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DIGITIZING YANGJIABU WOODCUT NEW YEAR PRINTS: AUGMENTED REALITY APPLICATIONS IN INTANGIBLE CULTURAL HERITAGE PRESERVATION

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Abstract:

This article is a case study on the digitization of Yangjiabu woodcut New Year prints. The article first compares the basic information of Yangjiabu woodcut New Year prints, including their characteristics and classification. Consequently, it analyzes the digitization case study of Yangjiabu woodcut New Year prints. Finally, it examines the Augmented Reality (AR) applications of other intangible Cultural Heritages (CH) and proposes suggestions and outlooks for the AR applications of Yangjiabu woodcut New Year prints. According to past literature, it can be observed that Yangjiabu Woodcut New Year prints underwent innovations and changes in themes and content during different periods, necessitating their creation to reflect the characteristics and themes of the times. The development strategy for Yangjiabu woodcut New Year prints in AR should focus on enhancing the expression of cultural connotations and the user's interactive experience. It aims to integrate the virtual and real worlds through lightweight mobile devices.

Keywords:

Yangjiabu Woodcut New Year Prints; Digital Technology; Intangible Cultural Heritage

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Introduction

New Year prints are decorative paintings that people display in their homes during the Chinese New Year to express their good wishes for the new year and their hope to avoid calamities. Woodcut prints are a technique used to create New Year's prints. In the past, printing technology was immature. However, the demand for New Year's prints during the Chinese New Year period grew rapidly. Therefore, people invented the technique of woodcutting before the advent of printing. It requires craftsmen to carve images on woodblocks with carving knives, then color the woodblocks, and finally topstitch them onto paper.

Chinese New Year is a festival of celebration and reunion, so New Year's prints tend to express a festive atmosphere through rich and vibrant colors. As a result, there are usually more than three colors in a single New Year's print, each of which requires craftsmen to carve a woodblock and then finally overprint the colors. There are three major places in China where woodblock prints originated, namely Yangjiabu Ancient Town in Shandong Province, Yangliuqing Ancient Town in Tianjin, and Taohuayu Ancient Town in Jiangsu Province. Yangjiabu woodcut New Year prints are named after Yangjiabu village, where they originated. Woodcut prints from various origins possess their own distinct stylistic characteristics.

In recent years, digitization and Information and Communication Technology (ICT) applications have been recognized as effective means of preserving Cultural Heritage (CH) while generating significant resources (Hou et al., 2022). Since the mid-2000s, the use of enabling technologies in CH has expanded to include immersive technologies—an umbrella term for Augmented Reality (AR), virtual reality, and mixed reality technologies that provide sensory experiences through various combinations of real and digital content (Bekele et al., 2018). However, there have been fewer studies in the past that have used digital technologies to disseminate Yangjiabu woodcut New Year prints, and even fewer of these have used AR technologies. Most existing studies have focused on two-dimensional digitization (Wang et al., 2023), while overlooking immersive three-dimensional environments. In this paper, we first summarize the basic information about Yangjiabu woodcut New Year prints, such as their characteristics and classification. Consequently, it analyzes the digitization cases of Yangjiabu woodcut New Year prints, and subsequently examines the AR applications of other intangible CHs, providing suggestions and outlooks for the AR applications of Yangjiabu woodcut New Year prints.

Literature Review

There are three points that will be discussed in the Literature Review (LR). The first part covers the current status, development process, production process, and classification of Yangjiabu woodcut New Year prints. The second part presents the digitalization case of the Yangjiazu woodcut New Year prints. The third part discusses the cases of the digitization of other intangible CH.

