

Analysis of Innovative Design Methods of Contemporary Gannan Furniture from the Perspective of Hakka Culture

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Abstract: Furniture is the carrier of culture. After nearly 40 years of development, Gannan furniture industry has a huge scale. Gannan Hakka furniture decoration elements have been preserved in the historical development. It is not only a witness to the development of Hakka architectural culture, but also a symbol of the vibrant and innovative quality of Hakka. At the same time, Hakka architectural decorative elements with national characteristics and traditional colors provide more aesthetic elements for furniture design. But on the whole, Gannan furniture design has not formed its own cultural style and characteristics. This paper takes the application of Hakka architectural decoration elements in furniture design as the research angle, and applies the parametric technology to the innovation of elements in Hakka architectural decoration to furniture design. The practical verification shows that the model built by the algorithm of this technology makes the accuracy of design entities increase by 22.14% and the security rate increase by 33.69%. It also optimizes the furniture design method while making Hakka cultural elements get modern application.

Keywords: Hakka culture; Contemporary, Gannan furniture; Design method; Innovation.

1. Introduction

China is rich in furniture types, and furniture shapes and decorations in different regional spaces show their unique characteristics due to cultural differences. Nankang District, Ganzhou City, Jiangxi Province, located in the old area of Gannan, is an important furniture industry cluster in China [1]. Nankang District, which is not along the border and not close to the sea, has transformed furniture, a "grassroots economy" derived from workshop processing, into an industrial cluster of 100 billion yuan, and achieved "buying global wood and selling global furniture" [2]. Nankang District, Ganzhou City, Jiangxi Province is one of the largest furniture industry bases in central China. There are more than 7000 furniture enterprises, more than 400000 employees, an annual output value of more than 100 billion yuan, an annual consumption of about 10 million cubic meters of wood, and 75% of the wood is imported [3]. In the process of formation and development, Gannan furniture is deeply influenced by Hakka culture. Its artistic features of modeling and decoration contain the connotation of Hakka culture, fully reflect the elements of Hakka culture, and are a vivid embodiment of the production, life and social development of Hakka people [4]. Hakka culture is a precious culture precipitated in China's long history. As an important part of the world culture, Hakka culture adheres to the fine tradition of "respecting education, farming, reading and passing on family" [5]. Incorporating it into furniture design can not only promote Hakka culture to the maximum extent, but also better protect and inherit Chinese excellent traditional culture [6]. In the process of integrating Gannan Hakka cultural elements into furniture design, designers should take the essence of local traditional cultural style and redesign and innovate [7]. Thus, while highlighting the regionalism of Hakka culture, it reflects the innovation and practicality of modern science and technology, and effectively inherits and carries forward the excellent traditional Chinese culture [8].

2. Application of Hakka Cultural Elements

2.1. From Hakka Architecture to Hakka Home Decoration

In history, Hakka people mainly lived on agricultural planting. In agricultural production and life, they relied more on nature. This concept is particularly prominent in the decoration of Hakka buildings. Hakka people's cultural consciousness has a strong color of idealism. Their moral values, which are full of courage to pioneer, hard work and conduct themselves, have not been annihilated in the historical migration process. On the contrary, it has strengthened this strong and resolute character and the spirit of pioneering and innovation [9]. Therefore, Hakka residential buildings pay great attention to the harmony and unity with the surrounding natural environment, and they will be decorated by carving animals, plants, characters and other graphic patterns in the nature on the buildings [10]. In Gannan Hakka architecture, there are almost no single-unit houses, and there are all the characteristics of enclosed houses with families. At first, houses with special structures and shapes were built for the purpose of defense practicality. On the basis of gradual absorption, improvement and innovation, Hakka architecture has become a wonderful work of national architectural culture with practicality and aesthetic shape and structure, and its unique shape and structure have also become the core elements of Hakka architectural decoration [11]. Culture, patriarchal clan system, moral concept, pioneering and innovative, industrious and simple character, etc. all have a profound influence on the decorative art of Hakka traditional dwellings in southern Jiangxi [12]. In the design of modern furniture, more or less, it is also applied to the elements of architectural decoration in Gannan Hakka. Therefore, in order to realize the innovative application and deep application of Hakka architectural decorative elements,

modern furniture design must apply the core elements.

