



## Extraction and Reconstruction Methods of Cultural Genes of Non-Heritage Craft Materials from the Perspective of Digital Media

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**SUMMARY:** *This paper takes the non-heritage craft material Shenyang walking horse lantern as an example of cultural gene extraction and digital reconstruction. Firstly, the explicit genes (shape, pattern, color) and implicit genes (cultural connotation, folk activities) of the walking horse lanterns are extracted by collecting literature, field research, visiting the non-genetic inheritors, etc., and applying the inverse engineering gene extraction method, the O.V.S architecture, and the Adobe Photoshop software. Then, a multi-level cultural gene evaluation model was constructed based on the hierarchical analysis method to evaluate the importance of the cultural factors of the walking horse lantern. Finally, the judgment matrix is used to compare the degree of influence among the cultural factors of the lantern, and the core cultural factors that can represent the cultural characteristics of the lantern are screened according to the quantitative results. With the help of digital media, we reconstructed the cultural genes of the dominant genes and the recessive genes of people's participation, historical allusions and festivals, and evaluated the genetically reconstructed lantern products, which were loved and purchased by the majority of consumers. The research in this paper realizes the cultural inheritance and value dissemination of the lanterns, and also provides a closed-loop research paradigm of "extraction-assessment-reconstruction" for similar non-heritage craft materials.*

**KEYWORDS:** *cultural gene extraction; digital reconstruction; hierarchical analysis; digital media; non-heritage craft materials*

## 1 Introduction

Non-heritage craft materials are the material carriers of regional wisdom and aesthetic consciousness. However, with the acceleration of modernization, many NRH craft materials, especially their "cultural genes" such as craft logic, symbolism and knowledge system, are facing the crisis of blurred identification and broken inheritance [1-3]. With the development of information technology, the application of digital media provides support for the extraction, reconstruction, protection and inheritance of cultural genes of non-heritage craft materials.

By utilizing high-definition photography, three-dimensional scanning and other technologies, digital media can make comprehensive and detailed records and feature extraction of cultural genes, and establish a huge digital archive, which can not only be permanently preserved, but also provide rich information for subsequent research and display [4-6]. On the basis of gene extraction, digital media bring the possibility of reconstruction, protection and

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inheritance of cultural genes of non-heritage craft materials, especially the application of virtual reality (VR), augmented reality (AR), three-dimensional laser scanning and other technologies. VR technology allows people to immerse themselves in the charm of the cultural genes of non-heritage craft materials, and through the creation of virtual scenarios, the craft materials will be presented in the form of three-dimensional models, enhancing people's cognition and understanding of this non-heritage culture [7-10]. It can also be reconstructed virtually using VR technology based on historical information and research results, so that future generations can intuitively understand its original appearance [11, 12]. The unique role of AR technology is reflected in the combination of virtual information and real scenes, when people scan the physical objects or scenes related to NRM craft materials with their cell phones and other devices, they can obtain rich background knowledge, historical stories and other information [13-16]. The 3D laser scanning technology, on the other hand, can accurately obtain the 3D data of the cultural heritage of craft materials [17]. It can quickly and accurately record the heritage's etc. information and provide detailed information for subsequent conservation, restoration and research [18, 19].

As an important carrier of Chinese excellent traditional culture, non-legacy carries national emotion and cultural memory. This paper takes Shenyang horse lanterns as an example and extracts explicit (shape/pattern/color) and implicit (cultural connotation, folk activities) cultural genes. Then, with the help of AHP method, the cultural gene evaluation model is constructed, and the weights of each factor are determined through matrix construction and consistency test. Then, based on the research results, the cultural genes are reconstructed with the help of digital media. Finally, the feasibility of reconstructing cultural genes with the help of digital media is verified through design practice, with a view to providing methodological reference for the protection and innovation of similar non-heritage craft projects.

## 2 Extraction and screening of cultural genes of non-heritage craft materials

Shenyang horse lanterns have a long history, but now face severe inheritance difficulties. Its production process is complex, long cycle, lack of advantage in the market competition, inheritance mainly rely on oral teaching, and scarce historical materials, part of the process is on the verge of being lost. This paper extracts the important cultural factors of the lantern based on hierarchical analysis, and reconstructs them with the help of digital media by integrating new elements, so as to bring new opportunities for the inheritance and development of the lantern.

