Research on Ecological Innovation and Modern Informatization Inheritance Path of Tantou Woodblock Printing

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Abstract

Tantou woodblock prints are traditional Chinese woodblock prints with a long history. Adding modern information technology elements to the excellent traditional culture can better combine regional contemporary woodblock prints and realize the cultural heritage. In this paper, from the perspective of modern informatization inheritance, we propose a way of displaying Tantou woodblock prints with AR enhancement technology, which breaks the limitation of physical experience with the help of virtual technology and improves the immersive experience of Tantou woodblock prints by combining with visual SLAM spatial localization technology. Based on the KANO model, the inheritance effect of Tantou woodblock prints was empirically analyzed. The data of Q, A, I, R, M, and O of the satisfaction results of the experience effect of Tantou woodblock prints were 1.132, 3.034, 2.828, 1.422, 1.237, and 0.978, which belonged to the excitatory type of demand. The inheritance satisfaction could be improved by enhancing the natural experience effect. The percentage of experiencers’ satisfaction with the information acquisition rate of Tantou Wooden Plank New Year’s Paintings that reaches excellent and above is 82.35%, and this paper effectively captures the user’s experience point in the visual, which contributes to the inheritance of Tantou Wooden Plank New Year’s Paintings.

Keywords: AR augmentation technology; Visual SLAM space; KANO model; Virtual display; Informational heritage.

AMS 2010 codes: 97P10
1 Introduction

Tantou New Year Painting is the only woodblock watermarked New Year painting in Hunan province, which is known as “one of the best folk art in China” for its bright and moist colors, ancient and exaggerated shapes, pure and natural local materials, and traditional and unique production technology, and was listed in the first batch of national intangible cultural heritages in 2006 [1-3].

Tantou woodblock prints are a cultural heritage with the characteristics of Hunan and belong to the national intangible cultural heritage. Due to the destruction of the intangible cultural heritage during the Cultural Revolution and the fact that the artists are generally old and have no successors, this precious human heritage will face complete disappearance [4-5]. Studying the history and examining the tradition of Tantou woodblock prints is undoubtedly a way to pass on the culture, but what is more important is how to reasonably protect and systematically excavate the historical, cultural, scientific, and artistic values behind Tantou woodblock prints [6]. Based on the maturity of photographic technology, it can realize the comprehensive acquisition and organization of the information of Tantou woodblock prints, provide accurate digital materials for its information sharing, protection and restoration, academic research, visiting and appreciation, development and utilization, etc., so as to achieve the digital security of Tantou woodblock prints [7-8].