2.2. Unique Cultural Elements in "Gan style" Furniture

Culture needs to be expressed in form, and the most direct way of expression is residential buildings and clothing. The cultural connotation is embodied through the external structure, internal space combination, internal utensils modeling, color, materials and other elements of the building. Hakka folk architecture and costume art can best reflect Hakka culture. The furniture of "Gan School" has obvious "Gan" cultural and artistic characteristics in modeling and decorative style. The furniture modeling and decorative elements draw from the decorative elements in the door head and window pane components of Hakka traditional buildings. The design of Hakka modular series furniture adopts a symmetrical enclosure pattern. The materials used for furniture are moderate in thickness. The main components of furniture, such as legs, feet, columns, etc., are simply carved. They are mainly made of process lines, with fine and elegant workmanship. They are suitable for modern industrial production, and the materials used are exquisite. Carving or ornamentation extract elements from Hakka traditional architecture and clothing, draw lessons from the totem of Han culture, and integrate into the totem of She and Yao cultures. The materials are mainly camphor wood, chinaberry wood, fir and bamboo in southern Jiangxi, and foreign high-grade wood such as black walnut, ash and mahogany are also appropriately used.



(a) Hakka culture



(b) Gannan Furniture

Figure 1. Hakka cultural elements in Gannan furniture

The overall shape of the furniture reflects Hakka people's rationality, simplicity and other connotations. However, the design of "Gan School" furniture still lacks unique regional cultural characteristics, and the cultural connotation contained in its furniture is not prominent enough. It is more traditional and lacks innovation. In the design of modern green ecological furniture, people pay more attention to the use function of furniture. The whole structure of the traditional Hakka enclosure is realized according to the function during the overall use. It represents the unique traditional culture and customs of Hakka people. Applying it to modern furniture design can not only show its aesthetic

value, but also play a good practical role. The central symmetric structural form, component carving theme and color and pattern patterns in costume art in residential buildings can be used in modern "Gan School" furniture design.

2.3. Characteristics of Gannan Furniture

Compared with the relatively uniform shape, the diversity of Gannan furniture manufacturing process has obvious geographical advantages and characteristics, and it is a distinctive feature of Gannan furniture to maximize the mosaic skills. In terms of home design, it is necessary to inherit the authenticity of Hakka traditional furniture without losing its practicality, exquisite materials and firm structure, and also to combine the needs of modern people for furniture functions. For example, Hakka residential building elements and Hakka clothing elements are integrated into the decoration and surface decoration of furniture components, the excessively complicated carving decoration is removed, and the modern furniture manufacturing process is combined to improve the efficiency of its production.

By applying modern design techniques to the design of Gannan furniture products, Gannan furniture can be integrated with the surrounding architectural environment, and can also meet the aesthetic and use needs of modern people. Then, how to introduce Hakka architectural design into another furniture design field to achieve integrated design? The following chapter is what we want to discuss.

3. The Road to Innovation in Home Design

3.1. Innovative Concept of Modern Furniture

In recent years, under the impact of the world design trend, a large number of innovative furniture has been developed and practiced. This urges us to reflect on how to understand and master the road of furniture innovation from art to technology, from theory to practice in the furniture design topic in China. Therefore, the design of furniture, which has special functions, is more in line with its design essence and design value significance. In general, the forms, elements, symbols and functions of artistic beauty can be extracted. After decomposition and reconstruction, new contents and forms are generated. However, these elements should not be copied, but should be recreated and re designed. This requires us to fully understand the traditional form, based on modern aesthetic needs to carry out transformation and "redesign".