### 2.1 Cultural gene extraction

#### (1) Dominant gene

##### 1) Extraction of modeling genes

The study comprehensively collects historical documents, academic writings, research reports and other materials related to the walking-horse lanterns and explores them in depth. At the same time, it extensively organizes images of various types of walking-horse lanterns, covering physical photographs and depictions of ancient paintings. After comprehensively analyzing the literature and images, the lanterns are divided into three types according to their appearance: bottle-shaped lanterns, palace lanterns, and special-shaped lanterns. Based on the product gene extraction method of inverse engineering, the figurative elements are abstracted and simplified, the effect is refined, and the cultural connotation of Shenyang lanterns is combined, and the styling characteristics are successfully extracted.

## 2) Pattern gene extraction

Pattern is a typical presentation of cultural genes and carries specific cultural significance. When extracting the pattern gene of Shenyang lantern, the O.V.S structure in semiotics plays a significant role. Among them, “O” refers to the object, ‘S’ is the support, “V” is the variable, the support is contained in the object, and the two can be transformed into each other under specific conditions. In the study, the sample body of the lantern is the object, the refining pattern is the support, the factor refining result is the variable, and the pattern and the factor refining result can be transformed into each other. By analyzing the pattern genes with the help of O.V.S architecture, the flexibility of factor transformation can be enhanced, which helps to explore the cultural connotation and innovative application of the lanterns.

## 3) color gene extraction

In order to accurately extract the color of Shenyang walking horse lantern cultural genealogy, collect picture information through multiple channels, visit the non-hereditary inheritors, and take physical photos of walking horse lanterns. At the same time, use the Internet to search for relevant high-definition pictures in the non-heritage database and picture sharing platform. In the picture processing, using Adobe Photoshop software, with the help of color extraction tools to separate and extract the main colors. The color genes of Shenyang Walking Horse Lanterns are unique in their charm and are the key elements of cultural expression. They intermingle with each other, not only gives the lantern a gorgeous appearance, but also carries a wealth of emotions and cultural meanings, becoming an important part of the unique cultural identity of Shenyang lanterns, showing a strong regional cultural characteristics.

### (2) recessive genes

#### 1) Cultural Connotation

Shenyang originated as early as the Qing Dynasty, and the ritual activities of releasing river lanterns in the Later Jin Dynasty laid the foundation for its development. At the beginning of the Qing Dynasty, Shengjing Lantern Festival rose and grew. During the Daoguang period, Hebei artists who broke into the East brought new techniques and promoted the development of the lanterns. At the beginning of the Republic of China, Zhang Zuolin's love and support made the related skills spread more widely. From a historical and cultural point of view, we will sort out the origin and development of the lanterns, explore the prototype of the lanterns during the Qin and Han Dynasties, and analyze the role of the socio-economic culture of the Tang and Song Dynasties in its popularity from the records of the ancient books, such as the Miscellany Records of the Western Capital.

#### 2) Folk Customs

Folk customs include Shamanism, Taoist philosophy, and the "Two-person Puppet Show", among others. Among them, Shamanic rituals are centered around "deity tree worship" and "totem belief", such as the "Tree of Life" shape and the bird pattern (like the "Raven Saving the King" design) commonly seen in traditional lanterns, which originated from the cosmic view of Shamanism for communicating with the heavens and earth. The art of "Two-person Puppet Show" integrates the character designs (such as the clown makeup, the female role's phoenix crown) and the movement trajectories of "fan dance" in the lantern design, forming the folk function of "telling stories through the lantern". The dynamic "Dance of the Family God" in Shamanic rituals is transformed into the visual trajectory of the lantern wick rotation, while the "Singing, Speaking, Acting, and Fighting" in the "Two-person Puppet Show" continues the festive entertainment attribute through the selection of themes (such as the "Rat's Wedding" pattern).

## 2.2 Cultural gene evaluation model construction

### (1) Evaluation modeling of the cultural genes of the lanterns

Hierarchical analysis method (AHP) is a decision-making method that categorizes the elements to be decided according to the nature of the hierarchy, forms an orderly layer with certain logic, and quantifies the weights of the factors in the matrix by comparing the degree of importance between the elements through the judgment matrix. In order to facilitate the categorization and organization of the cultural genes of the lantern, this paper adopts the hierarchical analysis method to compare the relative importance of the cultural factors of the lantern, and quantifies the relative importance of the factors into the weights of the factors in a more accurate mathematical method, which serves as the basis for the decision-making of the subsequent cultural reconstruction. The evaluation model of the cultural genes of the lantern is constructed in the order of the target layer, criterion layer, evaluation factor layer and criterion factor layer, and the evaluation model of the cultural gene mapping design of the lantern is shown in Figure 1. The layer where the cultural genes of the lanterns are located is coded as A, the layer where the dominant and recessive cultural genes are located is coded as B, the corresponding layers of the 14 cultural gene elements are coded as  $C_1$  to  $C_{14}$ , and the corresponding layers of the cultural factor samples extracted from each layer are coded as  $D_1$  to  $D_{42}$ .