In terms of intangible cultural heritage preservation, digital preservation provides us with a brand-new platform. Therefore, we should make good use of new technologies and concepts, so that the essence of the intangible cultural heritage of humanity can be continued, the value can be enhanced, and the culture can be disseminated. Chen, W. H elaborated that woodcuts were often used to record the shape of plants and disseminate knowledge and insights about botany during the Renaissance period [9]. Kim, J. et al. analyzed the Buddhist cultural and creative products of woodcuts and believed that the woodcuts played a significant role in the dissemination and inheritance of Buddhist culture. Buddhist cultural and creative products have played a significant role in the dissemination and transmission of Buddhist culture, and people often use such cultural and innovative products for praying for blessings and blessings, etc. [10]. Jones et al. studied the works of Kent woodcut style, which are full of nostalgia for non-industrialized labor and political uneasiness [11]. Motivation and sense of responsibility, indicating that residents’ cultural identity and value orientation significantly influence residents’ motivation and sense of responsibility to protect cultural heritage [12]. Gomez-Oljiva, A. et al. conceptualized an innovative and progressive WEB application to realize the publicity and promotion of NRM tourism and verified the validity and scientificity of the tool after an example study. The tool has been validated as practical and scientific, providing tourists with a window to understand NRM and stimulating their interest in field trips and NRM [13]. Lin, Q. et al. explored the awareness and protection of intellectual property rights of NRM in China and gave constructive suggestions, including the protection of NRM copyrights, patents, trademarks, and geographic locations [14]. Tzima, S. et al. discussed digital storytelling to explain and publicize cultural heritage stories and features and considered it a form of digital storytelling to promote NRM. Tzima, S. et al. discuss the use of digital storytelling to tell the stories and characteristics of cultural heritage as an effective and low-cost way to promote and transmit cultural heritage [15]. Bauelos, J. K. et al. emphasize the importance of the scientific management of information in the process of restoration and preservation of cultural and tangible heritage and point out, in a study of a wine culture region, that the interactivity and outreach of information management solutions for the preservation of tangible cultural heritage need to be optimized and improved [16]. Westmoreland, C pointed out that the digitization of tribal cultural heritage by museums violated the integrity and sanctity of tribal cultural heritage and argued that the congressional agencies have to fulfill their obligations and make sure that protective measures are implemented to ensure the integrity of tribal cultural heritage and their cultural property [17].
The expression of Tantou woodblock New Year’s Paintings consists of three aspects: composition, color, and symbolic elements, and this paper takes color as the primary research direction and integrates modern information technology to digitally display Tantou woodblock New Year’s Paintings. Using AR enhancement technology and contemporary information technology for image recognition, a three-dimensional model of Tantou woodblock prints was created. Using the SIFT algorithm, the somatic points in the image are extracted to obtain the transformation space necessary to implement the technique. To enhance the execution speed of the algorithm, an improvement in SIFT is proposed to achieve optimal spatial localization for visual SLAM. Using the method of empirical analysis, the analysis is carried out from two aspects: the color performance characteristics of Tantou woodblock prints and the inheritance effect. Based on the analysis results, the optimization path for the dissemination of Tantou woodblock New Year’s paintings’ inheritance is proposed.

2 Innovative display of Tantou woodblock prints under modern information technology

2.1 Digital Display and Interaction of Tantou Wooden Plank New Year Paintings

2.1.1 Forms of Expression of Tantou Wooden Board New Year’s Paintings

1) Composition

Tantou woodblock prints have a lot of similarities and differences with modern decorative paintings in terms of composition, and the content of the picture is handled in the form of line modeling, hand-painted from the side of the human and physical characteristics, with the characteristics of ancient and straightforward performance. Its composition also follows the principle of scattered perspective in traditional Chinese painting techniques, and there are often multiple focusing points of view on a picture, which makes the New Year paintings richer in terms of the overall picture level and also expands the space to be expressed. Tantou New Year paintings tend to use left-right symmetry, a combination of sizes, and lateral expression depending on the subject matter.

2) Color

Hunan and Chu people have distinct ways of using colors in their art paintings. Tantou Wooden New Year Paintings are both uniform and harmonious without sacrificing their liveliness. To a certain extent, colors can reflect people’s character traits. The colors used in Tantou woodblock prints are bold and bright. The Chu people’s straightforward and enthusiastic character is matched by their visual impact, which is both bright but not vulgar. The primary colors used in these paintings are often based on the “five colors,” which usually refer to the five colors of the five elements of nature: green, red, yellow, white, and black, with red as the main color scheme.

3) Symbolic elements

Different from the rough and bold painting expression on the surface of Tantou New Year’s Paintings, under the seemingly heavy artistic presentation, there is actually a mixture of many profound traditional cultural elements. It is by processing these conventional cultural elements in the form of abstract symbolization and integrating them into the paintings that a seemingly simple Tantou New Year’s Painting shows rich connotation and cultural and artistic value.
2.1.2 Theoretical foundations of digital presentation

Along with the development of the economy, the public’s demand for woodblock prints has gradually increased. As a theory of analyzing games, MDA theory connects game design, game analysis, and game technology research. By establishing a unified and common standard for game design analysis and research, the theory can enable different participants to interact more clearly and efficiently. Similarly, the MDA theory can be applied to woodblock prints for study and research. Figure 1 shows the analysis of the relationship between culture and creativity of the MDA theory, which can expand the product function of woodblock prints through the underlying mechanism, expand the interaction mode of woodblock prints through the dynamic gameplay, and extend the product function of woodblock prints through the aesthetic model. The aesthetic model can be extended to enhance the product appearance of woodblock New Year’s paintings as follows:

![Diagram](image)

Figure 1. MDA theoretical cultural and creative product analysis diagram

2.1.3 KANO model fundamentals

The Kano model divides product demand attributes into five categories based on the relationship between the product’s functional performance and the user’s subjective perception: i.e., Basic demand, charismatic demand, aspirational demand, undifferentiated demand, and reverse demand.

