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From User Needs to Cultural Innovation: Design and Evaluation of Intangible Cultural Heritage Products Based on the UCD Method

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Abstract
Amid globalization and growing cultural diversity, the preservation and innovative Design of intangible cultural heritage (ICH) have become key research areas. Based on cultural gene theory and the User-Centered Design (UCD) approach, this study investigates ICH product design and evaluation strategies. Using China's "Mianzhu New Year Pictures" as a case, it employs experimental design and focus group testing to develop a framework integrating user needs with cultural elements. Findings demonstrate that UCD, grounded in cultural gene theory, enhances user satisfaction, cultural identity, and cultural gene transmission, providing a balanced method for cultural preservation and user experience in ICH product design.

Keywords: User-Centered Design (UCD); Cultural Gene; Design Evaluation; Products Innovation

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1.0 Introduction

Intangible cultural heritage (ICH) is a significant carrier of national culture, embodying rich historical and artistic value. However, as globalization accelerates, the protection and transmission of ICH face severe challenges. Integrating traditional cultural elements into modern life through innovative Design has become a key strategy for its modernization and transformation. Research indicates that utilizing modern design techniques to innovate ICH products can sustain cultural vitality and enhance market competitiveness (Natsir & Sihombing, 2022). This study applies User-Centred Design (UCD) theory and cultural gene methodology to explore innovative applications of ICH in modern tourism product design, using China's national ICH, Mianzhu New Year Pictures, as a case study.

User-Centred Design(UCD), proposed by Norman (1988), emphasises designing based on user needs to improve user experience and cultural identity. Meanwhile, cultural gene theory, introduced by Dawkins (1976), provides a symbolic pathway for extracting cultural elements. This research extracts cultural gene elements from Mianzhu New Year Pictures, generates symbolic product prototypes, and employs experimental design and focus group testing to collect user feedback for iterative product optimisation. The study validates the effectiveness of the cultural gene method in enhancing product innovation.

By combining theoretical analysis with practical application, this study advances the application of cultural gene methodology in ICH product design, enhancing user-oriented and culturally expressive designs. It provides new insights into the protection and development of ICH, expanding the commercialisation and innovation pathways for tourism products rooted in cultural heritage.

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2.0 Literature Review

Olalere (2019) examined the role of intangible cultural heritage (ICH) in tourism development by presenting four Malaysian cases (Dit, Wau, Marongga) and argued that tourism product commercialisation can support cultural safeguarding. However, the study focused more on cultural and economic perspectives than on artistic analysis. User-Centred Design (UCD), a mature methodology in product development, stresses the importance of user feedback. Its relevance has been demonstrated in market interface design (Natsir & Sihomebing, 2022), film narrative enhancement (Hartawan, 2022), and the development of Multi-User Experience frameworks (Sylwain & Chaniaud, 2023). Yet, UCD remains insufficiently explored in the context of ICH tourism product development. In design research, the KANO model and the Analytic Hierarchy Process (AHP) are widely used to classify and prioritise user requirements. Dai and Zhang (2023) applied the integrated KANO-AHP model to construct an industrial product design and service platform, validating its methodological effectiveness. In cultural design studies, Zhu and Teng (n.d.) proposed a heritage-memory-based method for cultural product development, while Yang and Seo (2021) used memetic theory to reveal the coexistence of traditional and modern elements in Korean modern architecture. Collectively, these studies suggest that ICH tourism product design may benefit from integrating UCD for process structuring, KANO-AHP for user needs analysis, and cultural gene theory for innovative cultural transformation.

3.0 Methodology

This research analysed the challenges in transforming Mianzhu New Year Pictures, a Chinese national-level intangible cultural heritage. Issues identified include homogenization of tourism products, a lack of cultural connotation, and limited innovation. To further optimise the Design of Mianzhu New Year Picture tourism derivative products and avoid impacting tourism consumption and cultural development, the following method was employed: User-Centred Design (UCD) research methodology, encompassing Needs Analysis, Design and Prototyping, and Development and Iteration. See Fig. 1

