

# Digitalized Interactive Design and Application of Intangible Cultural Heritage Taking Beijing Embroidery as an Example

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## ABSTRACT

With the development of the times, personalized and interactive new media technologies are gradually changing people's way of life. The combination of traditional culture and technology has also become the most popular mode of communication in this era. This article explores the integration and innovation of Chinese intangible cultural heritage and digital interaction in the new media era by taking Beijing embroidery as an example. Firstly, this article analyzes the current situation of intangible cultural heritage and the digitization of intangible cultural heritage. Then, it explores the digital interaction design and application of intangible cultural heritage from three aspects: knowledge visualization, interaction design, and digital display. Intangible cultural heritage is rich in traditional cultural elements, similar to Beijing embroidery, which is difficult to be accessed and widely spread. With the continuous development of modern information media, mobile apps and H5 (HTML5, HyperText Markup Language 5) have gradually become the most widely used and easily accepted forms of communication in Beijing embroidery. The design work "Drama Rhyme Beijing Embroidery" is an interactive design game for children aged 6 to 8. Through digital technology, the work establishes a more interesting and accessible interaction mode for children, effectively integrating high-quality science popularization resources with information multimedia, leading children to experience the beauty of intangible cultural heritage Beijing embroidery and the connection between Beijing embroidery and traditional Chinese opera, which can wake up more people's attention to the Beijing embroidery itself and related intangible cultural heritage.

**Keywords:** *Beijing embroidery, Intangible cultural heritage, Digitization, Interactive design.*

## 1. INTRODUCTION

In the rapidly developing digital era, the living space of intangible cultural heritage has been impacted. At the same time, the widespread use of digital technology and the widespread dissemination of social media have brought market and vitality to excellent intangible cultural heritage. In order to better promote and inherit traditional culture, this author aims to integrate the intangible cultural heritage of Beijing Embroidery with children's interactive games and conduct innovation. Based on this, the author makes an attempt to design a science popularization interactive game for children aged 6-8, in order to promote traditional culture, enhance children's interest in traditional culture and achieve the goal of educational entertainment.

## 2. DIGITAL DISSEMINATION OF INTANGIBLE CULTURAL HERITAGE

This chapter mainly analyzes the problems currently faced in the dissemination of intangible cultural heritage, and analyzes the feasibility of digital dissemination combined with the characteristics of digitalization.

### 2.1 *The Current Situation and Problems Faced by Intangible Cultural Heritage*

Intangible cultural heritage is a very important and indispensable part of China's cultural soft power. It originates in various historical stages and regional cultures, with obvious characteristics of

the times and regions, and is of great significance for promoting the development of human society. However, under the influence of modernization and globalization trends, cultural exchanges and collisions between countries are inevitable, accompanied by the emergence of new popular cultures and changes in people's aesthetics. The living space of intangible cultural heritage has been severely impacted, and the phenomenon of decline is becoming increasingly apparent. Before this, inheritors of traditional intangible cultural heritage techniques had already been exposed to intangible cultural heritage techniques at a very young age and were taught through oral transmission. With the rapid development of the fragmented era and the fast-paced lifestyle of people, it is difficult for most young people to settle down and conduct deeper research on an intangible cultural heritage, let alone years of hard work. In this context, many problems have been exposed in the protection, utilization, and development of intangible cultural heritage. The overall social awareness of intangible cultural heritage has decreased, the audience has decreased, and the inheritors of intangible cultural heritage have become disconnected, leading to the phenomenon of "when the inheritor died, the art and the song also died". However, the simplification of inheritance and dissemination forms, the lag of digital protection and development methods, the insufficient awareness of heritage protection by the government and the public, the poor experience and interactivity of cultural heritage, and low participation of the whole people have led to many oral and behavioral inheritance of cultural heritage on the brink of extinction.<sup>1</sup>