1) Basic demand

At the basic level, the function must be provided by the product, and at the user level, it is the function that the user believes should exist. When this requirement is provided to the user, their satisfaction does not increase. However, when this requirement is not met, the user’s dissatisfaction rises dramatically. This type of demand is not visible to the user.

2) Desired needs
The user’s satisfaction is directly linked to the degree of realization of the desired demand. The more such demands are provided and the higher the degree of realization is, the higher the user’s satisfaction will increase. Conversely, when the product fails to satisfy such demands, the higher the user’s negative emotion will be.

3) Charming needs

Charming demand refers to functions beyond the user’s expectations. This kind of demand usually surprises the user and is the critical factor for the product to maintain its core competitiveness. When a product meets this requirement, user satisfaction will increase dramatically. However, if the product does not meet this requirement, users will not experience negative emotions.

4) Reverse Needs

Reverse requirements are requirements that users do not need or are resistant to, also known as reverse requirements. The more requirements are met, the more dissatisfied the user will be, and it is essential to avoid them in the planning and design of the product as much as possible.

The results obtained from the questionnaire were statistically analyzed against the KANO Quality Type Evaluation Scale to categorize the categories of each quality characteristic. For example, if the positive response to a need is delighted and the negative response is deserved, the quality characteristic is a type A need, i.e., charismatic. Each demand attribute is represented by letters, “M” stands for primary demand, “O” stands for expected demand, “A” stands for charismatic demand, “I” stands for undifferentiated demand, “R” stands for reverse demand, and “Q” stands for doubtful results and invalid data. The Kano quality-type evaluation table can be found in Table 1.

Table 1. KANO quality type evaluation Form

<table>
<thead>
<tr>
<th>Demand satisfaction</th>
<th>Do not have</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To feel quite pleased</td>
</tr>
<tr>
<td>Possess</td>
<td></td>
</tr>
<tr>
<td>To feel quite pleased</td>
<td>Q</td>
</tr>
<tr>
<td>Well-regulated</td>
<td>R</td>
</tr>
<tr>
<td>Cannot be designated as</td>
<td>R</td>
</tr>
<tr>
<td>Unswervingly accept</td>
<td>R</td>
</tr>
<tr>
<td>Far from gruntled</td>
<td>R</td>
</tr>
</tbody>
</table>

The formula for calculating the coefficient of satisfaction and the coefficient of dissatisfaction is as follows:

Better = \( (A + O) / (A + O + M + I) \)  
Worse = \(-1(M + O) / (A + O + M + I)\)  

2.1.4 Satisfaction with Demand for Beachwood Plank New Year’s Paintings

In order to improve the user demand satisfaction of the virtual display of Tantou woodblock prints, the following indexes are analyzed for demand satisfaction: A1 for the display of the artistic elements contained in the ecological innovation of Tantou woodblock prints, B1 for the display of the prints, B2 for the sharing of the prints, B3 for the collection of the prints, B4 for the search of the prints, C1 for the introduction of the place of origin of the paintings, C2 for the subject matter of
the paintings, C3 for the production process of the paintings, C4 for the history of the development of the inheritance, C5 for the customs of the industry, D1 for the AR display of the paintings, D2 for the search query function, E2 for the natural experience effect. C4 is the history of Chinese New Year paintings, C5 is the custom of the Chinese New Year paintings industry, D1 is the AR display of Tantou Wooden New Year Paintings, D2 is the purchase of Chinese New Year Paintings, E1 is the function of Chinese New Year Paintings searching query, and E2 is the effect of experience.

