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Exploration and Research on the Dynamic Display of Social Inheritance and Interaction of Hefei Pyrograph Intangible Cultural Heritage under Augmented Reality (AR) Technology

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Abstract

As one of the intangible cultural heritages of Anhui Province, Hefei pyrograph encountered many bottlenecks in the process of non-genetic inheritance. This paper deals with the problems and shortcuts in the process of transmission by taking Hefei pyrograph as the research topic. Aiming at the absence of pyrograph in the social inheritance, the paper puts forward the idea of innovative inheritance through the use of technology, emphasizes the importance of AR augmented reality technology to non-genetic inheritance and propagation. At the same time, the feasibility of interactive dynamic exhibition with AR augmented reality technology is explored and studied. This paper aims to provide some new ideas and references for the research of related departments and scholars in the process of non-genetic inheritance and protection of fire brush painting.

Keywords

Intangible cultural heritage; Pyrograph; AR augmented reality; Social inheritance; Interactive display.

1. Introduction

In recent years, with the universal popularization of the Internet and the rapid development of science and technology in our country, it has now entered into the "post-Internet era", augmented reality technology (AR for short) and virtual reality technology(VR for short), as a revolutionary cognitive tool and efficiency tool in the "post-Internet era", VR has now become one of the key technologies to promote future changes in various fields and industries in our country.

The AR technology has gradually been applied in more fields in Anhui Province in the past two years, in October 2018, the Anhui Museum decided to introduce AR technology into the museum's multiple collections for practical applications. In the future, the interpretation of the AR scene information of 120 precious cultural relics can be realized, as well as 20 sets of AR cultural relics dynamic story interpretation interaction, including video, image, voice, text, 3D interactive display, etc., and human-computer interaction can also be achieved. The AR intelligent explanation system can provide an interactive experience with a strong sense of substitution for the audience to visit the Anhui Museum. The visitors can use the cameras of their own devices (mobile phones, tablet computers) realize the real-time recognition experience of exhibits based on AR technology through smart Internet technology, so the scene information in the virtual screen and the real scene can be presented in the same screen.

At present, AR technology is still in the initial stage of development in China and Anhui Province, among which many projects are still in the planning, construction, and experimental stage. In today's digital Internet era, it is imperative for various industries and industries in Anhui Province to articulate with digitalization, informatization, technology and networking. However, as the representative of Anhui's intangible cultural heritage (folk art category), Hefei

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pyrograph has faced various difficulties in the process of inheritance, there is no successor and almost on the verge of being lost, this traditional folk painting technique seems to have no foothold in such an Internet era, and it is even more blank in the use of digital inheritance and innovation. Therefore, this paper is based on the research on the inheritance of pyrograph, the author uses AR technology realize the exploration and thinking of interactive dynamic display of pyrograph. It is hoped that this paper can throw away a brick in order to get a gem, makes more scholars and experts pay attention to and devote themselves to integrated and innovative research of Hefei pyrograph and even other more intangible cultural heritage in the Internet era.

2. Development Overview of Hefei Pyrograph

As one of the important birthplaces of Chinese civilization, there are rich and valuable intangible cultural heritage in the Anhui Province. Hefei pyrograph is a top in Anhui's intangible cultural heritage folk art, which is well-known at home and abroad for its unique craft and natural and simple artistic charm. The fire brush painting is a kind of craft and folk arts passed down in Jianghuai area of Anhui Province, which is also called as "pyrography", "burning painting" and "fire needle embroidery", and it is an extremely precious expression form of folk art in Anhui Province.

According to records of historical materials, ancient pyrograph originated in the Western Han Dynasty and has a history of more than two thousand years, during the war and disasters, the craft of pyrography was lost several times, it wasn't until the end of Ming Dynasty and the beginning of Qing Dynasty that it really entered the folk and developed. In 1984, Lu Yanshao, the dean of Zhejiang Painting Academy, named pyrograph as fire brush painting after discussion, fire brush painting has since joined the circle of Chinese painting and calligraphy, and has become an independent painting type, which is widely spread in the Jianghuai area. On December 14, 2006, Hefei pyrograph was selected as the first batch of intangible cultural heritage list in Anhui Province [1].

