scientific popularization work, humanistic education, vocational training and other activities, its vivid and unique experience makes it easier for readers to accept, deepen memory, and fully stimulate readers' desire for reading and knowledge. Especially in the cultural poverty alleviation work, it can fully draw on relevant technical methods for reader education in poor areas and improve cultural quality. Through panoramic roaming combined with stereoscopic display and sensor technology, it can establish virtual factories and virtual pipelines, etc. to provide users with vocational education and simulation technique training, enabling the people in poverty-stricken areas to acquire a livelihood technology, at the same time strengthening communication with the outside world, increasing their own knowledge, expanding their thinking and improving their wisdom and enhancing their wills. At the same time, it also enables the outside world to fully understand the current situation in remote and poor areas, adjust measures to local conditions, and implement targeted poverty alleviation.

*G. Using VR to develop reading promotion services for different groups of people*

Efforts should be paid to plan and implement sustainable development of reading promotion business, establish and promote the establishment of a positive interaction operation mechanism between libraries, society and the government, and carry out nationwide reading. According to the author's understanding, most of the targets for reading promotion in public halls and college halls are currently aimed at young people and students, and most of them will use traditional methods such as lectures, book fairs, picture book reading, and various competitions. In the digital age, it is possible to combine virtual reality technology with audio and video live broadcast methods, give full play to VR's own advantages, and continuously innovate reading promotion methods and forms, providing different regions and groups of readers with the educational resources and information platforms they need. Many of the public libraries' virtual picture books and virtual role-playing have been loved by many young readers. For example, in the "Interstellar Voyage" digital pavilion experience activity held in the National Children's Museum, readers can interact with the large screen through gestures, explore the universe from the perspective of astronauts, and experience immersive exhibitions with rich content.

### *H. The use of VR allows readers to have a personalized, intelligent and characteristic reading experience*

With VR technology, readers can travel through different spatiotemporal virtual scenes to meet individual needs and obtain a special reading experience. For example, a high school in the United States used VR technology to allow students to travel through Italy to learn about human history and watch the drama "Shakespeare", which greatly increased students' interest in reading. The panoramic mode is presented through VR technology, which has a strong sense of realism, and readers can get a synchronous and realistic experience in the real virtual tour.

## V. CONCLUSION

The rapid development of VR technology has penetrated into the culture and education industry, bringing challenges and opportunities to university libraries. The fundamental purpose of the library is to serve teachers and students and serve the society. VR, as a cross-science, leverages its immersiveness, interaction, and imagination to make full use of digital information and network technology to control the space-time simulation scene and break the restrictions of time and space, which can bring vast changes in services and immersive experiences for readers, fully reflect the reader service application and innovation of intelligent libraries, enhance the service function and service capabilities of information retrieval, and explore the maximum value of library literature resources.

## REFERENCES

[1] Xu Liang, Pan Xingxian. "VR Technology Application in College Library Freshmen's Education" [J]. Information Exploration, 2018, No.2: 79-83. (in Chinese)

[2] Tan Bo. "Basic Approaches and Implementation Strategies for "VR + Reading Promotion" in Libraries [J]. Books and Information, 2017, No.4: 13-17. (in Chinese)

[3] Zhou Xiaoyan, Cui Ran. "Overview of Research on VR Technology and Virtual Library Abroad" [J]. Information Science, 2018, Volume 36, No.3: 164-176. (in Chinese)

[4] Lu Hejian, Zhang Han. Thoughts on the Application of Virtual Reality Technology to Service Innovation in Chinese and American Libraries. [J]. Library Science and Research. 2017 (17). (in Chinese)

[5] Qian Li, Zhang Zhixiong, Zou Yimin, Huang Yongwen. Application of Information Visualization Retrieval in Digital Library [J]. Modern Library and Information Technology, 2012 (4). (in Chinese)

[6] Wei Meng, Wang Yingchun, Liu Yanquan. A Comparative Study on the Status of Library Intelligence Services in China and the United States [J]. Library Science Research, 2017 (19). (in Chinese)

[7] Wang Hong, Wang Huitao. Research on the Construction of 3D Virtual Library in Universities Under the Trend of Gamification [J]. Modern Information, 2017.3 (37-3). (in Chinese)

[8] Chen Xiuping, Liu Mengxi, Wang Sibing, Liu Tian, Wu Jianhong. Research on the Application of Virtual Reality Technology in the Entrance Education of Freshmen in University Libraries: Taking Fujian Agriculture and Forestry University Library as an Example. [J]. Information Exploration. 2017 (2). (in Chinese)

[9] Li Lijuan. Research on the Development and Practice of University Digital Library Based on VR Technology [J]. Network World, 2016. (in Chinese)

[10] Ma Xiaoting. Design and Implementation of Library Data Visualization Analysis System [J]. Library Science and Research. 2015 (10). (in Chinese)

[11] Xu Aijun, Li Feng. Construction and Optimized Browsing of VRML Virtual Library [J]. Application of Computer System. 2016 (25-4). (in Chinese)

[12] Su Donghua. Research on Library Role Positioning and Innovative Services Based on Virtual Reality (VR) applications. [J]. Books and Information. 2017 (2). (in Chinese)