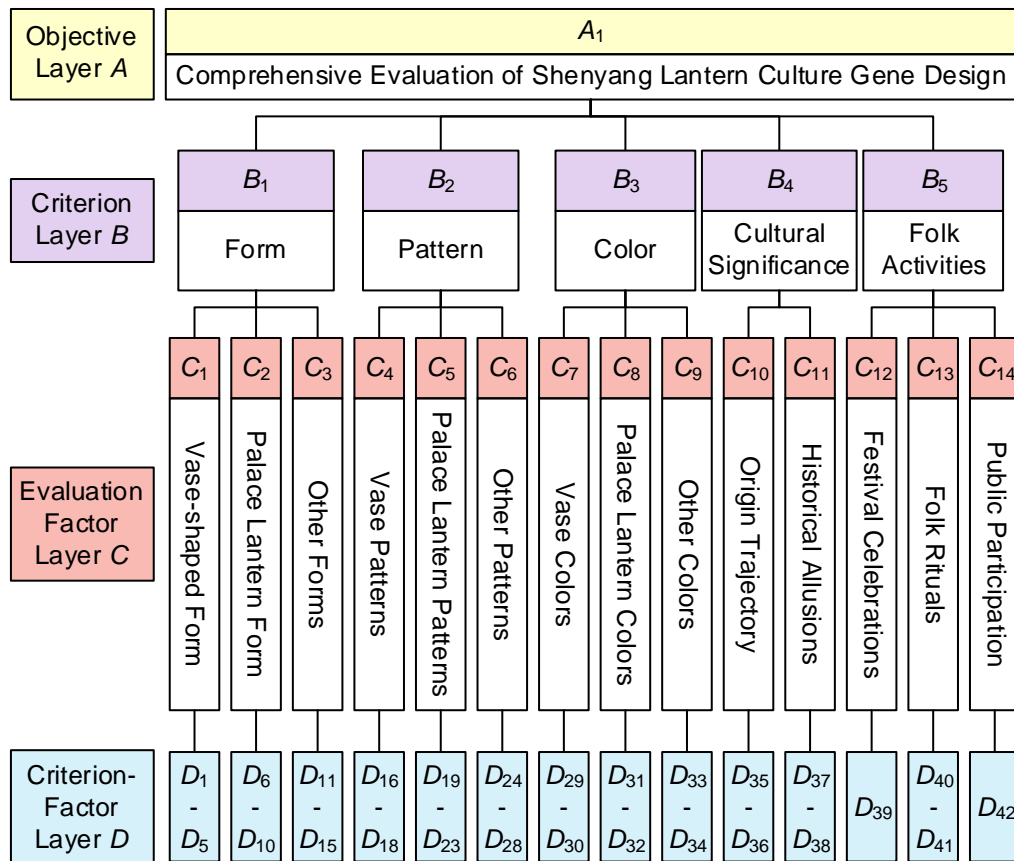


Figure 1: The model of the cultural gene map of the Lantern Festival

## (2) Decision-making process of hierarchical analysis method

The hierarchical analysis method is used to compare the degree of importance between the factors at each level of the Walking Horse Lantern Cultural Gene Evaluation Model and to rate the importance of the factors, the specific process is as follows:

1) Design of AHP nine-level scale questionnaire In order to avoid subjective decision-making as much as possible and to enhance the professionalism of the reconstruction design of the cultural genes of the walking-horse lanterns, this study used a decision-making group to

score the importance of the cultural genes of the walking-horse lanterns. Selective search for people who have a certain understanding of intangible cultural heritage, including 8 design industry practitioners, 2 cultural heritage-related researchers, 5 college students (15 people in total). Since the research subjects included people with different backgrounds and different understanding of the lantern culture, the experts were invited to watch the documentary film and works of the lanterns, which lasted no less than 25 minutes, to help the research subjects understand the culture and to balance the differences in perception caused by different professional backgrounds before the formal research. Since each scale is order-preserving, a 9-level scale was used to design the questionnaire for evaluating the genetic importance of the lantern culture.