The unique creative form of pyrograph is different from the traditional style of painting with brush and ink, pyrograph uses fire to heat the iron pen or iron block, after reaching a certain temperature, burning burn marks on wood boards, bark and other materials for painting. The record about the craft of pyrograph first appeared in the book "Outline of Chinese Artists" compiled by Li Fang in the late Qing Dynasty, the book recorded: "Zhang Chong, a famous painter in the Tang Dynasty. He was good at charcoal painting and was known as the ingenious Zhang Chong. his waist had hinges, each hip likes money, painted in gray and burned, and it disappeared at the sight of fire, it could shape fish, dragon, bird, and beast. [2] In the early days, pyrograph is created only on wooden boards and wood chips, as Hefei arts and crafts master Liu Zhuhua innovated painting tools in 1958, he transformed his homemade iron pen into an "electric soldering pen" (Figure 1), and later derived more painting media materials, such as rice paper, bamboo spring, silk, and gourd, etc., thus further enriching the visual expressive power of pyrograph.

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Figure 1. The improved electric fire pen

Although the pyrograph pays attention to the elements of traditional Chinese painting such as the distance, the virtual, the real, the space between the lines is arranged as a real painting, but because the fire pen (iron) is a hard material, the painting carrier is often the wood board, bamboo spring, etc., it can be said that "diamond cut diamond" is the biggest characteristic of pyrograph creation, and of course it is also the difficulty of its painting. Because this kind of painting method puts forward higher requirements for the artist's skill and ability, it is necessary to consider the characteristics of different painting media, as well as the degree of burning and heat resistance. Therefore, artists not only pay attention to the skills of "display skill in accordance with their aptitude", but also have "great facility" ingenuity[3]. It is just the unremitting efforts and long-term explorations of Hefei pyrograph masters over the years, modern pyrograph works have extraordinary visual charm and artistic value, the color traces burned by the iron pen are very rich, which blend black, brown, and coffee colors, they are simple and natural, elegant, and majestic. The smooth brush lines and the change of the brush strokes of different burning colors form the vital texture change, presenting the natural and vivid semi-dimensional relief visual sense (Figure 2).

Figure 2. The brush stroke effect formed by the burn marks of the fire pen on the wooden board

3. The Connection Between Intangible Cultural Heritage and Modern Technology

With the development and rise of the Internet, new media, digital technology, etc., people's lifestyles and habits have gradually changed. Under this background, the protection and inheritance of intangible cultural heritage is also facing increasing influence and dilemmas, the traditional inheritance ways are contrasts strongly with the people's life pace and habit at

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present. How to use the most advanced modern scientific and technological means and digital technology to carry out industrialized development for intangible cultural heritage resources, so that intangible cultural heritage resources can be effectively protected, inherited, and utilized is an Important new topic faced by scientific and technological workers and cultural experts. [4]. In October 2018, the General Office of the CPC Central Committee and the General Office of the State Council issued the "Working Guidance for Strengthening the Reform of the Protection and Utilization of Cultural Relics", it provided guidance for the protection and utilization of cultural relics and the protection and inheritance work of cultural heritage, the document pointed out that science and technology should be strengthened at the level of cultural heritage protection. The Internet, big data, cloud computing, artificial intelligence and other information technologies are made full use of to promote the integration and innovation of cultural relics display and utilization, and promote the "Internet + Chinese Civilization" action plan [5].