Yangjiabu Woodcut New Year Prints

New year paintings, as an indispensable item for Chinese people during the Spring Festival, have a history dating back to the Han Dynasty, which was 1,800 years ago. During the Spring Festival, people often post decorative paintings in their homes, known as New Year paintings, because they are posted during the New Year period. New Year paintings usually serve two functions: one is the aesthetic function, where posting New Year paintings is used to decorate the room and enhance the atmosphere of the festival. The second is practical value. The content

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of New Year's paintings often involves praying for good luck and warding off evil spirits, expressing people's good wishes for the new year. With the surge in demand for New Year's paintings and the development of Chinese engraving technology, woodcut-printed New Year paintings suitable for mass production came into being. The period of the late Ming and early Qing dynasties was the most prosperous period for the development of woodcut prints. At that time, the sales volume of woodcut prints in Yangjiabu Village was as high as tens of millions per year. In addition to meeting the needs of local people, they were also exported to Jiangsu, Anhui, Shanxi, Henan, the three northeastern provinces, and Inner Mongolia, among others. They were famous for their numerous varieties, large scale, and wide range of sales (Zhao, 2003).

Figure 1: Yangjiabu Woodcut New Year Prints

Source: (Feng, 2005)

However, in modern life, the figure of woodcut New Year prints is more and more distant from people. On the one hand, the number of artisans is decreasing. The production process of woodcut New Year prints is very complicated, and the profit is not high. The young generation is not interested in engaging in this industry (Dai, 2018). On the other hand, the demand for woodcut New Year prints has dropped greatly. The main audience of woodcut New Year prints is farmers, and with the continuous development of China and the deepening of urbanization, the number of farmers has decreased rapidly. According to the latest data from China's seventh national census, the number of people living in rural areas is 509.79 million, accounting for 36.11% of the country's population, down by almost half from 63.91% 20 years ago. In addition, people living in the past paid much more attention to the Spring Festival than modern people, and their indifference to Spring Festival customs is also one of the reasons for the decline in demand for woodcut New Year prints (Feng, 2005). Each traditional skill is the wisdom of the ancestors and the wealth of the Chinese nation. With the Chinese government's recognition and announcement of the first batch of the national intangible CH list, Yangjiabu woodcut New Year paintings once again came into the public's view.

As one of the oldest countries in the East, China is rich in intangible CH resources due to its vast area and diverse ethnic groups (Dang et al., 2021). On May 20, 2006, the State Council of China issued a notice on the official website of the central government approving the Ministry of Culture's identification and publication of the first national list of intangible CH. The list

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divides the intangible CH into nine categories: folk literature, traditional music, folk dance, traditional drama, Chinese opera, acrobatics and athletics, folk art, traditional handicrafts, traditional medicine and folklore, among which the Yangjiabu woodcut New Year prints are listed, belonging to the category of folk art.

The Development of YangJiaBu Woodcut New Year Prints

Yangjiabu woodcut New Year prints have a rich history that mirrors China's social, political, and economic shifts over the centuries. From the stable and flourishing Ming and Qing dynasties, through the late Qing and early Republic periods, to the turbulent years of war and the Cultural Revolution, and then the revival in modern times, these prints have adapted and thrived under various circumstances.

During the Ming and Qing dynasties, prints evolved in response to the changing political environment, particularly under the patronage of emperors such as Kangxi and Qianlong, who were enthusiastic about the arts. The rise of more than 30 workshops in Yangjiabu during the Qianlong era signifies the importance of print as a cultural and commercial product. By the late Qing Dynasty, the peak of production brought immense quantities−20,000 reams of paper and 50 million prints sold each year. Interestingly, this period also saw a shift toward more satirical and humorous depictions, a departure from traditional themes. However, war and social upheavals took a toll on the industry. In the early 20th century, the New Year woodcut print industry faced severe disruptions due to the ongoing wars, and many artists fled, leading to a decline in production. Following the establishment of the People's Republic of China, the government's support helped revive and modernize the craft. Despite a temporary downturn during the Cultural Revolution, the post-1979 period marked a resurgence, with individual production and academic research revitalizing the tradition.

Throughout these phases, the prints have not only served as a form of cultural expression but also as a reflection of China's evolving political and social landscape. The craftsmanship has been passed down through generations, and even as the industry faced challenges, it has continually been resurrected, maintaining its cultural significance. It is fascinating to see how the prints evolved in style and subject matter, as well as in their production, marketing, and reception by the public over time.