2) Establishing a judgment comparison matrix

Compare two by two under the same criteria and construct judgment matrix  $A$  based on the importance rating:

$$A_{n \times n} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (1)$$

3) Combining expert matrices

Consistency checking can be ensured using geometric averaging by multiplying the scoring matrices formed by  $m$  expert ( $m = 1, 2, \dots, k$ ) by the bits and then by a factor of  $n$  to obtain the unique integration matrix  $\bar{A}$ :

$$\bar{A} = \left( \prod_{k=1}^m a_{ij}^k \right)^{\frac{1}{m}} \quad (2)$$

4) Calculate the relative weight of judgment matrix

In this paper, we adopt the geometric mean method to calculate the weights, first multiply the elements of  $A$  by rows to get a new vector. Then each component of the new vector is divided by  $n$  times. Finally, the resulting vector is normalized to the weight vector. The formula is as follows:

$$W_i = \frac{\left( \prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}}{\sum_{i=1}^n \left( \prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}}, i = 1, 2, 3, \dots, n \quad (3)$$

5) Consistency of judgment matrix

In order to avoid possible logical errors in the expert scoring process and to ensure the accuracy and reliability of the analysis results, it is necessary to test the consistency of the judgment matrix. Generally CR (consistency index CI and the ratio of the average random consistency index RI) as a judgment matrix consistency criteria, if  $CR < 0.1$  indicates that the matrix passes the consistency test. the formula for calculating CR:

$$CR = \frac{CI}{RI} = \frac{\lambda_{\max} - n}{(n-1)RI} < 0.1 \quad (4)$$

$$CI = \frac{\lambda_{\max} - n}{(n-1)} \quad (5)$$

$$\lambda_{\max} = \sum_{i=1}^n \frac{[AW]_i}{nW_i} \quad (6)$$

### 2.3 Cultural gene screening

The judgment matrix was constructed based on the importance rating of each gene, and the weight vectors of each layer were calculated by square root method, and the data results were tested for consistency.

The weights of the judgment matrix of layer A are shown in Table 1. The weights of shape (B<sub>1</sub>), pattern (B<sub>2</sub>), color (B<sub>3</sub>), cultural connotation (B<sub>4</sub>) and folk activities (B<sub>5</sub>) are 0.325, 0.317, 0.193, 0.113 and 0.052, respectively.

Table 1: Weight table of judgment matrix for layer A

A	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>
B <sub>1</sub>	1	2	4	5	1/3
B <sub>2</sub>	1/2	1	3	1/2	4
B <sub>3</sub>	1/4	1/3	1	1/3	1/5
B <sub>4</sub>	1/5	2	3	1	1/4
B <sub>5</sub>	3	1/4	5	4	1
Single weight	0.325	0.317	0.193	0.113	0.052

The B<sub>1</sub> layer judgment matrix weights are shown in Table 2. The weights of bottle modeling (C<sub>1</sub>), palace lantern modeling (C<sub>2</sub>) and other modeling (C<sub>3</sub>) are 0.423, 0.253 and 0.324 respectively.

Table 2: Weight table of judgment matrix for layer B<sub>1</sub>

B <sub>1</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>
C <sub>1</sub>	1	1/2	3
C <sub>2</sub>	2	1	2
C <sub>3</sub>	1/3	1/2	1
Single weight	0.423	0.253	0.324

The B<sub>2</sub> layer judgment matrix weights are shown in Table 3. The weights of bottle pattern (C<sub>4</sub>), palace lantern pattern (C<sub>5</sub>) and other patterns (C<sub>6</sub>) are 0.355, 0.376 and 0.269 respectively.

Table 3: Weight table of judgment matrix for layer B<sub>2</sub>

B <sub>2</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>
C <sub>4</sub>	1	2	1/3
C <sub>5</sub>	1/2	1	4
C <sub>6</sub>	3	1/4	1
Single weight	0.355	0.376	0.269

The  $B_3$  layer judgment matrix weights are shown in Table 4. The weights of bottle color ( $C_7$ ), palisade color ( $C_8$ ) and other colors ( $C_9$ ) are 0.367, 0.311 and 0.322, respectively.

*Table 4: Weight table of judgment matrix for layer  $B_3$*

$B_3$	$C_7$	$C_8$	$C_9$
$C_7$	1	1/2	1/4
$C_8$	2	1	2
$C_9$	4	1/2	1
Single weight	0.367	0.311	0.322

The weights of the  $B_4$  layer judgment matrix are shown in Table 5. The weights of the originating vein ( $C_{10}$ ) and historical allusion ( $C_{11}$ ) are 0.399 and 0.601, respectively.

*Table 5: Weight table of judgment matrix for layer  $B_4$*

$B_4$	$C_{10}$	$C_{11}$
$C_{10}$	1	1/3
$C_{11}$	3	1
Single weight	0.399	0.601

The weights of the  $B_5$  layer judgment matrix are shown in Table 6. The weights of festival celebrations ( $C_{12}$ ), folk rituals ( $C_{13}$ ) and popular participation ( $C_{14}$ ) are 0.429, 0.233 and 0.338, respectively.