E1 and E2 are analyzed below.

Table 2 shows the KANO data table for the New Year painting search query function, (suspicious demand) Q=0.908, (excited demand) A=2.204, (undifferentiated demand) I=3.626, (reverse demand) R=1.546, (essential demand) M=1.404, (expected demand) O=0.796. According to the principle of the KANO model, the function attribute is the most significant when all the attributes are added up. According to the principle of the KANO model, when each attribute is added up, the maximum attribute is the function’s attribute. From the above, it can be concluded that the search query function for Tantou Wooden Plank New Year Paintings belongs to the non-differentiated demand. That is, the user search query function for Tantou Wooden Plank New Year Paintings cannot affect the user’s experience if the function is fulfilled or not fulfilled.

Table 2. New Year picture search query function KANO data table

<table>
<thead>
<tr>
<th>Demand satisfaction</th>
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<tbody>
<tr>
<td>Possess</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>To feel quite pleased</td>
<td>0.563</td>
<td>0.597</td>
<td>0.845</td>
<td>0.762</td>
<td>0.796</td>
<td></td>
</tr>
<tr>
<td>Well-regulated</td>
<td>0.165</td>
<td>0.236</td>
<td>0.478</td>
<td>0.365</td>
<td>0.463</td>
<td></td>
</tr>
<tr>
<td>Cannot be designated as</td>
<td>0.321</td>
<td>0.365</td>
<td>0.678</td>
<td>0.496</td>
<td>0.563</td>
<td></td>
</tr>
<tr>
<td>Unswervingly accept</td>
<td>0.136</td>
<td>0.198</td>
<td>0.463</td>
<td>0.347</td>
<td>0.378</td>
<td></td>
</tr>
<tr>
<td>Far from gruntled</td>
<td>0.096</td>
<td>0.163</td>
<td>0.396</td>
<td>0.269</td>
<td>0.345</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows the natural experience effect. The calculation can be obtained Q, A, I, R, M, and O data are 1.132, 3.034, 2.828, 1.422, 1.237, and 0.978. According to the principle of the KANO model, the above can be obtained for the experience of the effect of the Beachwood New Year’s Paintings function belongs to the excitement type of demand when the use of the AR display can be satisfied with the natural effect of the experience, the user satisfaction significantly increased. User satisfaction has obviously increased.

Table 3. Real experience effect

<table>
<thead>
<tr>
<th>Demand satisfaction</th>
<th>Do not have</th>
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<th>Well-regulated</th>
<th>Cannot be designated as</th>
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<tbody>
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<td>Possess</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>To feel quite pleased</td>
<td>0.798</td>
<td>0.763</td>
<td>0.945</td>
<td>1.326</td>
<td>0.978</td>
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</tr>
<tr>
<td>Well-regulated</td>
<td>0.235</td>
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</tr>
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<td>0.198</td>
<td>0.139</td>
<td>0.267</td>
<td>0.063</td>
<td>0.378</td>
<td></td>
</tr>
<tr>
<td>Far from gruntled</td>
<td>0.069</td>
<td>0.067</td>
<td>0.367</td>
<td>0.323</td>
<td>0.334</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2 shows the Better-Worse analysis of 14 indicators. By analyzing the better-worse coefficients of each demand, the results of the study are imported into the quadrant diagram to form
the demand scatter diagram. Where the absolute value of worse is the horizontal coordinate and the value of better is the vertical coordinate, the mean of the absolute values of the satisfaction coefficient and the dissatisfaction coefficient is used as the critical line to split the demand quadrants. Quadrant 1 is the expectation type of demand. The fulfillment of this type of demand will increase the participants’ satisfaction with the inheritance of Tantou Wooden Plank New Year’s Paintings. The non-fulfillment of it will also increase the participants’ dissatisfaction. The number of this quadrant is 4, which are A1, B3, B4, and C4. Among them, B3 (collection of New Year paintings) has the highest WORSE coefficient. The value of New Year paintings should be reflected in the display to enhance participants’ satisfaction. The second quadrant is the excitatory need, and this quadrant has the highest number of 5. Fulfilling this need is efficacious in improving participants’ satisfaction, as indicated by C5’s highest BETTER coefficient of 0.698.