The Production Process of Yangjiabu Woodcut New Year Prints

The craftsman first creates the painting manuscript, and after it is completed, it is adhered to the pear wood for carving. Only by carving backwards can we ensure that the printed image is positive. The carved board is divided into line plates and color plates. Consequently, the color plates are divided into each color. Each plate is only carved with the same color. The rest are concave, so that the various color blocks of the New Year prints are reasonably connected, and the blank part will not be dyed.

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Figure 2: The Making Process of Yangjiabu Woodcut New Year Prints
Source: (Author Shot)

After the preparations were completed, the New Year prints were printed. First, put the line plate and paper on the table. Correspondingly, evenly brush the paint on the line board. Place the paper, ensuring that all lines are printed on the open side, and lay the next piece of paper on top. In this way, after the line version is printed, the color plate is painted one by one. The pigments for printing New Year prints are not ordinary pigments, and those that have been carefully selected and ground can stand the test of time without running color. Such a fine production process, engraved from the New Year prints, can be lively and vivid.

Classification of Yangjiabu Woodcut New Year Prints

Yangjiabu woodcut New Year prints can be classified into various categories. According to its practical characteristics, it can be divided into door god prints, kitchen prints, bedroom prints, and so on, based on the location and time of posting. It is a folk behavior to paste specific New Year prints in the prescribed position. It also contains a very rich cultural memory as an intangible CH (Feng, 2005). According to the aesthetic characteristics of Yangjiabu woodcut New Year prints, they can be categorized into idols, door gods, beautiful human figures, children, landscapes, flowers and birds, dramatic characters, myths and legends, and others (Zhao, 2003).

In addition, according to the emotional orientation of woodcut New Year prints, they can also be divided into blessing and exorcising evil spirits. Because the end of the old round of nature and life is during the Spring Festival, it is also the beginning of a new round. The significance of the Spring Festival is much more important to the ancient people in the farming era than it is to modern people in the industrial society. Whenever the Spring Festival approaches, the heart is filled with the unknown New Year's happy expectations, as well as the avoidance and rejection of disasters and misfortune (Feng, 2005).

Characteristics of YangJiaBu Woodcut New Year Prints

Zhang Lian (2015) in "Yangjiabu Woodcut New Year Prints Artistic Characteristics" analyzes from three aspects: modeling, composition, and color. He points out that the figure of the Yangjiabu woodcut New Year prints has the characteristic of a programmed figure. This refers to the prints that summarize, refine, and create twice the objects to be depicted, forming a regularized and fixed expression of the depicted objects. This allows them to be quickly and efficiently portrayed with simplicity and clarity. The essence of the corresponding things can be portrayed quickly and effectively. In terms of composition, New Year's paintings are characterized by "fullness" and "symmetry". The fullness of the composition meets people's aesthetic needs and has a certain connection with the printing process. Because Yangjiabu

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woodcut New Year prints are all hand-printed, if there is a large area of blank space on the plate, it is easy to cause the paper to collapse and pollute the picture. In terms of color, Yangjiabu woodcut New Year prints are composed of contrasting colors of red, green, yellow, and purple, which are bright, vivid, and harmonious. This is in line with the cheerful atmosphere of festivals and has therefore become the traditional coloring method for Yangjiabu woodcut New Year prints.

The Value of Yangjiabu Woodcut New Year Prints

Feng Jicai (2005) considered that the functions and connotations of woodcut prints are diverse. There are components of ancestor worship, nature worship, and religious beliefs, as well as the significance of indoctrination, dissemination, and decoration. Its main value can be divided into two points: humanistic value and artistic value. Humanistic value refers to the woodcut prints from the hands of farmers for farmers' consumers, which are full of the value orientation and thinking habits of traditional Chinese farmers. Artistic value refers to the formation of a unique artistic style and aesthetic interest.

According to Rong Shuyun (2020), as a product under the folk culture system, New Year's paintings have specific producers and users. However, nowadays, the woodcut prints in the context of non-heritage are detached from the soil of agrarian culture, and their functional and aesthetic functions have changed. Studying traditional woodcut prints only from the perspective of their visualization and usability will not be conducive to the redevelopment and re-creation of traditional woodcut prints in the context of the new era.