How to effectively protect intangible cultural heritage in the process of inheritance, and how to develop while protecting? This has become an issue concerned by the country and the people. In fact, the protection of intangible cultural heritage cannot just be put in "safe" to "offer up" it, and the traditional promotion of intangible cultural heritage and the propaganda forms in paper pictures and words no longer conform to people's material, spiritual and cultural needs. Only by combining intangible cultural heritage with new technologies to achieve "reproduce" can the value of intangible cultural heritage be truly reflected. From the global perspective, at present, basic technology applications of intangible cultural heritage digitization are mainly focused on retrieved record and preservation work of intangible cultural heritage, and online and offline databases that combine text, image, audio, and video are the main support means. The developmental applications of emerging technologies such as virtual reality and augmented reality are more concentrated in the field of display and communication [6].

The augmented reality technology (AR for short) is a revolutionary cognitive and efficiency tool in the "post-Internet era", this technology is based on computer display and interaction, network tracking and positioning, etc., it applies virtual information to the real world, and superimposes virtual objects, scenes, or system prompt information generated by computer onto the real scene, and achieve the enhancement of reality. AR has the three characteristics of virtual and real combination, real-time interaction and three-dimensional registration [7]. Due to the characteristics of combination of "real scene + virtual" of augmented reality, it is closer to the real scene in practical applications, so it will make the interactive experience more intimate, and it will be easier to produce phenomenal visual effects and expression ways (Figure 3).

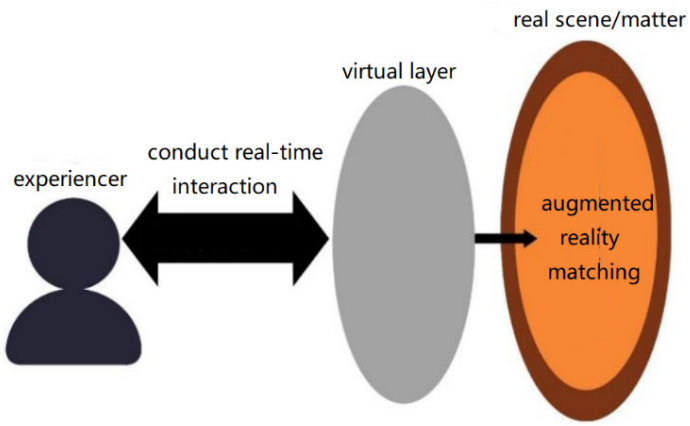

Figure 3. Schematic diagram of augmented reality principle

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4. Inheritance State and Dilemma of Hefei Pyrograph

The rise and fall of intangible cultural heritage are closely related to its internal inheritance mechanism and mode. The good inheritance mechanism and inheritance mode are the basic conditions for the sustainable development of intangible cultural heritage [8]. Vice versa, if there is a problem with the inheritance mechanism and the inheritance mode, it is very likely to lead to the decline of intangible cultural inheritance. In fact, as the 20th century began, pyrograph has gradually declined due to various reasons, the most important thing is obvious problems in the inheritance, which are in the following three aspects:

4.1. Too Single Inheritance Forms

The biggest problem facing intangible cultural heritage skills is on the verge of disappearing due to no inheritor, in the final analysis, intangible cultural heritage skills cannot keep up with the times in time and lack innovation in inheritance, which leads to become very niche, pyrograph also faces this problem.

The long-term inheritance form of pyrograph is the master-apprentice inheritance, the craft and skill of pyrograph is difficult, it also has certain requirements for the overall quality of the learner, it requires the master and apprentice to get along with each other for a long time and monster demonstrate personally, teach by precept and example, the apprentices must carry out long-term practice and exploration After mastering the basic skill.

Related units have organized and carried out pyrograph training class, but because learning pyrograph requires art foundation, fewer people register, in addition to the difficulty in making pyrograph, long cycle, and economic value cannot be immediate, as a result, it is difficult for many students to stick to it [9]. As a result, Liu Kailao (Liu Zhuhua's son), the current master of Hefei pyrograph, can only teach the skills to his children, due to limited study or working time, the children can only take pyrograph as a hobby and cannot further carry forward the skill of pyrograph. (Figure 4)