![Figure 2. A better-word analysis of 14 indicators](image)

2.2 Digital display of Tantou woodblock prints based on AR enhancement technology

In the implementation of the augmented reality module of the Tantou Wooden Plank New Year Paintings AR application, the immersive interactive experience of the Tantou Wooden Plank New Year Paintings is deepened by the new functions of AR technology such as picture recognition and SLAM spatial recognition and localization. According to the video recognition technology, it means that after recognizing the plane graphics through or using the video function of the mobile terminal, the model of the Tan Tou New Year’s Paintings is directly presented on the cell phone’s display for the user to view in the vicinity. According to the SLAM spatial localization technology, it means that after using the cell phone to recognize and measure the location of the physical surroundings, the model of Tan Tou Wooden Plank New Year’s Paintings is placed in the plane of the surroundings. Then, the user can touch the cell phone screen through gestures. Can interact with the model by touching the cell phone screen using gestures. Specific functions generally refer to the development, including the manufacturing of the Nantou Wooden New Year Paintings 3D model and the drawing of material stickers, the manufacturing of video clips, the construction of the virtual environment on the Unity platform, the design of AR recognition graphic products, the development of AR technology products, the design of interactive functions and the writing of the program, debugging, and the summary of the data, and the final launch of the project.
2.2.1 AR-enhanced technology

AR technology, a technology that skillfully integrates virtual information with the real world, is widely used in multimedia, intelligent interaction, sensing, and other technological means to apply computer-generated virtual information such as text, images, and other virtual information to the real world after simulation.

2.2.2 Image Recognition

The AR function of this project is realized on the Unity platform through the construction of the virtual environment until debugging parameter modification, and so on. The three-dimensional modeling design of the Tantou woodblock New Year’s Paintings, the material texture rendering, and the video footage were all created by ourselves during the early stage. The virtual presentation of the Tantou Wooden New Year’s Paintings model is mainly run on the Unity platform.

2.2.3 Visual SLAM-based spatial localization

The SIFT algorithm applies the method of cascade filtering to the extraction of feature points. The SIFT algorithm solves the camera in the process of movement. The location of objects in the scene, as well as the size of the scene, will change with the change of the camera’s viewpoint. At the same time, the SIFT uses a continuous scale transform space and the search for stable features to determine the location of those in the image that do not change with rotation. The Gaussian function may be the only scale transformation space that meets these conditions if multiple premise assumptions are relatively reasonable, according to related scholars.

Assuming that the variable scale Gaussian equation is: \( G(x, y, \delta) \), the image equation is: \( I(x, y) \), and the scale-transformed space equation of the image is: \( S(x, y, \delta) \), then \( S(x, y, \delta) \) can be represented by the convolution of the variable scale Gaussian equation and the image equation as shown in the following equation, where is the sign of the operation of the convolution:

\[
S(x, y, \delta) = G(x, y, \delta) * I(x, y)
\]  (3)

Gaussian equations with variable scale:

\[
G(x, y, \delta) = \frac{1}{2\pi\delta^2} e^{-(x^2+y^2)/2\delta^2}
\]  (4)

Lowe, the proposer of the SIFT algorithm, breaks it down into four steps:

1) Detect the specific location of the feature point. Firstly, the difference of neighboring scales in the Gaussian difference function is used to calculate the scale transformation space. Then, the corresponding extreme values in the scale transformation space are used to detect the position of the stable critical points in the image. Let the Gaussian difference function scale space that needs to be constructed is: \( H(x, y, \delta) \), which is constructed by calculating the difference factor \( k \) of the neighboring scales. Then, the Gaussian beauty function scale space is expressed by the following equation:

\[
H(x, y, \delta) = (G(x, y, k\delta) - G(x, y, \delta) * I(x, y)) = S(x, y, k\delta) - S(x, y, \delta)
\]  (5)
\( \delta^2 \nabla^2 G \) is the Gaussian difference function scale space \( H(x, y, \delta) \) scale normalized to the Gaussian Laplace approximation. The relationship between \( H(x, y, \delta) \) and \( \delta^2 \nabla^2 G \) is given by the following equation:

\[
\frac{\partial G}{\partial \delta} = \delta \nabla^2 G
\]