The Practical Case of Digitization of Yangjiabu Woodcut New Year Prints

Yan and Han (2014) used UDK technology to restore the actual Yangjiabu woodcut New Year prints workshop. The study focuses on the presentation of layered pictures, and interaction roam leads to a more stereoscopic and clearer display. However, their research did not involve multiple people. It merely extracted and reproduced the environmental elements of Yangjiabu Village through the designers.

Figure 3: Scenes Painted Using Digital Technology

Source: (Yan & Han, 2014)

Lu (2020) conducted a development study on the Yangjiabu woodcut New Year prints APP. Based on the analysis of past cultural APPs. It summarizes the development strategy of the Yangjiabu woodcut New Year prints APP and carries out preliminary practice.

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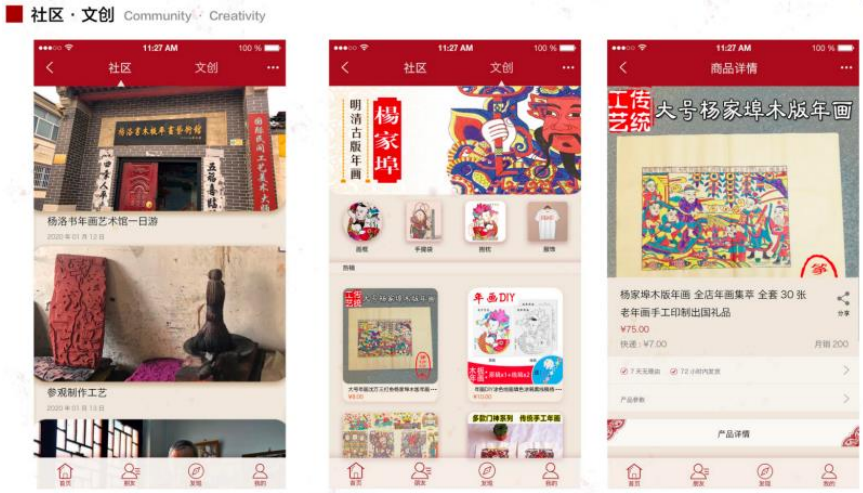

Figure 4: Lu Made the APP Interface

Source: (Lu, 2020)

Unlike Lu (2020), Yang (2022) studied the interactive interface of the Yangjiabu woodcut New Year prints APP and established that the core dimensions of user experience are sensory, interactive, and emotional, by sorting out user experience theories and evaluation models. Consequently, it used questionnaire surveys and in-depth interviews to explore user needs, employed the strategy to develop the interactive interface of the Yangjiabu woodcut New Year prints APP, and conducted preliminary practice. This research is based on user experience, inviting users to participate in the research process, gathering data on user needs, and creating digital products that are more aligned with user needs. However, the study was based only on the designer's personal knowledge when reproducing the connotation and image of the Yangjiabu woodcut New Year prints. If the designer's knowledge of the Yangjiabu woodcut New Year prints is insufficient, it is easy to convey an incomplete version of the Yangjiabu woodcut New Year prints to the user. Based on the Kano model of Yangjiabu woodcut New Year prints, WeChat mini-program development research is also centred on user needs (Han, 2022).