*Table 6: Weight table of judgment matrix for layer  $B_5$*

$B_4$	$C_{12}$	$C_{13}$	$C_{14}$
$C_{12}$	1	1/2	3/1
$C_{13}$	2	1	3
$C_{14}$	3	3/1	1
Single weight	0.429	0.233	0.338

Based on the scoring results of the research questionnaire, the 15 subjects' opinions were synthesized to calculate the consistency index CI and the consistency ratio CR. If  $CR < 0.1$ , the test was passed. Otherwise, it needs to be corrected again. The test results of the Walking Horse Lantern culture gene data are all less than 0.1, which passes the consistency test and can be used as the basis for data analysis.

The results of the calculation of the weight of each factor are shown in Table 7. The dominant genes ( $B_1$ ,  $B_2$ ,  $B_3$ ) have more weight than the recessive genes ( $B_4$ ,  $B_5$ ), which proves that the dominant genes are more important genes in the lantern culture genes, and they are more recognizable in the reconstruction design, so it is more advantageous to choose the factors under the dominant genes for reconstruction in the design practice. In the C level, the historical allusion gene  $C_{11}$  has the largest weight of 0.601, followed by the festival gene  $C_{12}$  and bottle modeling gene  $C_1$ , with 0.429 and 0.423, respectively, which proves that the historical allusion gene, the festival gene and the bottle modeling gene are more important in the cultural genes of the lanterns.

Table 7: Calculation results of each factor's weight

Cultural gene type	Criterion layer B	Weight	Evaluation factor layer C	Weight	Criterion factor layer D	Weight	Composite weight
Dominant gene	B <sub>1</sub>	0.325	C <sub>1</sub>	0.423	D <sub>1</sub>	0.253	0.107
					D <sub>2</sub>	0.211	0.089
					D <sub>3</sub>	0.236	0.1
					D <sub>4</sub>	0.193	0.082
					D <sub>5</sub>	0.107	0.045
			C <sub>2</sub>	0.253	D <sub>6</sub>	0.199	0.05
					D <sub>7</sub>	0.213	0.054
					D <sub>8</sub>	0.255	0.065
					D <sub>9</sub>	0.201	0.051
					D <sub>10</sub>	0.132	0.033
			C <sub>3</sub>	0.324	D <sub>11</sub>	0.193	0.063
					D <sub>12</sub>	0.157	0.051
					D <sub>13</sub>	0.259	0.084
					D <sub>14</sub>	0.236	0.076
					D <sub>15</sub>	0.155	0.05
	B <sub>2</sub>	0.317	C <sub>4</sub>	0.355	D <sub>16</sub>	0.332	0.118
					D <sub>17</sub>	0.342	0.121
					D <sub>18</sub>	0.326	0.116
			C <sub>5</sub>	0.376	D <sub>19</sub>	0.274	0.103
					D <sub>20</sub>	0.213	0.08
					D <sub>21</sub>	0.209	0.079
					D <sub>22</sub>	0.225	0.085
					D <sub>23</sub>	0.079	0.03
			C <sub>6</sub>	0.269	D <sub>24</sub>	0.163	0.044
					D <sub>25</sub>	0.211	0.057
					D <sub>26</sub>	0.257	0.069
					D <sub>27</sub>	0.236	0.063
					D <sub>28</sub>	0.133	0.036
B <sub>3</sub>	0.193	C <sub>7</sub>	0.367	D <sub>29</sub>	0.522	0.192	
				D <sub>30</sub>	0.478	0.175	
		C <sub>8</sub>	0.311	D <sub>31</sub>	0.463	0.144	
				D <sub>32</sub>	0.537	0.167	
		C <sub>9</sub>	0.322	D <sub>33</sub>	0.571	0.184	
				D <sub>34</sub>	0.429	0.138	
Recessive gene	B <sub>4</sub>	0.113	C <sub>10</sub>	0.399	D <sub>35</sub>	0.518	0.207
					D <sub>36</sub>	0.482	0.192
			C <sub>11</sub>	0.601	D <sub>37</sub>	0.477	0.287
	D <sub>38</sub>	0.523			0.314		
	B <sub>5</sub>	0.052	C <sub>12</sub>	0.429	D <sub>39</sub>	1	0.429
					D <sub>40</sub>	0.623	0.145
			C <sub>13</sub>	0.233	D <sub>41</sub>	0.377	0.088
C <sub>14</sub>					0.338	D <sub>42</sub>	1

Comparison of the integrated factor weights of the cultural genes of the walking horse lanterns is shown in Figure 2.  $D_{39}$ ,  $D_{42}$  and  $D_{38}$  are the higher integrated weights of the D level, which are 0.429, 0.338 and 0.314, respectively, indicating that the cultural factors under the people's participation, historical allusions and festivals are more in line with the people's perceptions of the walking horse lanterns and their cultural values, and the concept of these factors should be emphasized in the reconstructive design.