Figure 4. Liu Kai, a master of Hefei pyrograph, creates pyrograph

4.2. Very Limited Inheritance Group

Nowadays, the people who learn, study, and pass on pyrograph are mainly concentrated in the middle and old age groups, on the contrary, no one shows any interest in pyrograph among the young groups with creativity, innovation, and influence, as a result, there is no inheritor phenomenon in the inheritance process of pyrograph. As for Hefei specialty products, most citizens only know about inch gold, white cuts, sesame cakes, and baked cakes, but pyrograph

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is rarely known by people, and its "Hefei household registration" has even been cancelled [10]. Although there are some pyrograph text, image introduction and video on some platforms on the Internet, they are obviously form system and scale. Especially on some We-media APP platforms which young people are more enthusiastic for, it is impossible to search for any video materials on pyrograph at all.

It follows that the single inheritance form leads to very niche inheritance, the promotion is very weak if the people concerned are few, however, young people have almost no more channels to learn about the past and present of the pyrograph, Not to mention the interest in pyrograph, as a result, there are very few young people who understand, learn, and pass on pyrograph.

4.3. Serious Lack of Social Inheritance

Social inheritance means that the inheritance and continuation of a certain culture has a broader mass basis, its cultural connotation and skills can not only be known by the people, but can also be passed on among the people.

From the psychological angle, people have feelings and emotions for things that can be recognized by themselves. If people encounter something they don't know or don't understand, they won't have any emotional expression. Similarly, if an intangible cultural heritage is not understood and recognized by the public, how can it be inherited and protected?

Hefei pyrograph is little known in Hefei. Such an embarrassing situation is exactly the most vivid portrayal of the lack of social inheritance, and it will inevitably lead to the declining influence and reputation of pyrograph.

5. The Importance of Augmented Reality Technology for the Social Inheritance of Intangible Cultural Heritage

As far as the many precious intangible cultural heritage skill on the verge of being lost in our country, if they want to return to people’s vision, they must be combined with new technology and new methods to make it rejuvenate, give the value in the new era to intangible cultural heritage again, thus getting the attention, protection, and inheritance of the public. If the augmented reality technology can be effectively combined and used, it will have an extremely important and far-reaching impact on the inheritance and development of intangible cultural heritage skills, which will be reflected in the following three aspects:

5.1. Augmented Reality Technology "Reproduce" Intangible Cultural Heritage Innovation

Augmented reality technology can integrate real scene and virtual static and dynamic elements through the integration digital media, film and television animation, the Internet, and multiple technologies, thus adding rich virtual visual effects and multiple display forms to the original real scene, so there are more possibilities. AR technology can transform the history, development, and craft of a certain type of intangible cultural heritage into digital display effects, it can be combined with the real intangible cultural heritage works through mobile phones and AR glasses to present realistic display with virtuality and reality combination and ''vivid''.

These "reproduced" AR display contents are not only interesting and technological, but more importantly, the AR display make people to fully understand the story, development and inheritance behind intangible cultural heritage works. As a result, while spreading the connotation of intangible cultural heritage, the channels of social inheritance are fully expanded, and the public awareness of inheritance and protection of intangible cultural heritage is improved.

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5.2. AR Technology Increases the Audiences' Engagement and Interactivity

As far as the exhibition and promotion of intangible cultural heritage works are concerned, it is obvious that only the description and display of images and texts cannot make people truly understand, participate, and experience the cultural essence of intangible cultural heritage, and it cannot effectively arouse the public awareness of the protection and dissemination of intangible cultural heritage.

AR technology can not only present virtual digital content based on real scenes, moreover, users can freely move, rotate, and zoom the corresponding contents through gestures, and select, switch, and obtain information that users care about in real time simultaneously. If such technology is used in the display and promotion of intangible cultural heritage, it will give more modern sense of science and technology to traditional intangible cultural heritage, it also makes viewers enhance their engagement and devotion on the field, understand and feel historical allusions and legendary anecdotes behind the cultural charm and technical inheritance of intangible cultural heritage throughout history.

