Research on the application of VR technology in the digital inheritance of ancient papermaking technology

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Abstract. The traditional papermaking technique of ancient method is confronted with the problem of difficult inheritance. In order to enable the public to experience or learn the ancient papermaking technology with the help of virtual platform and make the ancient papermaking technology have more possibilities for future development, the VR experience project of ancient papermaking technology is designed and planned through data collection, virtual scene production, digital interactive design and other steps by means of integrating disciplines. It can retain the integrity of the information of ancient papermaking technology to the greatest extent, provide a safe, efficient and green simulation learning platform, rapidly promote the traditional ancient papermaking culture in a large range, enrich the presentation of ancient papermaking materials and predict the future development direction.

1. Introduction

Papermaking is one of the four great inventions in ancient China. During the eastern Han dynasty, Lun Cai used bark, rags and fishing nets as raw materials to make paper [1]. The paper industry of all countries in the world originated in China and spread from China directly or indirectly. Therefore, China is called the hometown of paper. After the continuous development and change of papermaking, it still exists in Guangdong, Guangxi, Guizhou, Anhui, Yunnan and other places in China. In recent years, with the development of the protection of intangible cultural heritage, the ancient papermaking technique, as the excellent cultural heritage of the Chinese nation, has attracted the attention of the whole society.

2. General situation and present situation of Ancient Papermaking Technology

The process of the traditional papermaking is complicated, and the paper making methods are slightly different in many places. The production method of bamboo paper can be summarized into 8 main steps: 1. Cut down the bamboo and air dry it; 2. Lime soaking; 3. Flush impurities; 4. Break the bamboo with water wheel; 5. Mixing and ramming; 6. Papermaking in trough; 7. drying in the air; 8. Packing. These procedures are very complex and can be further subdivided. Experience and skill are very important in paper making. Young people need long-term help from old workers to master [2].

Although there are many producing areas of ancient papermaking in China, but they are mainly distributed in remote and closed areas, and mainly in family-type workshops. There are few written data records, and most experience is passed on by mouth and hand. Therefore, the inheritance and development of the technology are greatly limited. According to the investigation, the number of the
technicians of the papermaking is less than one thousand, and most of them are over seventy years old, energy is not followed. Many young people do not want to learn from teachers because of the high labor intensity and low economic pay of manual papermaking. As a result, there are fewer and fewer people working in it. The ancient papermaking technique is disappearing at a very fast rate [3].

At present, the display of Ancient Papermaking Technology in many places is not good. It's just a static display of some items on the narrow display cabinet. This makes the display of Ancient Papermaking Technology monotonous, and it is difficult to take into account the different cultural level, knowledge composition, interest, age level and viewing needs of visitors. Visitors are accepted in a passive state, lack of initiative and interactivity.

3. The application foundation of VR technology in the inheritance of ancient papermaking
VR (Virtual Reality) is a comprehensive information technology developed by computer network, computer graphics, simulation, multimedia, artificial intelligence, parallel processing, multi-sensor and other technologies [4]. About the basic characteristics of virtual reality technology, American scientists Burdea g. and Philippe Coiffet once put forward a "triangle of virtual reality technology", which simply expressed the three most prominent characteristics of virtual reality: immersion, interactivity and imagination, namely the "3I" characteristic of virtual reality. The application of the ancient papermaking technology in the "3I" characteristics is as follows.

Immersion, also known as the sense of immediacy, refers to the user as the main character in the simulation of the sense of reality. The realization of immersion relies on the VR system to provide all the senses including vision, hearing, touch, taste and smell. The good simulation environment should make it difficult for users to tell the difference between real and virtual, allowing them to devote themselves to the 3D virtual environment created by computers. For example, in the virtual system of ancient papermaking, the experimenter would feel cold when he put his hand into the paper trough.

Interactivity refers to the degree to which the user can manipulate objects in the simulated environment and the degree of naturalness to get feedback from the environment. For example, when the experimenter uses the bamboo curtain to make paper, different forms of force can get different virtual paper. At this time, the objects in the virtual paper mill also move with the line of sight. Real-time is very important in this interaction process. If there is a large delay in the interaction, which is inconsistent with human psychology and experience, it is difficult to make participants fully engaged.