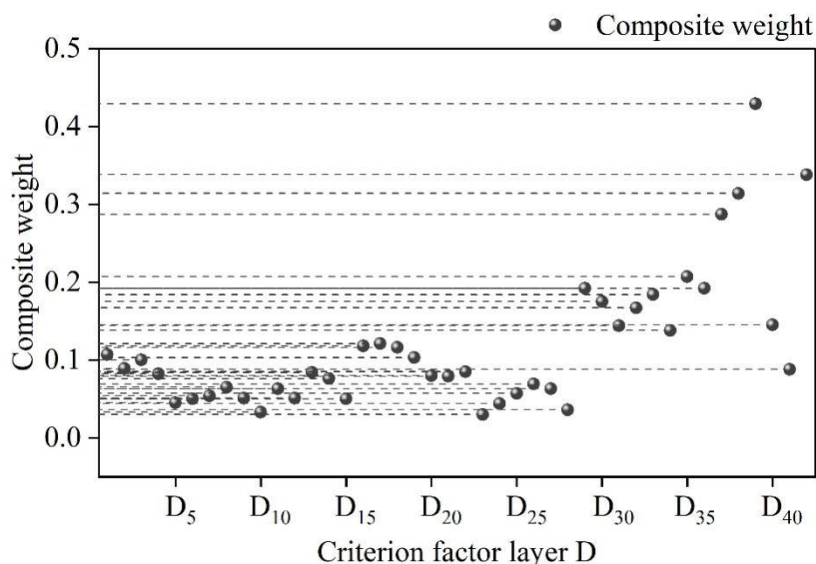


Figure 2: The weight of cultural gene composite factor is compared

### 3 Reconstruction and assessment of cultural genes of non-heritage craft materials

Based on the screening results of the Walking Horse Lantern cultural genes in the previous section, this paper believes that the factors under the dominant genes, such as shape, pattern and color, as well as the cultural factors under the recessive genes, such as people's participation, historical allusions and festivals, are more representative of the cultural concepts of the Walking Horse Lantern, and therefore the above factors can be used to design the products when reconstructing the cultural genes of the Walking Horse Lantern.

#### 3.1 Digital reconfiguration

Cultural reconstruction as defined in this study refers to the transformation of symbolic cultural genes into design symbols with recognizable features based on a comprehensive and accurate interpretation of cultural genes and the adoption of theories and methods related to semiotics and design. The reconstruction process is divided into three levels according to the cultural hierarchy theory, namely the material layer, the behavioral layer and the spiritual layer. The reconstruction of the material layer is based on the visual interface construction of art forms. The reconstruction of the behavioral layer is based on the interaction mode of craft characteristics. The reconstruction of the spiritual layer is the creative narrative design based on the story theme. The cultural reconstruction carried out in this study takes the cultural gene of intangible cultural heritage as the link, mobile Internet as the carrier, and digital interface as the form, and translates the intangible cultural heritage from the surface to the inside, in a true and natural way, into the visual expression, interactive form and scene imagery of mobile

Internet products, and the path of reconstructing the cultural genes of the lanterns is shown in Figure 3. This means of cultural reconstruction is a conversion process from surface to depth, from form to narrative, and from vision to imagery, which can activate the original conceptualized and patterned cultural genes, and transform them into new products with cultural characteristics of intangible cultural heritage and in line with the principles of the new era design.