The products of Beijing embroidery fully reflect the function of "the emblem of the body", which is different from the literati's elegance and poetic charm permeated by famous embroidery in Su, Xiang, Gu, and other places. Beijing embroidery reveals the robust temperament of northern culture. On the basis of northern embroidery, Beijing embroidery combines the characteristics of exclusive embroidery techniques from Suzhou embroidery, Guangdong embroidery, and other regions, integrating the skills of the world, and ultimately forming its own system to become the embroidery used by the royal court. Compared to other types of embroidery, Beijing embroidery did not develop independently in a fully free cultural

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1. Ju Huaqian, Peng Wenli, Research on the Application of Digital Technology in the Protection of Intangible Cultural Heritage: Taking Foshan Woodcut New Year Pictures as an Example [J]. Hunan Packaging, 2021 (04).

environment. While individual embroidery workers constantly sought their skills, they were also deeply influenced and influenced by the culture and will of the ruling class, thus forming a unique style. With the disappearance of the feudal era, its influence has penetrated into the traditional craftsmanship and culture of Beijing embroidery, and stood out among the numerous embroideries in the modern and contemporary cultural context. Beijing embroidery, as a unique cultural heritage in the field of Chinese embroidery, has become an urgent responsibility for China to protect its culture and inherit its skills. Due to the high standard craftsmanship and limited social demand of Beijing embroidery, it is facing the danger of no one inheriting and disappearing. If the techniques, patterns, and systems in Beijing embroidery are lost, it will be a huge loss to Chinese and even global culture.<sup>2</sup>

## ***2.2 The Characteristics of Intangible Cultural Heritage Digitization***

The digital application in the protection and development of intangible cultural heritage refers to the use of digital technology for data collection, storage, transmission, processing, analysis, and application, to assist in the protection, display, inheritance, and dissemination of intangible cultural heritage, and to explore the creative transformation and innovative development of traditional culture.<sup>3</sup>

The advantages of digitizing intangible cultural heritage are reflected in many aspects: in terms of intangible cultural heritage inheritance, data updating and preservation are achieved through digital storage. The current digital storage technology is becoming increasingly advanced, which not only allows for long-term storage of image data, but also digitizes audio and video to avoid audio distortion. With the expansion of the scope of cultural heritage protection, when collecting data, it is not only limited to audio and video recording, but also the sense of smell, taste, and touch can be reproduced through simulation technology. In terms of cultural dissemination, digitization can be equipped with display screens, sensors, etc., which can fully mobilize various

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2. Lu Yixuan, Research on the Cultivation of Intangible Cultural Heritage Talents in Fengtai District Vocational Education Center School in Beijing [J]. Chinese National Academy of Arts, 2021 (09).

3. Huang Yonglin, Tan Guoxin, Research on the Digital Protection and Development of China's Intangible Cultural Heritage [J]. Journal of Central China Normal University, March, 2012.

senses of the human body, and enable the audience to have a more comprehensive and systematic understanding of the exhibition content, which is also more in line with the information acquisition habits of contemporary people. Due to the openness and interactivity of digitization, both large-scale parties and daily apps used by people can better spread intangible cultural heritage. The continuous updating and maturity of interactive technology has enabled the widespread application of mobile terminals that combine education with entertainment, attracting more attention from young people to intangible cultural heritage.

Taking Beijing embroidery as an example, not only can its origin and development history be preserved and displayed in a digital way, but also the techniques, patterns, and formats related to oral transmission in Beijing embroidery can be visualized. This digital technology can not only better preserve and inherit intangible cultural heritage, but also integrate it with today's society, making it easier for it to be recreated and promoted on mainstream media.

### **3. VISUALIZATION AND INTERACTIVE DESIGN OF INTANGIBLE CULTURAL HERITAGE DIGITIZATION**

This chapter further explores the immersive characteristics of knowledge visualization, the innovative significance of interactive design, and the openness of digital display.