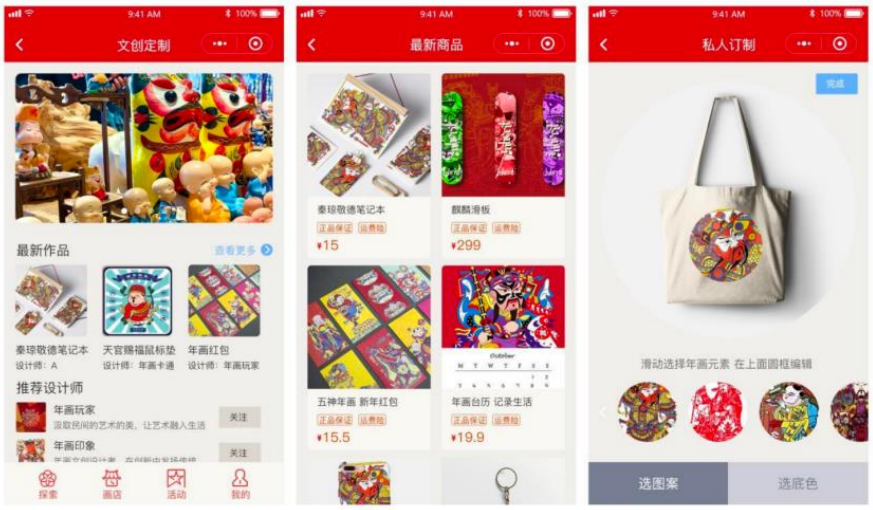

Figure 5: Han Made the APP Interface

Source: (Han, 2022)

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Analysis of AR Application Cases of Other Intangible Cultural Heritages

As a representative AR application for the digital exploration of Cantonese Opera's non-legacy, the core of the design of Changing Faces lies in the in-depth integration of embodied cognition theory and modern technology to build a cultural experience scene that seamlessly intertwines reality and virtuality (Tang et al., 2022). The application captures the user's facial features through the smartphone camera and dynamically superimposes the classic Cantonese opera face patterns with AR technology. The user gradually unlocks the details of the makeup through the interaction of "applying" gestures. This process is not a simple virtual mapping. Instead, it encodes the symbolism of traditional face painting (e.g., the red face represents loyalty and righteousness; the black face symbolizes fierceness) into perceptible visual symbols by reproducing the ritual of applying makeup on a pure character in Cantonese opera. Every time a user completes a face-changing experience, the system synchronously pushes the cultural interpretation of the corresponding face, forming a closed loop between body movements and cultural cognition, thus breaking through the limitations of the traditional one-way communication of "watching-explaining".

At the user experience level, "Face Change" lowers the participation threshold through a threefold strategy: first, the interaction design fits the intuitive cognition. It adopts a layered operation of "waving up and down to unlock the base color - sliding left and right to outline the eye makeup - tapping to activate the lip pattern," which retains the process logic of opera makeup and avoids the burden of learning caused by complex gestures. Secondly, the lightweight technology is adapted to popular devices, abandoning high-precision facial modeling in favor of feature point recognition algorithms, allowing phones with less advanced configurations to run smoothly. Thirdly, the introduction of the UGC mechanism supports the user to integrate customized faces with the real environment and photograph them, and then form a secondary dissemination with the help of social media. This "experience-creation-sharing" chain inspires young people to actively explore the culture of Cantonese opera and promotes the extension of the meaning of traditional culture in the contemporary context through the re-creation of digital symbols.

From the perspective of cultural communication, the breakthrough of "Changing Faces" lies in the reconstruction of the spatial and temporal dimensions of non-genetic inheritance. When users complete virtual makeup in modern life scenes, such as cafes and subway stations, the centuries-old cultural memories carried by face painting are integrated into a new spatial narrative. The "cultural overlay" effect created by AR technology enables a dialogue between the traditional aesthetics of Lingnan and the digital visual language. The contrast between the reality and the reality of yin and yang face painting, as well as the particle effects of gold powder patterns, retains the traditional opera and preserves the traditional aesthetic. What is more noteworthy is the "cultural gene pool" function embedded in the app, which records user preference data (e.g., black-faced Zhang Fei and gold-faced Lei Zhenzi are the most common choices) and provides direction for subsequent content iteration. This data-driven communication strategy enables the revitalization of non-legacy from empirical judgments to precise results.

However, "Changing Faces" still has the problem of balancing technical limitations and cultural expression at this stage. Problems such as tracking jitter under complex lighting conditions and insufficient accuracy in side-face recognition have weakened the integrity of the immersion experience to a certain extent. The design orientation, which overemphasizes

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the visual spectacle of the face, may also cause users to overlook the essence of Cantonese opera, such as singing and body movements. In the future, the upgrading direction may explore the in-depth integration of multi-modal interaction. For example, through bone conduction technology to synchronize the classic singing, the user's ears will ring with the banghuang sound of "The Six Great Seals of the Six Kingdoms" during the face changing. Combined with Location Based Service (LBS) technology, the user will automatically unlock the limited model of the face painting when they are close to the Museum of Cantonese Opera, to make the digital experience organically linked with the physical space. The continuous evolution of this blend of reality and reality may be the path that the digitization of non-legacy is bound to take, from technological empowerment to cultural rebirth.