(6)

It follows that a finite difference approximation of \( \partial G / \partial \delta \) yields \( \nabla^2 G \), and then \( \delta \nabla^2 G \) can be approximated as the following equation:

\[
\delta \nabla^2 G = \frac{\partial G}{\partial \delta} \approx \frac{G(x, y, k\delta) - G(x, y, \delta)}{k\delta - \delta}
\]

(7)

Finally, the following equation is obtained:

\[
G(x, y, k\delta) - G(x, y, \delta) \approx (k - 1)\delta^2 \nabla^2 G
\]

(8)

Where \((k - 1)\) is a constant and has no effect on the detection of scale-transformed spatial extremes, and \( k \) is generally taken as \( \sqrt{2} \).

2) Determine the location of critical points. Comparing the information of the adjacent pixels of the image can extract the candidate key point. The location and scale of the candidate key point can be obtained by fitting a quadratic function based on the nearby adjacent data. On this basis, excluding specific low-contrast points and points with unstable edges, the scale and location near the central sample point are determined. Finally, the maximum insertion location is located by fitting the sample point and the ternary quadratic function. Below, you can see the specific process:

Do a Taylor expansion of \( H(x, y, \delta) \):

\[
H(x) = H + \frac{\partial H^T}{\partial x} x + \frac{1}{2} x^T \frac{\partial^2 H}{\partial x^2} x
\]

(9)

Let \( H'(x) \) of the derivative of \( H(x) \) be 0 to obtain the position of the extremum \( \hat{x} \), where \( x = (x, y, \delta)^T \), as shown in the following equation:

\[
\hat{x} = -\frac{\partial H^T}{\partial x} \left( \frac{\partial^2 H}{\partial x^2} \right)^{-1}
\]

(10)

Bringing Eq. (8) into Eq. (7) yields the following equation:

\[
H(\hat{x}) = H + \frac{1}{2} \frac{\partial H^T}{\partial \hat{x}} \hat{x}
\]

(11)

The criterion for candidate extreme points to be sensitive to noise is \( |H(\hat{x})| \leq 0.03 \). These candidate points become unstable due to noise and are eliminated.
3) Determination of keypoint orientation and magnitude. Usually, each filtered key point has its direction, i.e., the direction of the critical point descriptor, on which the rotational invariance of the image is based, is the direction of the critical point descriptor. The following introduces an algorithm with better results, firstly, the image content includes: scale space is denoted as $S(x, y)$, gradient magnitude is denoted as $m(x, y)$, and gradient direction is denoted as $\theta(x, y)$. Then $3 \times 1.5 \times \delta$ is used as the size of the window between neighborhoods, and finally all the candidate keypoints within the window that meet the requirements are captured and the gradient magnitude and gradient direction of these candidate key points are computed, and the results are shown in Eqs. (12), (13) respectively:

Gradient magnitude:

$$m(x, y) = \sqrt{(S(x+1, y) - S(x-1, y))^2 + (S(x, y+1) - S(x, y-1))^2}$$ (12)

Gradient direction:

$$\theta(x, y) = \tan^{-1} \left( \frac{S(x, y+1) - S(x, y-1)}{S(x+1, y) - S(x-1, y)} \right)$$ (13)

4) Calculate descriptors. The calculation of the descriptor is the process of establishing the feature vector of the feature point, and the feature vector of each key point is 128 dimensions. The specific content includes: each key point is divided into $4 \times 4$, a total of 16 sub-points to describe, and each sub-point contains the relevant information of 8 direction vectors so that 128 data are generated.