#### ***3.1 Immersion of Knowledge Visualization***

In 2004, the term "knowledge visualization" was first proposed, referring to the application of visual representation to express abstract content, promote knowledge dissemination and innovation, and help others correctly reconstruct, remember, and apply this knowledge. Early knowledge visualization mainly involved image visualization techniques such as concept maps and semantic maps. With the development of artificial intelligence, virtual reality, and other technologies, new spaces for knowledge experience have been expanded. Animation videos, AR/VR, and others have gradually become effective methods for achieving knowledge visualization.<sup>4</sup>

With the increasing demand for digital protection of cultural heritage, cultural heritage knowledge is becoming increasingly complex, informationized, and heterogeneous. The presentation methods have shifted from text, images, etc. to rich and intuitive videos and interactions. As a result, research on the visualization of cultural heritage knowledge has emerged. For example, knowledge discovery of cultural relics information resources, virtual museums for knowledge visualization, etc., there are many elements in traditional intangible cultural heritage that can be visualized.

Taking the digitization process of the Mogao Grottoes of Dunhuang as an example, in view of the irreversible decline of the Mogao Grottoes, the Dunhuang Research Institute has put forward the idea of "digital Dunhuang" since the late 1980s, making use of computer technology and digital image technology to permanently protect and utilize the Dunhuang grottoes. The large number of tourists to Mogao Grottoes places great demands on the protection of cultural heritage in the scenic area. The use of science and technology to make Dunhuang "live" and "go out" is the only way for the development of Dunhuang civilization. After more than 30 years of unremitting exploration and reform, the "digital Dunhuang" project has not only formed a scientific, complete, and systematic documentation of Dunhuang grottoes, but has also been applied in archaeological surveying, art copying, cultural relic protection, exhibition and display, and cultural promotion. The "Encounter Dunhuang - Light and Shadow Art Exhibition" held in Beijing (as shown in "Figure 1") utilizes 3D light carving digital technology, using 48 high-resolution projectors to condense Dunhuang's thousands of years of culture and art into a dazzling immersive space. The overall presentation of Dunhuang's unique features such as vermilion, stone blue, and stone green reflects the traditional aesthetic of color design in China. In addition to the visual experience, the music also uses classical instruments such as the konghou, drum, qin, etc. Through the deep experience of knowledge visualization, visitors can immerse themselves in various sensory experiences, pay attention to and understand Dunhuang in an immersive experience, and reproduce the artistic style of Dunhuang culture.

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4. Zhang Xiao, Xu Jiaqi, Wang Yihui, Research on Digital Activation of Shanxi Ancient Stage based on Knowledge Visualization [J]. Art and Design, 2022.



Figure 1 Encounter Dunhuang - Light and Shadow Art Exhibition.

For example, at the 2019 Beijing International Horticultural Exposition, the "Xianghe Yiju" digital experience space is the most eye-catching part of the China exhibition area, which has achieved remarkable results internationally. The "Xianghe Yiju" digital space strives to create literati gardens in the Song Dynasty and royal gardens in the Qing Dynasty, allowing visitors to immerse themselves in the spatial environment, understand the evolution of ancient Chinese humans and nature, and experience the ecological concept of thick wood bamboo dwelling and the garden style of palace gardens. (As shown in "Figure 2") The designers of "Xianghe Yiju" boldly adopted "gauze curtains" in the design of the space to create a feeling of entering the experience space. The transparent and ethereal artistic conception in Chinese painting is cleverly expressed through the gauze curtains, which is also the perfect combination of Chinese painting and landscape architecture art. In terms of content, it reproduces traditional cultural landscapes with modern techniques, making people enter the painting realm, and brings an immersive feeling that transcends time and space. In terms of technical expression, through innovation in traditional Chinese painting creation methods, the technology of digital 3D traditional Chinese painting has been improved. Through 3D modeling technology, high-resolution stereo projection technology, surround sound technology, and other technologies, visitors can feel the unique charm of Chinese painting and Chinese gardens in a 360° immersive space.