Imagination is also called conceivability. Virtual reality technology should have a broad Imagination space, which can broaden the cognitive range of human beings. It can not only reproduce the real environment, but also arbitrarily imagine the objectively non-existent or even impossible environment [5]. For example, in the digital protection of ancient paper making, VR technology can be used to reproduce some paper making tools that cannot be directly observed in the real world, so that users can experience touch papermaking tools, and even make different paper.

Virtual reality is an all-round imitation of things in reality or imagination. It has a high sense of verisimility in the display of ancient papermaking. It is not only a new display tool, but also an effective form of cultural inheritance.

4. The important significance of the integration of Ancient Papermaking and VR technology
In the era of new media, we introduce VR technology into the field of inheritance of ancient papermaking technology, and display its technology in a new way. This will open up a new way for its inheritance and innovation, which is of great significance. It mainly reflected in the following aspects:
First, it preserves the integrity of the information of the ancient papermaking technique. The ancient papermaking technique was usually taught orally by family workshops. In this way, it is difficult to clearly and completely teach the ancient method of papermaking. In addition, conventional recording methods such as text, sound and video cannot objectively and completely reproduce the original appearance of handicraft. VR system has good tolerance. It can generate high-definition three-dimensional digital image in the digital simulation processing of the real environment of human features.
It can also integrate traditional media forms such as text, image, voice and image into the virtual reality system, so as to achieve better comprehensive utilization [6].

Second, it provides a safe, efficient and green simulation learning platform. The inheritance of the ancient papermaking technique is based on personal understanding, and it emphasizes epiphany based on practice. Environmental factors have important influence on the experience and cognition of the learners of ancient papermaking techniques. VR technology uses various simulated sensory signals and real-time information feedback technologies to act on the experiencer and create a near-real illusion. Experiencers can make use of multiple information interaction functions in a safe virtual environment to have a comprehensive and in-depth understanding of the object and object, and can experience and learn repeatedly with the help of the virtual platform, so as to quickly accumulate experience and improve the actual operation level.

Third, it can enrich the presentation way of ancient papermaking materials and predict the future development direction. By using dynamic images and other technical means, the static paper information materials previously confined to traditional media such as text, painting and photos can be presented in a more vivid and dynamic way, which is conducive to users’ profound understanding of the cultural connotation of ancient papermaking. At the same time, VR technology can not only reproduce real existing objects, but also enable people to construct things that do not exist in reality according to their needs, and predict future development [7]. This has a prospective guiding significance for the inheritance and innovation of ancient papermaking techniques.

Fourthly, we should promote the traditional papermaking culture on a large scale. No matter what era, information dissemination always depends on the progress of technology. Using VR technology to make the virtual display of ancient papermaking technology can spread rapidly in a large range through the network platform. This can make internet users all over the world feel the charm of the papermaking technology without leaving home. It can also promote the coordinated development of traditional culture and realize the sustainable development of ancient papermaking technology in modern society.

5. Planning of VR demonstration project of ancient papermaking technology.

5.1. Data collection of ancient papermaking techniques
This part mainly collects the static 3D data of the ancient papermaking process with the help of the static data measurement technology. In this process, special attention should be paid to recording the variables generated by the same object in the making process. For example, when bamboo is transformed into paper through multiple processes, changes in its shape, texture, color and thickness should be collected comprehensively. At the same time, dynamic capture technology is used to complete the tracking and recording of the hand movement details of the inheritors of ancient paper making. The data types to be collected are shown in Table 1. This kind of synchronous recording method of dynamic and static combination is very good. It can combine video, audio, picture, text and other information to truly, comprehensively and concretely save every detail in the ancient papermaking technology. It provides a necessary reference for the application of VR technology in this project [8].

| Data type                      | Number of groups of data | Allowable data error |
|--------------------------------|--------------------------|----------------------|
| Setting of papermaking environment | 64                       | ±5mm                 |
| Parameters of papermaking materials | 35                       | ±1.5%                |
| Dimensions of paper tools      | 18                       | ±3mm                 |
| Action of papermaking operation | 128                      | ±1mm                 |
| Standard of paper effect       | 93                       | ±2%                  |
5.2. Making of virtual scene of Ancient Papermaking Technology