5.3. AR Technology Promotes the Social Inheritance of Intangible Cultural Heritage

As far as the protection, inheritance, and development of intangible cultural heritage are concerned, we must not only pay attention to social publicity and promotion, but also pay attention to the attention and participation of youth. Youth are the future of the motherland and the hope of the nation, they are the most energetic, imaginative, and creative group in society [11], and they are also the communication group that shoulders social responsibilities. As far as young people is concerned, it's not that they don't care about intangible cultural heritage and don't like traditional culture. Moreover, they lack opportunities for contact and understanding in daily life, as a result, they “far away” from paying attention to and participating in intangible cultural heritage.

Intangible cultural heritage should not be the rigid existence, but the cultural construction, one generation understands one generation, and then some elements of the times are added to continue to be passed on under a new form [12]. Only fully exploiting the social value and trend attributes of intangible cultural heritage and making the intangible cultural heritage truly enter people's lives, can the vitality of the intangible cultural heritage in the new era be fully "activated". Not only can young people feel the fusion of traditional culture and modern technology, the dissemination of intangible cultural heritage become "very fashionable", more importantly, it can make intangible cultural heritage knowledge and traditional cultural connotation popular among young people, and fully give the cultural value of intangible cultural heritage in the new era.

6. Exploration of Interactive Dynamic Display of Pyrograph Based on Augmented Reality Technology

Considering that that the exploration of the digital dynamic display of pyrograph is still blank at home and abroad at present, in this exploratory research, the project team members focus on the design plan of the digital interactive dynamic display link based on augmented reality technology, aim to combine the skill process display and dynamic effect expression of pyrograph for innovative visual design. The idea of this exploratory research is shown in the figure below (Figure 5):

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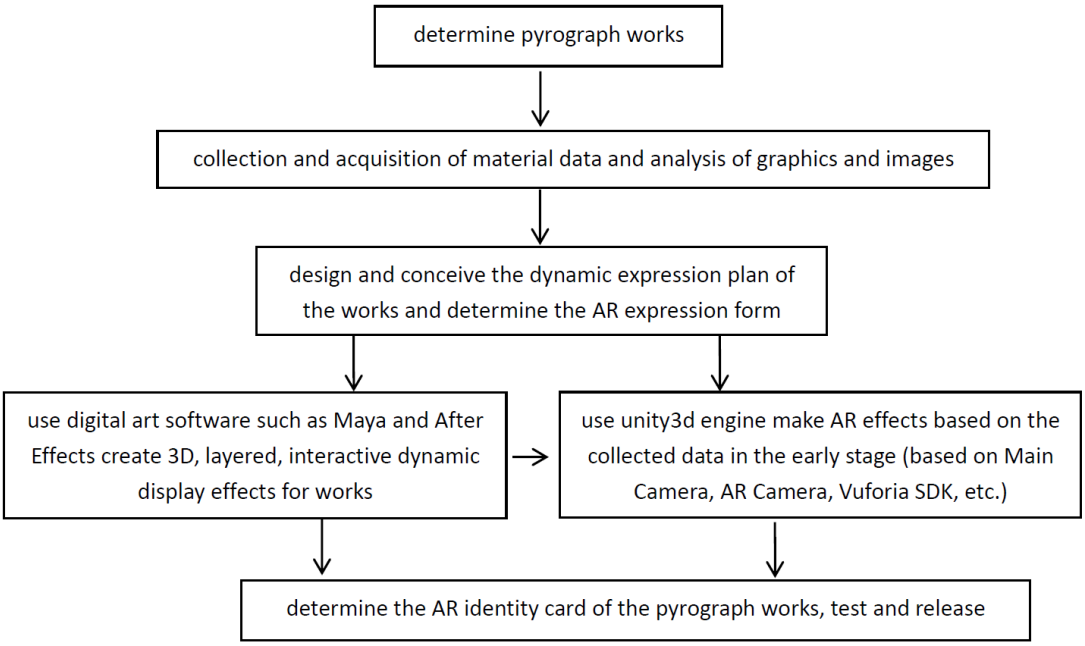