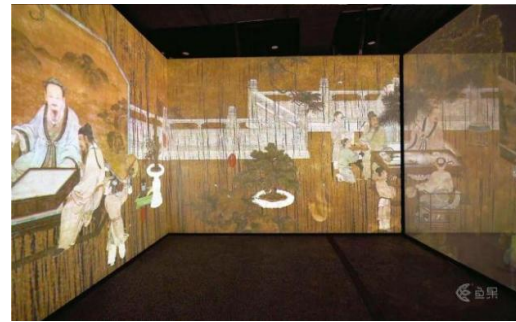


Figure 2 "Xianghe Yiju" in China Pavilion of Beijing International Horticultural Exposition.

The immersion of knowledge visualization is beneficial for people to efficiently and proactively understand the knowledge itself, fully understand the immersion of knowledge visualization, and apply it reasonably, which is greatly helpful for the dissemination of intangible cultural heritage.

### 3.2 Innovation in Interactive Design

Early interactive technologies mainly utilized human-computer interaction between software and screens to achieve digital display of intangible cultural heritage, such as images, videos, and text display. This display method had low technical requirements. With the continuous progress of science and technology, the performance of various pressure, temperature, sound, and tactile sensors continued to improve, some new interactive methods were constantly developed, such as virtual reality (VR) and augmented reality (AR). By simulating the visual, auditory, and tactile aspects of virtual space through computer simulation or applying virtual information to the real world, the authenticity of digital information is enhanced with high fidelity.<sup>5</sup>

For example, the Museum of Intangible Cultural Heritage in Haishu District in Ningbo is located in Chenghuang Temple, Ningbo, and consists of four parts: "Haishu Intangible Cultural Heritage Digital Scroll", "Benevolence of Doctors", "Food for Health", and "Wisdom of Technology". In the human-computer interactive experience environment, the integration of display and digital information has added a new wing of "technology + art" to the intangible cultural heritage museum. Through the projection of digital scroll and holographic screen, people can better understand

5. Ju Huaqian, Peng Wenli, Research on the Application of Digital Technology in the Protection of Intangible Cultural Heritage: Taking Foshan Woodcut New Year Pictures as an Example [J]. Hunan Packaging, 2021 (04).

the production process of rice dumpling in Ningbo and the weaving skills of Huanggulin straw mat. The unique atmosphere of the entire space creates a "gravity free" world that roams in the world of human creation. This novel experience blurs the boundary between reality and virtuality, revitalizing the previously monotonous intangible cultural heritage content with scientific packaging and rendering. (As shown in "Figure 3" and "Figure 4") In today's historical development, due to the departure of the inheritors of traditional intangible cultural heritage techniques, traditional intangible cultural heritage techniques have gradually been replaced by factory assembly lines, and these traditional techniques have gradually declined and even disappeared. The ultimate goal of reviving intangible cultural heritage is to pass down culture. The perfect combination of this new technology and intangible cultural heritage not only breaks the traditional way of artistic expression, but also creates a sustainable development opportunity for intangible cultural heritage. This technology uses computer 3D models to create a more realistic interactive experience, immersing the audience in it, bringing joy to the public's soul, collision of thinking, and aesthetic innovation. Through the combination of multiple interactive technologies, the visual effects of intangible cultural and artistic design have been strengthened, creating a brand new interactive experience.<sup>6</sup>



Figure 3 Ningbo Chenghuang Temple: Food for Health.



Figure 4 Ningbo Chenghuang Temple: Food for Health.