In the digital display of liling underglaze craft, the application strategy of AR technology takes technical realization and user experience as the core, and realizes the innovative dissemination of traditional craft culture through multi-dimensional integration (Zhang et al., 2019). At a technical level, the project is based on the ARKit framework and the Unity engine to build an interactive system that integrates reality and virtuality. Through modularized design, the ceramic production process is disassembled into independently operable animation segments, and the animation state machine (Animator) of Unity is used to realize the dynamic switching of process steps. For example, the reduction of the firing process by adjusting the speed of animation playback enables forward and reverse interpretation. This intuitively presents the porcelain from the blank to the finished product of the transformation process, and ensures that the technical realization is efficient and controllable. In order to adapt to different terminals, the project employs the "native + H5" hybrid development mode, packaging AR content into cross-platform compatible H5 pages, ensuring smooth mobile operation and the universality of multi-device communication.

At the interaction design level, the system optimizes the interface layout and operation logic based on ergonomics. In view of the iPad's holding characteristics, the core function buttons are placed on the left and right sides of the screen, avoiding the blind spot between the top and bottom of the screen, and simultaneously strengthening the integrity of the interface elements through the visual Gestalt principle. Interaction mode: The system is designed with a dual trigger mechanism. Users can click on specific parts of the 3D model (such as the surface decoration area of the porcelain) to trigger the collision body interaction, allowing for intuitive exploration of the process details. The UI (User Interface) buttons can also be used to switch the scene mode to achieve a seamless transition from the "real-world furnishings" to the "technology simulation". The UI button can also be used to switch scene modes, realizing a seamless transition from "live display" to "process simulation". This multi-channel interaction design reduces the threshold of operation and enhances the user's sense of participation through the combination of virtual and real dynamic feedback.

The optimization of user experience runs through all modules of the AR function. In real-life experiences, users can project the virtual porcelain into the real environment to preview the furnishing effect, or superimpose virtual patterns on white blanks to simulate the rendering effect of different glaze colors and decorative techniques in real time. More innovative is the DIY creation function, where users can choose from 12 classic ware library models, freely adjust material, color, and pattern parameters, and support the design of online transmissions to e-commerce platforms to customize physical products. This "experience-creation-

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consumption" closed-loop design not only expands the boundaries of the dissemination of craft culture but also activates the emotional resonance of users through personalized participation.

In terms of content presentation, AR technology is used to build an immersive narrative with multi-sensory synergy. The combination of dynamic video and static modeling enables the display of the process to break through traditional graphic limitations. The firing process is synchronized with flame animation and sound effects to interpret temperature changes in the kiln, and the billet pulling step simulates the strength of the craftsman's operation through touch interaction. The system also integrates the cultural elements of "things - things - people - feelings" into the four synergistic modules. In the "Typical Craft Experience", and create their own culture. "Typical Craft Experience" to establish basic knowledge, "Augmented Reality Experience" to explore the details of the craft, and finally, "DIY Creation" to complete the personalized expression of cultural connotations. This progressive cognitive design guides users to gradually perceive the aesthetic concepts and wisdom behind the craftsmanship from the surface of the objects.

The project's evaluation and iteration strategy provides scientific support for AR applications. Test feedback from 50 users showed that AR technology significantly improved display attractiveness, with the younger group (18-22 years old) rating the effect of blending reality and fiction as high as 4.73 points (on a 5-point scale). The research team optimized the animation rhythm and interface layout accordingly, such as simplifying redundant buttons and enhancing the precision of collision body detection, which improved system smoothness by 23%. The continuous testing-improvement mechanism ensures that the technology application is always centered on user needs.