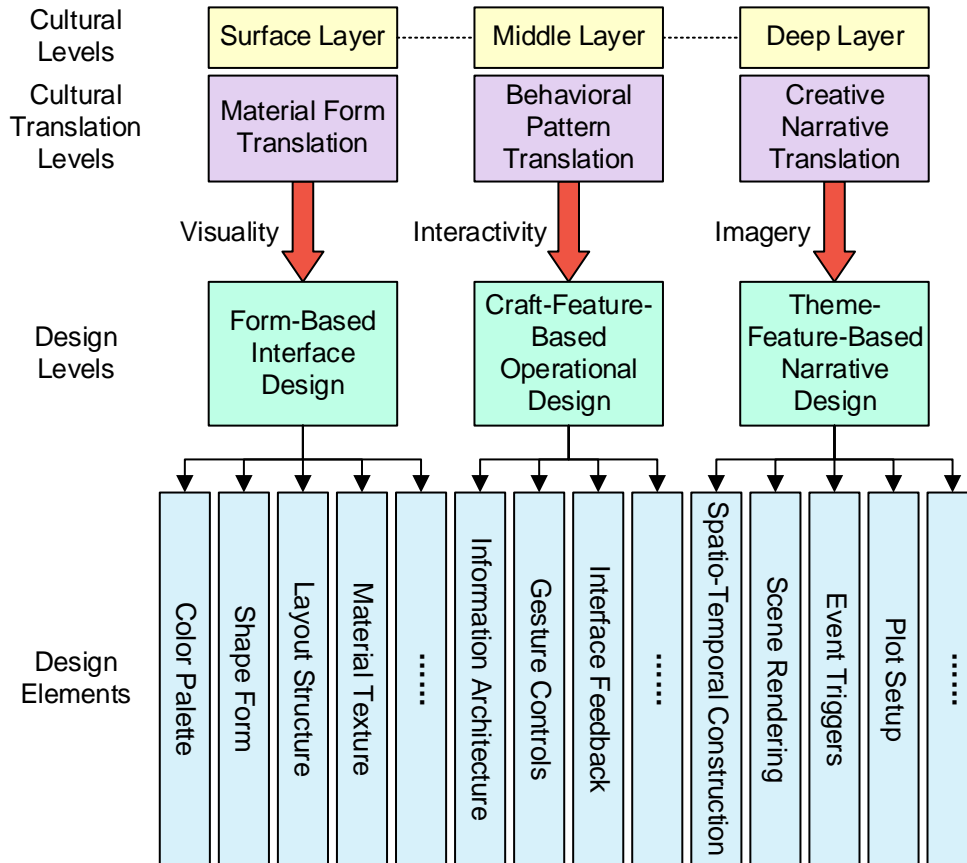


Figure 3: The path of the genetic reconstruction of the horse flower lamp

### 3.2 Effectiveness evaluation

In the form of questionnaire survey, we evaluate the Walking Horse Lantern cultural and creative products designed after the reconstruction of cultural genes, and judge whether the reconstructed cultural and creative products meet the needs of current consumers. This paper seeks to prove whether the final designed products can be accepted and purchased by modern consumers from three dimensions: basic issues, innovative design evaluation, and product application evaluation. The design feedback survey was conducted in the form of an online questionnaire, with a total of 13 questions and 100 valid responses.

Utilizing the evaluation method of “Likert five-point scale” and semiotic theory, we take the lanterns as the carrier, explore its application in the creative design of cultural and creative products, and test whether it can be accepted by consumers. The subjective evaluation was conducted on the design of the lanterns. It is divided into five levels with corresponding scores, with “1” representing negative absolute negation and “5” representing positive absolute affirmation.

The 7 basic questions involved are as follows:

Q1: The design of the cultural product is personalized.

Q2: The color characteristics of walking lanterns are reflected.

Q3: The stylistic characteristics of the walking horse lanterns are reflected.

Q4: The pattern characteristics of the walking horse lanterns are reflected.

Q5: The concept of environmental protection and sustainable development is reflected in the choice of materials.

Q6: The integration of traditional culture and modern design elements in the design meets people's aesthetic needs.

Q7: The product has strong regional characteristics of Shenyang, fully reflecting the local culture.

The results of the basic question survey are shown in Figure 4. In response to the design works reflecting personalization, the analysis resulted in a consumer rating mean value of 4.134, indicating that the design works have innovative value. The ratings of the color, shape and pattern features of the lanterns were 4.103, 4.122 and 4.137 respectively, indicating that the color, shape and pattern elements of the lanterns were able to be reflected in the work, and the degree of recognition was high. The mean value of the concept of environmental protection and sustainable development embodied in the choice of materials is 4.235, indicating that consumers agree with the concept of environmental protection in cultural and creative products. The average value of conforming to the aesthetic demand of modern people is 4.223, which shows that the design works conform to the aesthetic orientation of consumers. The mean value of fully conveying local culture is 4.177, which indicates that consumers believe that the design reflects strong regional characteristics.