### 3.3 The Openness of Digitalized Display

In the current society, disruptive digital technologies such as AI, big data, and 5G are constantly emerging. For many emerging industries, cross-border competitors are constantly emerging, especially for intangible cultural heritage that is already on the brink of extinction. The inheritance of this traditional skill is often passively eliminated by the times. The original responsibility of the intangible cultural heritage is to provide spiritual entertainment, such as opera, or to guide court etiquette, such as Beijing embroidery. Nowadays, the main responsibility of intangible cultural heritage such as traditional Chinese opera and Beijing embroidery is to become a part of culture. There is a great responsibility to record history and promote the Chinese spirit. The new responsibilities of this new era need to be carried out in a way that adapts to the times. Only by maintaining an open mindset and not forgetting innovation while maintaining integrity can we truly improve. The digitization of intangible cultural heritage is precisely an innovation that is very adaptable to the times. Taking Dunhuang Cultural and Creative as an example, the "Tour Dunhuang in Cloud" mini program developed and launched during the 2020 epidemic has so far attracted nearly 40 million users to browse Dunhuang online. The "digital Dunhuang" resource library, which shares high-definition images of 30 caves worldwide, currently has over 10 million views. (As shown in "Figure 5")

6. Liu Xiaoqian, Li Ximing, He Renke, Digital Inheritance and Innovation of Intangible Cultural Heritage from the Perspective of Interactive Virtual Reality Technology [J]. Art Work, 2022.



Figure 5 "Tour Dunhuang in Cloud" mini program.

With the development of digital cultural relics, the Dunhuang Research Institute has organized 38 exhibitions, including the "Dunhuang Stone Carvings Exhibition" and the "Mogao Spirit". Two of them were listed as "Cultural Exchange on the Silk Road - Tibetan Era Fine Arts Exhibition" and won the "World and Hong Kong-Macao-Taiwan Cooperation Works Award". Dunhuang Research Institute has successively released digital media products such as "Dunhuang Seasons Order", "Words in Dunhuang", and "One Thing, One Life, One Person, One Cave". By 2020, the number of tourists has reached 235 million, with tourists spread across 120 different countries. Through the openness of digital display, the dissemination of intangible cultural heritage has a broader prospect.

#### 4. DESIGN PRACTICE OF INTERACTIVE GAME "DRAMA RHYME BEIJING EMBROIDERY"

This chapter is the design practice of the interactive game "Drama Rhyme Beijing Embroidery".

##### 4.1 Technical Process and Framework Design

The principles and contents of interaction design are different in different fields. To combine the promotion of Beijing embroidery with digital interactive design, the first step is to analyze its feasibility.

It can be roughly divided into two steps: the first is to identify user needs. It can be found that children aged 6 to 8 feel a sense of responsibility to inherit national culture during the learning process. However, the traditional expression of Beijing embroidery culture is not easy for children of that age group to understand, and its content can be relatively dull, causing children to lose interest. And a digital interactive Beijing embroidery themed game can well meet this demand. The second is to have a reasonable design plan, referring to the mini game "Emperor's Day" released by the Forbidden City, which showcases the design process of Beijing embroidery in a more cartoonish children's hand drawn style. Through logical scene switching, players can better participate, reduce the threshold for knowledge dissemination, and also increase fun. Considering the focus and understanding of children of this age group, the author has organized the production steps of Beijing embroidery and redesigned it into different categories. Referring to the documentary of Beijing embroidery, the production process of Beijing embroidery is depicted in a way that is easier for children to understand, and written explanations are provided. The painting style in the game combines the traditional pattern of Beijing embroidery with the modern China-Chic painting style, and at the same time adds opera elements, giving people a rich visual experience. The game is equipped with game functions such as coloring and puzzles, which not only deepens children's impression of Beijing embroidery, but also improves their hands-on skills and learning and thinking abilities. In addition to popularizing traditional culture, it can also increase the fun of games.

This work first uses mind maps to create a framework flowchart, followed by the use of create and Photoshop for element and page drawing and layout, and finally uses Adobe effect for interactive dynamic design. The work "Drama Rhyme Beijing Embroidery" is a popular science interactive game, with its main structure (as shown in "Figure 6") divided into four parts: map, game center, knowledge manual, and personal center. The map is a place for players to explore the production process of Beijing embroidery, as the audience is young children, so every step will have prompts and icons. The mini games in the game center will be unlocked during the process of exploring the production steps of Beijing embroidery. The purpose of setting these mini games is to help children better understand the intangible cultural

heritage of Beijing embroidery, and to exercise their hands-on skills and brain development. The knowledge manual provides a specific classification of Beijing embroidery and a detailed introduction.