We need to build a virtual scene based on the information obtained. This is the basis of immersion and realism. In the process of three-dimensional modeling of ancient papermaking technology, we should strive to achieve accurate model scale size, model number optimization, model surface number optimization, scene mapping optimization and so on. These factors have a very important influence on the accurate restoration of virtual scene and the smooth operation of interactive system. It is worth noting that in order to make the virtual effect closer to the reality, we need to be very skilled in the establishment of VR model of ancient papermaking technology. We need to maintain the authenticity and fixity of the basic framework in the process flow. We should also emphasize the true reflection of personality characteristics and random factors. Specifically, in the virtual scene of ancient papermaking technology, we need to consider the influence of some important factors, such as pulp raw materials, time, speed, process. These factors will change the thickness, size, color and shape of paper. When VR designers make virtual environment, they should bring all these factors into the scope of design to fully show [9].

5.3. Interactive design for the digital inheritance of ancient papermaking techniques

5.3.1. Interest cultivation (primary)

VR technology can be used to reduce the technical threshold to a large extent. Experiments can reproduce the operation process with the help of 3D data images, and realize the expected effect with the guidance of sensor input device and information feedback device [10]. At the same time, in order to ensure the smoothness of the whole experience process, in the process of simulation operation, the application of automatic error correction technology can automatically ignore the slight deviation and error of the user's operation, so that the experiencer can successfully make qualified handmade paper and obtain a good interactive experience. In addition, in order to enhance the interesting learning atmosphere of the whole interactive display space and enhance people's interest in participating in the interaction, we can also try to add some production processes that can reflect the traditional characteristics, such as chopping, beating, dividing paper, drying paper, ramming and so on.

5.3.2. Systematic learning (intermediate)

Different from the interest experiential learning model at the entry level, the interaction of VR platform at this stage will be more professional. The core content of ancient papermaking technique is the key and difficult point of this technique teaching. With the help of VR technology, we can improve the user's sense of experience and learning efficiency, so that they can fully understand and master the essence of this technology in a limited time. For example, in the process of making paper, the particularity of technicians' techniques and tools determines the thickness, texture, shape and texture of the paper. The hand shape capture device can acquire the dynamic hand data information of learners in real time. By using the high-speed computing, modeling, rendering and screen dynamic simulation technology of the terminal processor, handmade paper products made according to the simulation of learners' hand shape can be generated synchronously in the display device. In addition, the system can also record the information about the tool used by the learner through the action capture device. It can use multimedia imaging equipment to render the 3D simulation process. With the help of multi view stretching and magnification functions, users can observe the principle of manual paper generation. This enables users to have a more comprehensive and in-depth understanding of the relationship among production tools, technological processes and operation methods.

5.3.3. Development and innovation (advanced)

In order to inherit the ancient papermaking technology better, we need to optimize the original form. When learners systematically master the core technology of ancient papermaking and fully understand
the relevant cultural connotation, they can achieve reasonable and moderate recreation on this basis. For example, we can use interactive technology to modulate the virtual pulp without contacting with the real pulp, and finally create a new hand-made paper and experience the process of developing new paper. In addition, VR technology can be combined with the Internet. It can also realize the remote interactive communication between users and the ancient paper-making masters who are not in the same space. This can ultimately improve the learners’ ability to control the ancient papermaking technology in the actual operation process [11].

6. Conclusion
As an emerging form of digital media, VR technology is gradually connected with our work and life. With superior simulation and interaction effects, VR technology can provide powerful technical support for the modern inheritance of ancient paper making. The combination of ancient papermaking and modern scientific and technological means will have a very important impact on the long-term survival of regional and national characteristic culture and even promote the development of cultural industry. The reasonable development and utilization of VR technology will be one of the important ways to inherit and innovate the ancient papermaking technology, and its application effect in other traditional cultural fields is also worthy of attention and expectation.

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