Figure 5. Research ideas of interactive dynamic display of pyrograph based on AR

In order to achieve the research goals and exploration and innovation of this project, this paper focuses on testing and exploring the dynamic expression of virtual digital contents in AR (as shown in Figure 6 and Figure 7), takes the latest research results of digital art, computer graphics, and computer science applications as innovative inspiration points, combines the dynamic technical principles and implementation means of film and television animation, and innovatively integrate AR with unity3d engine, image dynamic effects, sound and image combination, human-computer interaction and many other technological methods, makes the pyrograph works present dynamic image effects through many digital terminal devices (mobile phones, tablets, AR enhanced glasses, etc.), moreover, have audiovisual and interactive experience with the sound and image combination, human-computer interaction. At present, certain progress and innovation have been made in the test performance of interactive dynamic display, the specific contents are as follows:

Figure 6. Scan and present the pyrograph AR effect with the smart phone

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Figure 7. Application and option interface after enter AR interactive dynamic display

6.1. Pyrograph "Painting"-The Story Presentation of the Behind Pyrograph

Traditional pyrograph videos or images are generally difficult to show the creative process to the public, even if the video is shot, it is difficult to see the specific brush stroke expression in the creation due to the shooting angle or the creator's hand, electric burn pen, smoke, etc. (As shown in Figure 8).

Figure 8. The creation process of the pyrograph

In order to be able to clearly reproduce the creative process and brush stroke effects of the pyrograph, the project team decided to use frames the photography as dynamic expression means (as shown in Figure 9). As far as pyrograph, this frames the photography way not only retains the original flavor of the hot brush strokes; but when the continuous dynamic picture is formed, it will make the viewer fully understand the skill expression and skill process of the pyrograph.

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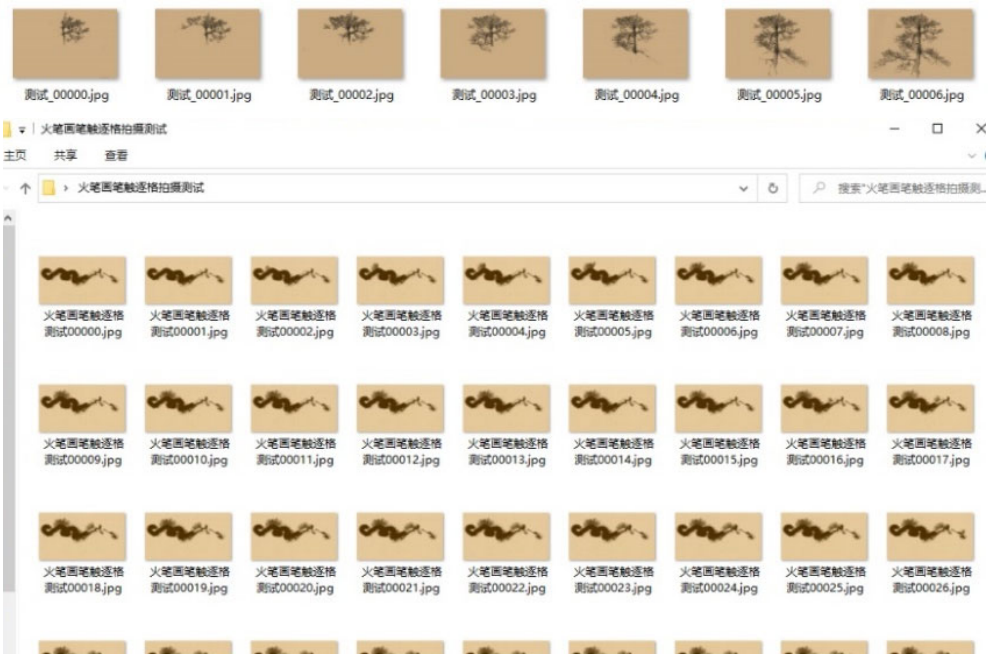

Figure 9. The test effect of using frames the photography (part)

After actual testing, digital production, and synthesis of the collected frames the photography materials of pyrograph are carried out, and the digital virtual interactive dynamic display effect of AR is made. Combining AR technology and smart phone hardware features can not only make the experiencer observe the dynamic effects of pyrograph through interactive operations, but also make the experiencer to enlarge or reduce the interactive display contents based on the needs of the observation habits (as shown in Figure 10).