The advantage of doing so is that parents of children can also have a more direct understanding of Beijing embroidery culture.

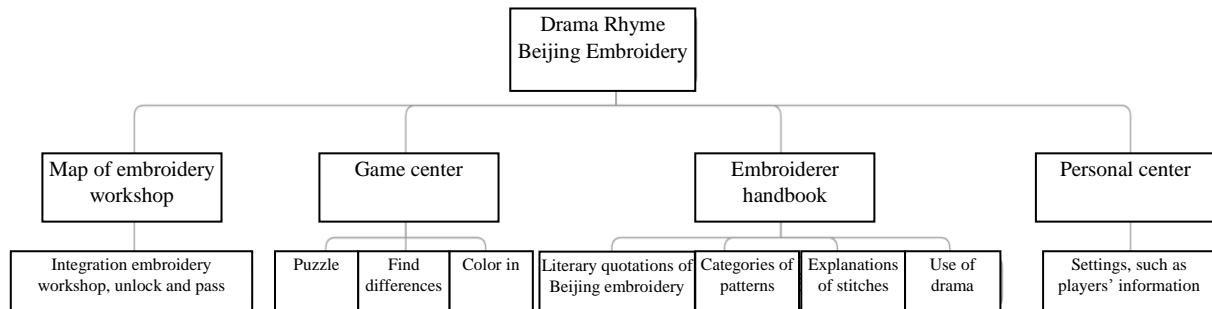


Figure 6 Flow diagram of the game “Drama Rhyme Beijing Embroidery”.

In the work "Drama Rhyme Beijing Embroidery", the steps of Beijing embroidery are presented with vivid game plots, and the ultimate goal of the game is to rush to make costumes to celebrate the Empress Dowager's birthday. Allowing children to engage in purposeful games is beneficial for them to understand the complete production process of Beijing embroidery, understand Beijing embroidery culture, generate some interest, and promote the dissemination of traditional culture.

#### 4.2 Extraction and Application of Beijing Embroidery Colors

In traditional Beijing embroidery patterns, the use of color is very particular. In the Qing Dynasty's "Draft of the History of the Qing Dynasty" and other regulations, there were extremely strict regulations for the use of different colors. For example, the emperor's "court uniform, the color is bright yellow, only blue is used for worship of the sky, red is used for the morning sun, and white is used for the night noon". In addition, Beijing embroidery has always had the traditional coloring concept and color application standards of "yellow is the right, red is the joy, blue is precious, black is mysterious, and white is plain".<sup>7</sup> The "Drama Rhyme Beijing Embroidery" extracts the traditional colors of Beijing embroidery as the main color expression, using the "fading" method in Beijing embroidery. This "fading" method mainly focuses on gradient colors, leaving a gap at the intersection of each color. When the colors are arranged in a certain order of brightness and

darkness, the halo not only gives the entire picture a clear sense of rhythm, but also creates a harmonious aesthetic feeling. The color design of "Drama Rhyme Beijing Embroidery" (as shown in "Figure 7") not only draws on the color patterns and color matching relationships of ancient people, but also takes into account the color psychology and preferences of children aged 6-8. The development of visual ability and observation ability of children in this age group has begun to clarify the differences in color clarity. For example, the concept of red is no longer just about red, but rather establishes different color concepts such as deep red, bright red, and pink, enabling them to better understand colors and color differences. So the color design in this game is also quite rich, but it also includes gradients, which can ultimately achieve a harmonious state of the screen. (As shown in "Figure 8")



Figure 7 Color design of “Drama Rhyme Beijing Embroidery”.

7. Cui Wei, Xiao Bin, Qiang Kai, Embroidering Colorful Jinghua: A Study on the Aesthetic Characteristics of Traditional Jingxiu Coloring [J]. Aesthetic Education, 2020 (01).