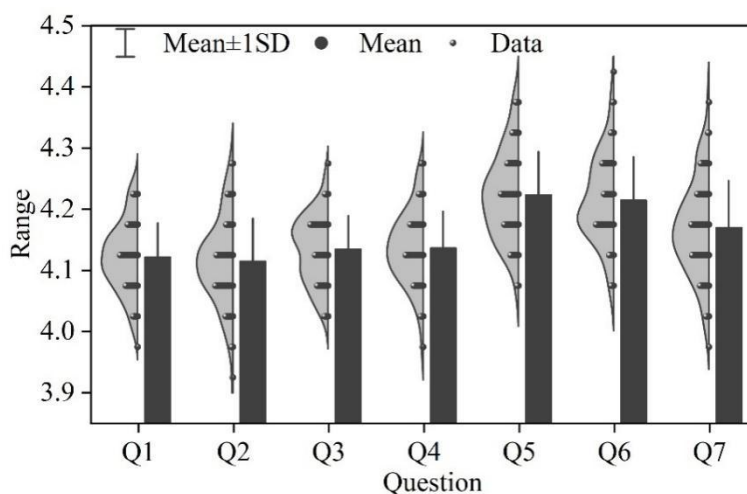


Figure 4: The results of the basic problem survey

Meanwhile, in order to determine whether the design of the survey work is usable and practical at the application level, the survey was conducted in the form of a single-choice question, and the five questions involved in the evaluation of innovative design are as follows:

Q8: Would you choose to buy the products related to the design?

Q9: Does the design have a distinctive regional style and cultural color?

Q10: Does the product meet your material and spiritual needs?

Q11: Is the design innovative and contemporary?

Q12: Do you have a certain understanding of the lantern culture through the application of the product?

The statistical results of innovation design evaluation are shown in Figure 5. The number of people who agree with the above five questions is more than 83.25%, which concludes that the designed products can be loved and purchased by most consumers.

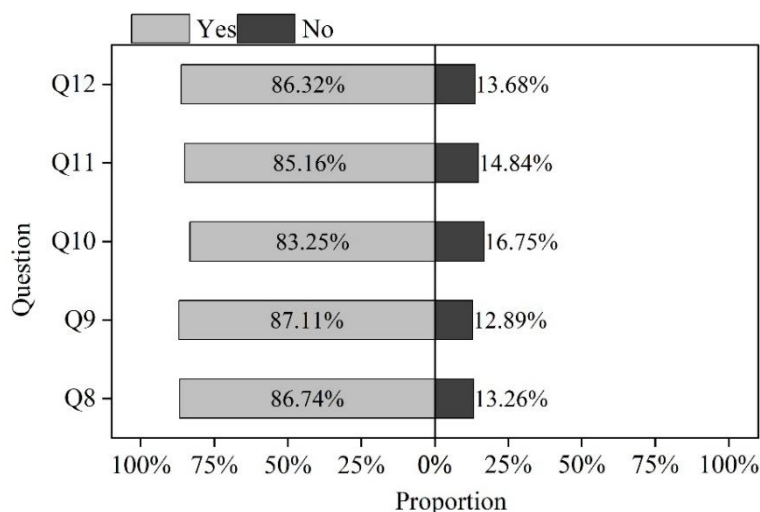


Figure 5: Innovative design evaluation statistics

The product types designed based on cultural gene reconstruction include stationery, office supplies, household goods and daily necessities, in response to Q13: Which product type do you like the most? Consumers' preferences for product categories are shown in Table 8. Among them, daily necessities accounted for 45%, the highest percentage. By expanding the application environment of walking lanterns in products, it can effectively strengthen consumers' understanding of walking lantern culture in the process of using cultural and creative products.

Table 8: The extent to which consumers enjoy product categories

Design plan	Number	Proportion
Stationery	23	23%
Office supplies	12	12%
Household goods	45	45%
Everyday goods	20	20%

## 4 Conclusion

This study takes Shenyang lanterns as an example, constructs a multi-level cultural gene evaluation model based on the hierarchical analysis method of “shape-pattern-color-cultural connotation-folklore activities”, screens out the highly recognizable cultural factors of lanterns, and reconstructs the cultural genes with the help of digital media according to the screening results. The calculation results of the weights of the factors show that the dominant gene is the more important gene of the lantern, i.e., it is more advantageous to reconstruct the cultural factors under the styling gene, pattern gene and color gene. The cultural factors under the recessive genes of people's participation, historical allusions and festivals have larger weights, which are suitable for the reconstruction of cultural genes. Evaluating the cultural and creative products designed based on digital reconstruction, the mean scores of the color, shape and pattern features of the walking-horse lanterns are 4.103, 4.122 and 4.137, respectively, and the designed products can reflect the dominant genes of the walking-horse lanterns, while the products have a certain degree of innovation and aesthetics. The research in this paper provides a replicable research paradigm for similar non-heritage projects (e.g. shadow, ceramics, lacquer).

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