The execution speed of the SURF algorithm is about 3 times that of the SIFT algorithm, which is an optimized algorithm of SIFT and also a robust algorithm for local feature point extraction and analysis and description, which specifically includes the following steps:

5) Detecting feature points. In the SURF algorithm, the response of the Hessian approximation matrix is utilized to measure whether a point is a feature point or not, for a point $x = (x, y)$ in the image $I$, as in the following equation (14), $H(x, \delta)$ denotes the Hessian matrix of the point $x = (x, y)$ under the scale factor $\delta$:

$$H(x, \delta) = \begin{bmatrix} L_{xx}(x, \delta)L_{xy}(x, \delta) \\ L_{yx}(x, \delta)L_{yy}(x, \delta) \end{bmatrix}$$ (14)

The determinant $\det(H_{app})$ corresponding to the approximation of the Hessian matrix is approximated by using $C_{xx}, C_{xy}, C_{yy}$ to represent the convolution obtained from the approximation filter computation, where $j$ is a tuning parameter, which is related to the scale factor $\delta$, and the following equation shows the specific computation formula:

$$\det(H_{app}) = C_{xx}C_{yy} - \left(jC_{xy}\right)^2$$ (15)
3 Analysis of the Color Performance and Inheritance Effect of Tantou Wooden Board New Year’s Paintings

3.1 Characteristic Analysis of Color Expression in Tantou Woodblock Prints

Tantou woodblock prints were chosen and applied to 15 different design frames using three commonly used color expressions. 3 inheritors of Tantou woodblock prints, 12 design teachers, 13 students, and 23 people from various industries, a total of 51 people, were invited to evaluate the effect of innovative color expressions of Tantou woodblock prints. The direct assessment method was adopted to assess the overall impact, color control, and expressiveness, and the evaluation threshold was divided into five grades, namely, very satisfactory, more satisfactory, average effect, poor effect, and inferior effect. The score is 5~1. In this experiment, a pair of New Year’s painting images need to go through three different dataset models, and firstly, the collected images of original ink line drafts of New Year’s paintings are inputted into the initial dataset model that has been trained in advance. Figure 3 shows the evaluation results of the three color performances. Figure (a) is the original dataset model, Figure (b) is the network crawling dataset model, and Figure (c) is the data augmentation dataset model. Based on the overall effect, the scores for the three color expressions are 2.6-3.8, 3.25-4.25, and 3.3-4.51 respectively. The score of the third color expression is higher than the other two in terms of color control and expressiveness, so it is chosen as the eco-innovation of the Beachwood board.

![Graphs showing evaluation results](image)

**Figure 3.** Evaluation results of the three colors
3.2 Analysis of the interactive effects of Tantou woodblock New Year paintings

In order to verify the adaptability of the immersive visualization display interaction of the Tantou Wooden Plank New Year Painting with the virtual reality environment, a user experience survey was carried out according to the requirements of the design. The results of the survey of 51 experienced professionals are shown in Fig. 4.

From the results, it can be seen that the experiencers’ satisfaction with the overall interactive experience effect of the Tantou woodblock New Year’s Paintings work is above reasonable, which shows that the work successfully realizes the interactive experience of the immersive visualization display in the virtual reality environment. Among them, the satisfaction rate of the information acquisition rate of the work is the highest, and the satisfaction level of excellent and above reaches 82.35%, which shows that the Nantou woodblock New Year’s paintings designed in this paper can effectively seize the user’s experience points in the visualization. Following the visual and interactive effects of the work, the satisfaction of the experiencers in the excellent proportion reached about 37.25% and 25.49%. The visual impact of the work and the interactive experience effect are inextricably linked. On the whole, the interactive experience effect of the Nantou woodblock print in this paper is superior.