Figure 8 Page color design of "Drama Rhyme Beijing Embroidery".

### 4.3 Innovation in the Ideographic Representation of Patterns

The pattern design of Beijing embroidery emphasizes decoration and rigorous structure, while the patterns of Beijing embroidery emphasize stylization and rich meanings. Beijing embroidery products emphasize "the design must be intentional, and the pattern must be auspicious". For example, peonies convey meanings such as wealth and beauty, while passionflowers and lilies are often used to symbolize happiness and good luck, and the themes of flowers, birds, fish, and insects, such as phoenix, crane, magpie, and butterfly, are commonly used to symbolize good wishes. The patterns of Beijing embroidery are very exquisite and complex. Considering that the audience of this work is children aged 6-8, it is difficult to understand such complex patterns. Therefore, the author has simplified and redesigned these patterns and patterns in her work. (As shown in "Figure 9") In terms of pattern selection, animal patterns and floral patterns that children prefer were selected, such as the interesting bat pattern. Due to the homophonic relationship between "蝠 (fú bat)" and "福 (fú blessing)", people associate bats with the character "福", and therefore, bats are considered a symbol of happiness. This design can also help children understand some traditional Chinese cultural knowledge. After some investigation and research, it was found that they have a preference for rounded patterns. Therefore, the author simplified and rounded the complex patterns and patterns, while adding annotations, so that children can better understand the meaning of Beijing embroidery patterns. And these patterns and patterns are also used in every corner of "Drama Rhyme Beijing Embroidery". This not only makes the picture more rich and vivid, but also allows children to better understand the beauty of Beijing embroidery.

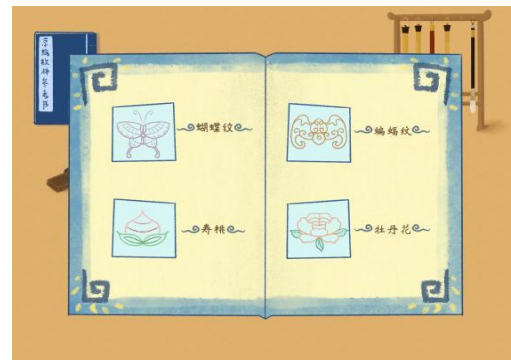


Figure 9 Pattern design of "Drama Rhyme Beijing Embroidery".

## 5. CONCLUSION

Intangible cultural heritage, as a valuable cultural resource, has great significance for the study of Chinese history and culture. From the popularity of cultural and creative works in the Forbidden City in China to the popularity of Han Chinese clothing on the streets, the Internet has made people more closely connected with traditional culture. Traditional skills can no longer just stay in their original form. Integrating traditional intangible cultural heritage into science popularization interactive games not only realizes the digital inheritance of traditional culture, but also enriches the application practice of integrating traditional design elements into modern design. In order to better promote and inherit intangible cultural heritage such as Beijing embroidery, it is necessary to combine it with contemporary aesthetics, science and technology, while retaining its own cultural individuality and spreading it in a new form. The design practice of this article is an innovative combination of traditional intangible cultural heritage handicraft culture and children's interactive games. Through interactive learning through games, the production process of Beijing embroidery and the traditional Chinese culture contained therein can be disseminated. Cooperating with rich colors and cartoon patterns, it can convey



the artistic and cultural significance contained in this craft to children, which will be able to let children learn about the meanings of traditional patterns, traditional opera art, and other knowledge during the happy game process, making games a carrier for spreading traditional culture. In addition, there is a combination of traditional and modern elements in the game, crossing the boundary between ancient and modern times. In the new era, appropriate changes are needed to adapt to the needs of the times. It not only attracts children to engage in interactive learning during the game process, but also stimulates children's interest in history and culture. Through this form of game, it deepens people's impression of traditional culture. It is hoped that through this interactive learning approach, more people can pay attention to and understand traditional intangible cultural heritage.

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