Figure 10. AR interactive dynamic display and interactive control with frames the photography

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The interactive dynamic display effect presented by AR can closely reproduce the stroke trajectory of the pyrograph from nothing, moreover, it can control the display range such as enlargement and reduction to a certain extent based on personal needs. In this way, the intangible cultural heritage skill of pyrograph breaks the constraints of time and space and is presented to the viewers instantly.

6.2. "Everyone Draws 3D Pyrograph"-Virtual Simulation Drawing Interaction of Pyrograph

The unique painting tools and expressive skills of pyrograph can create a "hot" texture visual effect different from ordinary painting. It is just since the temperature of the pyrograph is high when painting, which is dangerous, many people who are interested but have no professional foundation dare not try it easily, especially, young people rarely have the opportunity to get in touch with the creation tools and production process of pyrograph.

In order to break the barriers of intangible cultural heritage transmission and promotion, so that more people can feel the charm of pyrograph in person. In this project exploration, the project team used 3D animation software create a series of professional tool models and tiles of pyrograph, and used tiles and 3D layering technology achieve the virtual handwriting burning effect, and finally make 3D stereoscopic AR virtual simulation interactive painting effect in combination with Unity3d engine.

In the "everyone draws 3D pyrograph" mode, the experiencer can choose free painting, followed paint, etc. (as shown in Figure 11). In the free drawing link, the experiencer can freely draw and do graffiti on the wooden board by pressing the electric fire pen with their fingers in the 3D space. Moreover, according to the observation needs of the experiencer, the lens rotation and zoom status of the 3D scene are switched (as shown in Figure 12).

Figure 11. The interface and painting selection method of " everyone draws 3D pyrograph"

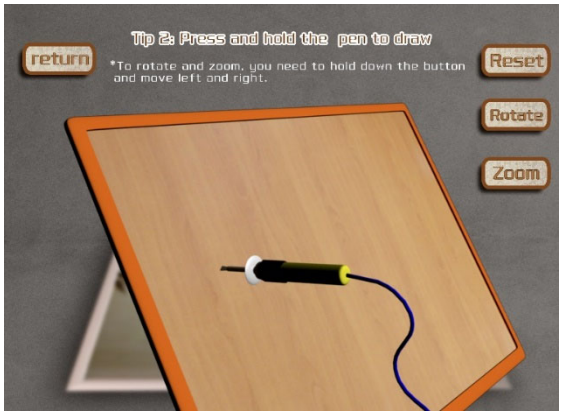

Figure 12. Press and hold the 3D fire pen to start free drawing

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In the followed painting link, the line drawing sketch based on the current actual pyrograph works will be presented on the 3D wooden board, and the experiencer can paint based on the direction and range shown by the line. Moreover, the temperature button can make the experiencer adjust the temperature of the virtual fire pen at any time, in order to simulate the difference of burning effect caused by the temperature of the real fire pen (as shown in Figure 13).

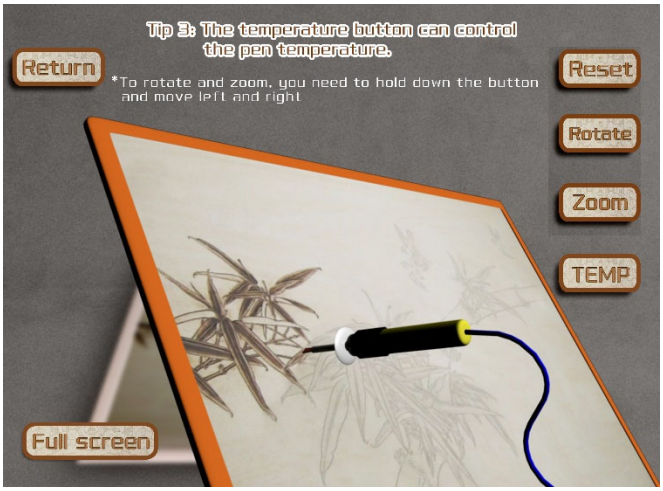

Figure 13. Interactively control the 3D fire pen to conduct followed drawing mode