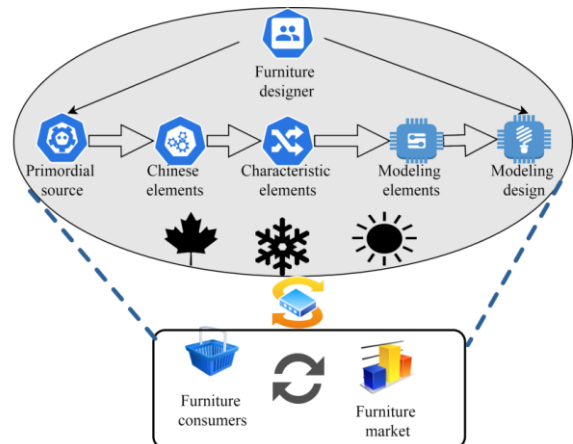


Figure 2. The process of conveying innovative ideas of modern furniture

The direction of the improvement and innovation design of traditional furniture is to learn from the ancient to the modern, to remove the rough and store the fine. Emphasizing the innovative design of traditional style furniture, the final innovative design work should also belong to the category of Chinese traditional furniture aesthetic style. We should inherit the ancient tradition, but not deviate from the needs of the current era. We should adapt to the changes of the current era to develop and innovate. According to the innovation concept communication process in Figure 2, we need to further integrate innovation factors into practical application, such as:

(1) In the process of furniture production, if the form and structure of Hakka traditional buildings can be integrated into it, it will give a refreshing feeling. While improving the modeling level of household products, the use of special structures of buildings will also improve the use of design furniture.

(2) In modern furniture design, we should abandon those false decorations that are designed for design and have no practical value. While increasing the cost, it also causes a waste of design resources. The recognized decoration should be able to play a certain kind of specific function.

(3) In addition to considering the decoration style and the styling elements of the furniture, the designer must also consider the psychological effect of the indoor and outdoor environment colors of the furniture on consumers. The design emphasizes people-oriented, and the furniture design should consider whether it is ergonomic and whether it can make users feel comfortable and get a good experience during use.

3.2. Application of Parameter Design Algorithm

Parametric technology provides furniture designers with a tool to efficiently change the shape of the model, making the model results more diversified. Mathematical algorithms can be used to optimize the structure topology, shape and size. Help designers to turn creativity into reality. Its application and development in the furniture field will have a positive impact on the improvement of product quality and the overall improvement of the home environment. The application process of the algorithm is roughly to construct a weight judgment matrix according to the corresponding indicators. The judgment matrix is used to solve the eigenvector, and then the consistency test is conducted to obtain the maximum eigenvalue and judge its rationality. The specific process is as follows:

First normalize the columns of the processing matrix, that is:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad (1)$$

After normalization, the total number of elements in each column is 1. Calculate the sum of normalized columns by row, namely:

$$F_{t+1} = \frac{1}{k} \sum_{i=1}^t Y_i \quad (2)$$

Where, k is the number of periods of historical data used for prediction. F_{t+1} indicates the forecast of future demand. When a new demand period becomes reality and observable, Y_t becomes available.

Build a judgment matrix. Compare the indicators in the hierarchical structure one by one, and sort them according to their importance from high to low. The meaning of the indicator comparison scale:

$$V_i = \sum_{j=1}^n b_{ij} \quad (3)$$

Where, $i, j = 1, 2, \dots, n$.

According to the combination of the user demand weight obtained by the analytic hierarchy process and the product characteristics, the house of functional quality is constructed, from which the user's comprehensive demand weight is obtained and the design practice of furniture suitable for southern Jiangxi is guided. Then, the problem conclusion theory is used to eliminate the conflict between user requirements and product features. Since there may be large differences in user ratings, which may lead to self-contradiction, consistency must be checked. The consistency indicator formula is:

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

Table 1. Stochastic consistency index

Order	1	2	3	4	5	6	7	8	9
RI	0	0	9.2	8.4	7.5	4	9.8	9.8	2.1

To evaluate the furniture design effect according to the consistency indicators in Table 1, the covariance matrix is used for correlation analysis. The correlation coefficient is a statistical indicator reflecting the closeness of the relationship between variables, and the value range of the correlation coefficient is between 1 and - 1. The closer the data is to 0, the weaker the correlation. The formula for calculating correlation coefficient of covariance matrix is as follows:

$$r_{x,y} = \frac{\text{COV}(x, y)}{\sqrt{\delta R_x \cdot R_y}} \quad (5)$$

Finally, the relationship between stress state and strain increment of metal materials needed for furniture is obtained by introducing constitutive equation. Then, according to the established finite element geometric model, the temperature of bending forming is determined, the bending forming of metal materials is realized, and the feasibility and stability of the scheme are demonstrated.

According to the comprehensive weight analysis and the ranking of the importance of product features, different customer groups have different requirements for several indicators at the behavioral level. On the basis of the above demand analysis, core product feature mining and internal contradiction resolution, the innovative concept is carried out, and Table 2 furniture design demand scale is obtained by computer aided modeling and rendering.

The innovative design method constructed in this paper tries to start with the user's demand analysis of furniture (Table 2), abstract and simplify the modeling elements of traditional Chinese furniture, and adopt the composition method to design. So that the design is more rational and can be understood, accepted and used by more people. In innovative design, we should capture the charm, essence and style of traditional modeling, remove the complexity and simplify, decompose and combine, and comprehensively consider people's nostalgic psychology and modern aesthetic consciousness for reprocessing. Finally, the expected and actual index demand values of design indicators (Figure 3) are

obtained to guide the design details. For example, the principle of space separation of building materials can be expressed as separating the two contradictory parties in space to ensure that only one contradictory party appears in the same space. The whole furniture space is separated and zoned, and the system function is designed in a separate zone.

Table 2. Furniture Design Demand Scale

User demand	A	B	C	D	E	F	Comprehensive weight
Beautiful appearance	1	2	2	1	4	5	0.1234
Natural color	1	4	3	2	0	5	0.0703
Safety and health	0	5	5	2	3	4	0.193
Moderate price	4	5	4	2	4	4	0.1602
Low maintenance cost	4	2	4	1	5	5	0.1022
Long service life	0	4	5	3	5	2	0.155
Simple operation	5	1	1	2	5	1	0.1874

In Figure 3, the covariance and respective variances of the predicted value and the actual value of the Holt Winters model are calculated, and the correlation coefficient r is 0.77. The

value is greater than 0, indicating that the two variables are positively correlated. At the same time, 0.77 is very close to 1, indicating that the predicted value is highly correlated with the actual value, and the prediction is more accurate. The predicted value is used to design the furniture in Voronoi diagram. The furniture design is completed by first collecting user demand and ergonomic data, material pressure data and deformation map, and analyzing the collected data, and then building the unit according to the analysis results. In many parametric programming tools, Voronoy algorithm has been provided to users as a basic algorithm for parametric design.

According to the data in Figure 4, the model established by the algorithm of parameterization technology makes the accuracy rate of design entities increase by 22.14% and the security rate increase by 33.69% compared with traditional methods. It also optimizes the furniture design method while making Hakka cultural elements get modern application. This design mode facilitates the traceability and analysis of product quality problems, and is conducive to the process control and prevention of product quality in the future. It also accumulates sufficient data and practical experience for the application of parametric design in indoor household products in the future, and provides reference for the R&D and design of new products.