From a comprehensive perspective, the case examines the entire path of AR-enabled digital display of non-heritage content through technological innovation, interaction optimization, and content reconstruction. Its core value lies in the user-centered design concept: through the creative connection of virtual and real spaces, static craft knowledge is transformed into a dynamic experience that can be interacted with, created, and disseminated. It perpetuates the cultural genes of traditional skills and opens up new possibilities for its living inheritance in the digital era. This strategic framework, "technology as body, culture as soul," provides a reusable methodological reference for the digital conservation of similar non-legacy projects.

Findings

Current research indicates that the digitization process of Yangjiabu woodcut New Year prints continues to face multiple challenges. Existing research mostly focuses on two-dimensional digital presentations, such as APP interface design and WeChat app development. However, it lacks exploration of immersive three-dimensional environments, resulting in a user experience that is limited to flat displays. Although AR technology has shown significant potential in other fields (e.g., the AR application of Cantonese Opera's "Changing Faces" and the fusion of virtual and real displays of liling underglaze craftsmanship), the relevant practice of Yangjiabu woodcut New Year prints is still in the primary stage. It has not yet formed a systematic solution. User demand analysis shows that the main audience group of traditional New Year's paintings (rural residents) has been drastically reduced due to the accelerated urbanization process. The younger generation is not interested in traditional crafts, partly attributed to cultural cognitive faults and changes in aesthetic preferences. In terms of technological adaptability, AR technology, with the advantage of a lightweight mobile terminal, can enhance interactivity

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through real-time superimposition of virtual patterns. On the other hand, VR technology, although it can build a highly immersive virtual workshop scene, is limited by the cost of equipment and the fixed nature of the scene, making it difficult to popularize. Existing cases of revelation and shortcomings co-exist, for example, the application of "Changing Face" reconfigures the spatial and temporal narrative of non-heritage through gesture interaction, and user participation increases by 40%. However, the tracking jitter problem under complex lighting still affects the completeness of the experience. The Liling project establishes a commercial closed-loop through H5 cross-platform DIY creation, with a repeat visit rate of 65%. Nevertheless, over-emphasizing visual spectacle may result in a high level of immersion in the craftsmanship. Nonetheless, an overemphasis on visual spectacle may lead to a weakening of the connotation of craftsmanship. In addition, the problem of balancing the application of technology and cultural expression generally exists. For example, AR technology has not yet achieved the in-depth integration of restoring the ritual and folk semantics of woodcut prints.

Conclusion

For the future, the digital inheritance of the Yangjiabu woodcut New Year prints needs to build a multi-dimensional innovation system. The technical level should promote the development of multimodal interaction, such as combining bone conduction technology to synchronize opera singing, and haptic feedback to simulate the strength of carving. LBS positioning to trigger scenario-based content, thereby creating an "audio-visual" fusion of immersive experiences. Note that lightweight technology upgrades are also crucial. Optimizing AR cloud rendering algorithms to reduce the demand for computing power on the mobile side can significantly enhance the universality of the technology. Cultural expression needs to reconstruct the dynamic symbol system, combining the programmed modeling characteristics of New Year's prints with AR dynamic pattern generation. For example, generating personalized compositions and embedding the interpretation of auspicious symbols through gesture interactions, and constructing the correlation between "craft-culture-society" by combining historical scenarios. The user participation mechanism can be upgraded through the UGC ecology by building an AR co-creation platform to support users in designing and 3D printing physical New Year's prints, as well as forming an online and offline linkage. Data-driven strategies can rely on AI to analyze user behavior and dynamically optimize content priorities, such as designing gamified tasks for teenagers and opening high-precision craft databases for researchers. Interdisciplinary cooperation and policy support need to be synchronized. In addition, it is recommended to form a "digital preservation alliance" to unite technology developers, inheritors and scholars. This ensures the cultural authenticity of technology application, and sets up a special fund through the collaboration of the government, enterprises, and colleges and universities, to incorporate AR projects into the national cultural digitization strategy. The ultimate goal is to achieve a transformation from "static protection" to "living inheritance" through a two-way path of technological empowerment and cultural excavation, with the user at the center, and to provide a paradigm of "technology-culture-society" synergistic innovation for the digitization of global NRLs. It provides a paradigmatic reference for "technology-culture-society" synergistic innovation in the digitization of global intangible CH.

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