In addition, in order to make the experiencer better simulate painting in the 3D space, this exploratory test has made certain optimizations for the painting perspective, so that the experiencer can use buttons or fingers to adjust the scene angle and lens scene at any time, and meet the painting needs and interactive experience of experiencers with different ages (as shown in Figure 14).

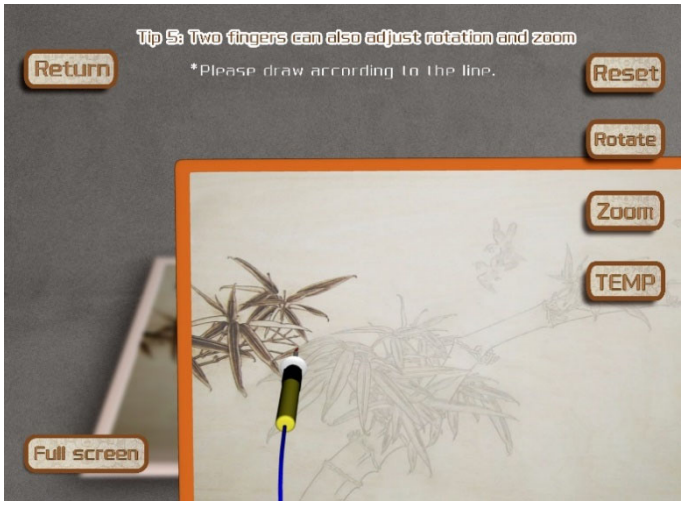

Figure 14. The lens angle and shots setting can be adjusted during the painting process

The burning drawing skill of pyrograph is its biggest characteristic, in the process of simulation interactive display, in order to make the experiencer more accurately see the handwriting effects and changes brought by the fire pen during drawing, further understand the effects of the burning move and enhance the simulation interaction experience, the full-screen mode is added in the followed painting link, so that the color change and texture presentation of the fire pen can be observed more clearly. Therefore, by integrating the pyrograph with AR technology,

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the experiencer can fully feel the display and charm of the intangible cultural heritage brought by the pyrograph in the interactive operation of virtual simulation (as shown in Figure 15).

Figure 15. Followed drawing mode in full screen state

7. Conclusion

As far as Hefei pyrograph and other intangible cultural heritages, the inheritance and development of intangible cultural heritages will inevitably face many challenges under the background of rapid social development and the rise of various emerging cultures.

Under this background, it is even more necessary to open innovative ideas, transform challenges into opportunities, and use new technologies and new technologies to open a new situation for the inheritance and protection of intangible cultural heritages. As one of the manifestations of modern technology, AR technology can give new energy to the intangible cultural heritage promotion and dissemination of pyrograph, make the public to have zero-distance contact, understand the charm of pyrograph through interactive experience, make the public have a new understanding for the inheritance history and skill process of pyrograph personally. Moreover, AR technology will attract more young people to pay attention to the inheritance, protection, and dissemination of intangible cultural heritage of pyrograph, make the people foundation who inherit pyrograph intangible cultural heritage more extensive, and prompt the pyrograph that was once the Jianghuai skill regain attention and protection.

I believe that in the future, with the further integration of modern technology and traditional culture, more and newer digital protection and inheritance forms will emerge as the times require, as the cultural treasure of the country and the nation—intangible cultural heritages, and they will also be reborn again and once again bloom its unique cultural charm.

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