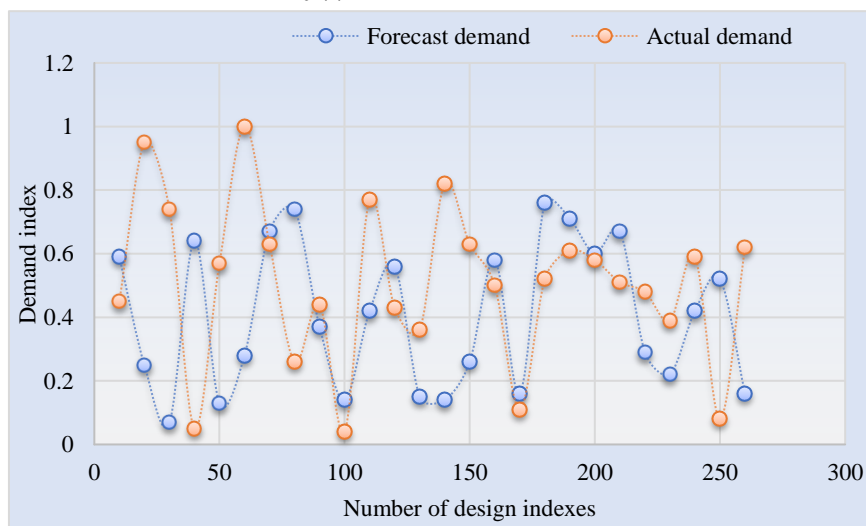


Figure 3. Comparison of design index requirements

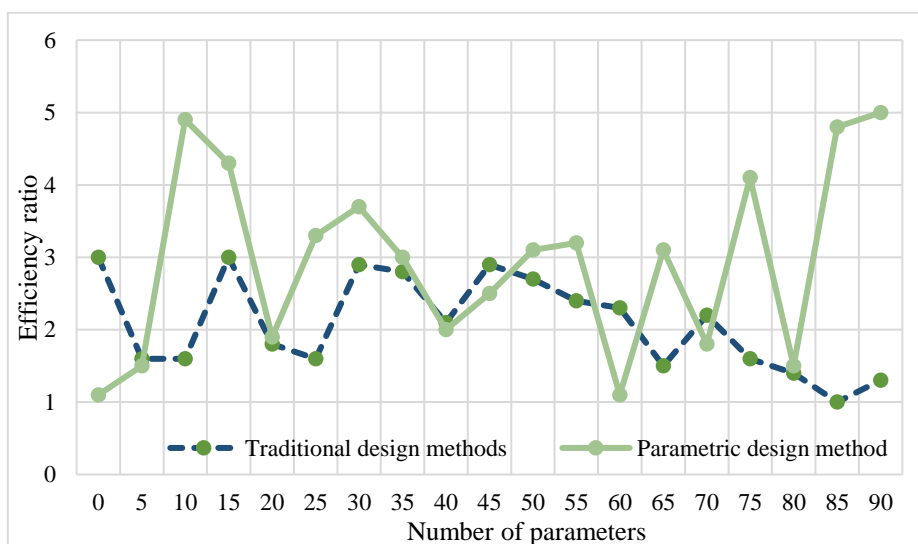


Figure 4. Efficiency comparison between traditional design and parametric design

4. Conclusions

Gannan furniture industry has realized the development framework of "buying and selling the world", and its development momentum continues to increase. It is very important to further strengthen the competitiveness of Gannan furniture industry. The needs of human beings are constantly changing, so the innovative concept of design should also be constantly updated. The foothold and power source of this innovation are coming from tradition. In the innovative design of furniture in Gannan, we need to seek the best balance between "inheriting tradition" and "breaking through tradition", and at the same time, we must be good at "advancing with the times" and integrating new design elements that meet the aesthetic requirements of the times. Only in this way, Gannan furniture can continue to continue the traditional culture, and at the same time, blossom a new era of light. Gannan furniture, developed on the basis of traditional Hakka furniture style, gradually realizes the improvement and innovation in materials, structure, technology, modeling, decoration and style in terms of inheriting traditional techniques, so that Gannan furniture can continue to innovate on the basis of inheriting Chinese traditional culture. Further strengthen the use and cultural value of Gannan furniture, so as to better inherit and develop Gannan furniture culture. This paper takes the application of Hakka architectural decoration elements in furniture design as the research angle, and applies the parametric technology to the innovation of elements in Hakka architectural decoration to furniture design. The practical verification shows that the model built by the algorithm of this technology makes the accuracy of design entities increase by 22.14% and the security rate increase by 33.69%. It also optimizes the furniture design method while making Hakka cultural elements get modern application.

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