<table>
<thead>
<tr>
<th>Range</th>
<th>Same as</th>
<th>Good</th>
<th>Outstanding</th>
<th>Rattling</th>
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<td>Visual effect</td>
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<td>0</td>
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<td>17</td>
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<tr>
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<td>12</td>
<td>29</td>
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<td>Information acquisition efficiency</td>
<td>0</td>
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<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Interactive experience effect</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>22</td>
</tr>
</tbody>
</table>

Figure 4. Immersive visual interactive experience effect

4 Path of transmission and dissemination of Tantou woodblock prints

Aiming at the phenomena that the inheritance construction of Tantou New Year’s Paintings needs to be improved and the dissemination lacks strength, according to the factors affecting the improvement of users’ satisfaction with the virtual experience of Tantou Wooden Plank New Year’s Paintings obtained from the analysis of this paper, the dissemination should be strengthened by improving the objective conditions, encouraging the inheritance of young people, and strengthening the dissemination of propaganda, with the specific recommendations as follows:
4.1 Strengthening the construction of inheritance places such as training centers and New Year’s painting workshops

Improving the conditions of inheritance bases starts with hardware facilities, such as enlarging the scale, selecting sites in multiple locations, enriching the facilities for course experience, and increasing the number of training and organizing personnel. In addition to the hardware of the inheritance sites themselves, it is also necessary to open up the links between different places, integrate the scenic platforms related to Tantou woodblock prints into an organic whole, plan recommended visiting routes, and provide an essential public transportation system.

4.2 Enhancement of the teaching curriculum for woodblock prints in Tantou

To address the characteristics of experiential, one-time, and limited depth, a professional “Tantou New Year Paintings Cultural Manual” can be designed. The manual can introduce the historical background and cultural connotation of Tantou New Year paintings in text form, introduce the production process of Tantou New Year paintings in the form of pictures and cartoons, and set up experiential activities and work display areas for visitors of different age groups.

4.3 Field site construction of dissemination sites

That is, to build dissemination venues in areas other than Tantou Town to expand the scope of dissemination services. For example, the Changsha Yuhua District Non-Heritage Pavilion has a “Gao Lamei Tantou New Year’s Paintings Workshop,” which displays New Year’s Paintings, demonstrates the printing process, and allows for on-site trading. This combination of traditional culture with exhibitions can attract the attention of a wider audience and bring new opportunities for non-heritage to be inherited.

4.4 Improvement of the virtual experience system

The virtual interactive system aims to utilize advanced 3D Internet technology, 3D simulation technology, virtual reality, and other technologies to create a multi-angle virtual visit environment based on simulating the natural visit environment for those aspects of Tantou New Year’s Paintings production that are inconvenient to show on site due to the limitations of venues and personnel, such as raw material collection, pigment grinding, etc. The natural production scenes can be reproduced through 3D projection and VR virtual technology so that the complex production process can be visualized, which is conducive to visitors’ enhanced understanding and more profound impression.

5 Conclusion

The innovative display of Tantou woodblock New Year’s paintings is achieved by using image recognition and visual SLAM spatial localization technology in conjunction with AR enhancement technology, which provides a modern information-based inheritance method. Tantou woodblock New Year paintings are used to explain the principle of digital display. The feasibility of the innovative display method for Tantou woodblock prints was analyzed from the aspects of color expression and inheritance effect, respectively. In the overall effect of color presentation of Tantou woodblock prints, the score intervals of the three color presentation forms are 2.6-3.8, 3.25-4.25, and 3.3-4.51, respectively. The third one is more effective, so it is chosen as the innovative presentation form for Tantou woodblock prints. The KANO model is used to quantitatively analyze the satisfaction of the inheritance demand in Tantou Wooden Board New Year’s Paintings. In the
coordinate system of 14 evaluation indexes, the number of indexes located in the second quadrant (excitatory demand) is the most, 5, among which the better coefficient of C5 is the highest, reaching 0.698, and the inheritance satisfaction of the participants can be significantly improved by realizing this index. In the inheritance interaction effect, the satisfaction of the experience participants with the information acquisition rate of the work is the highest, and the percentage of those with excellent satisfaction level and above reaches 82.35%, and the visual effect and interaction experience effect of the work are also good. Hence, the inheritance experience of the Tantou woodblock New Year’s Paintings designed in this paper has a good effect.

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**References**