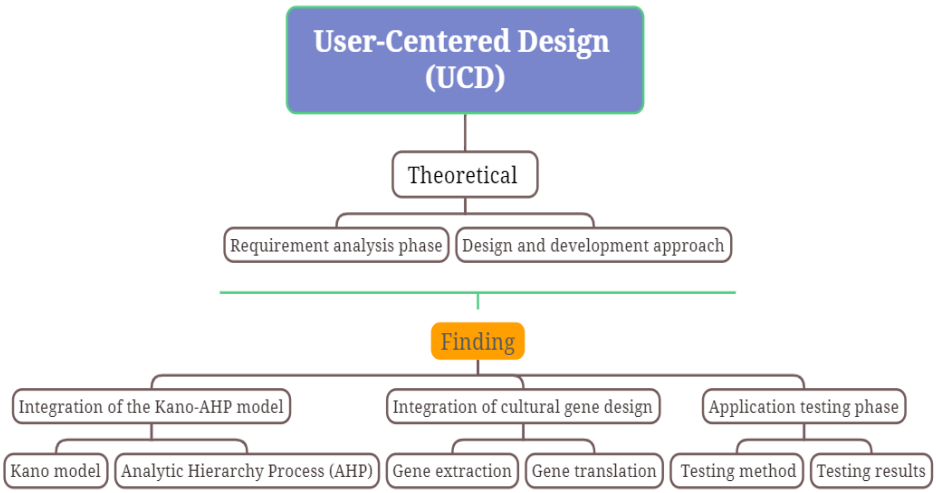


Fig. 1: Theoretical framework

3.1 Hypothesis

This study stems from an in-depth examination of the research question to explore why Mianzhu New Year pictures are not popular with consumers, the problem of design homogeneity, and the insufficient embodiment of art and culture. Proposes three hypotheses, which together form the core of this study and can guide subsequent exploration and empirical analyses.

Hypothesis 1: A design that retains the graphic and colour features of traditional Mianzhu New Year pictures can improve users' cultural identity and Aesthetic satisfaction.

Hypothesis 2: Integration of regional cultures can enhance users' positive feelings and their cultural awareness of the product.

Hypothesis 3: Applying digital interactive features enhances users' cultural understanding and aesthetic sensibility.

3.2 User needs

The first phase employed the Kano model (Kano, 1984) to explore the non-linear relationship between product performance and user satisfaction. This survey method categorises user requirements into five types—must-be, one-dimensional, attractive, indifferent, and reverse quality (Hogstrom et al., 2010)—and was used to assess responses to features of Mianzhu New Year Picture tourism products.

A set of 30 evaluation indicators, covering basic attributes, art-technology integration, cultural communication, and tourism consumption needs, was developed and validated by three professors in design and tourism. The survey was conducted using purposive sampling (Neyman, 1934) in the Mianzhu New Year Picture tourism area and neighbouring cities. Participants included 124 individuals familiar with the products—50 tourists, 34 university students, 20 souvenir retailers, and 20 artists. The questionnaire was administered via the Chinese survey platform WJX (https://www.wjx.cn/), with access restricted to eligible volunteers. Of the 124 questionnaires

distributed, 120 valid responses were received—a 97% response rate. Respondents rated 30 demand indicators on a 5-point Likert scale ranging from "strongly like" to "unacceptable" for both functional and dysfunctional forms of each feature.

The second phase used the Analytic Hierarchy Process (AHP), a decision-making method developed by Thomas Saaty (Saaty, 1987) that combines qualitative and quantitative analysis. AHP structures a problem hierarchically, from the overall goal down to criteria and alternatives. By solving the judgment matrix and corresponding eigenvectors, priority weights for each element are derived. In this study, the goal level was the optimised design of the tourism products; the criteria level included must-be, one-dimensional, and attractive quality; and user demand indicators formed the sub-criteria level. The resulting AHP model is shown in Fig. 2.

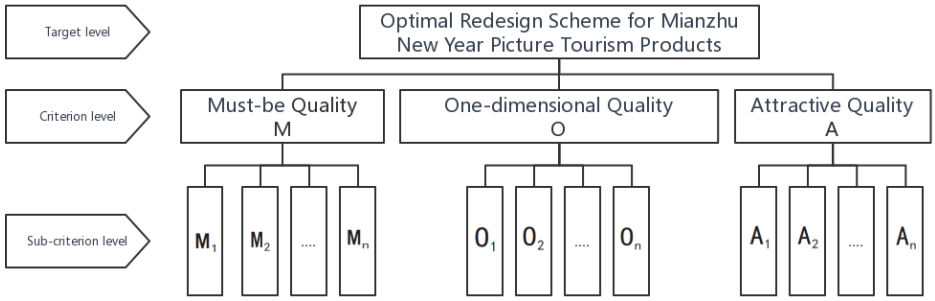


Fig. 2: Hierarchical analysis model

3.3 Design Cultural gene

Based on the new research hypothesis, the study applies the cultural gene theory (Dawkins, 1976) to user needs. By deconstructing the cultural DNA, it extracts the cultural gene elements of the Mianzhu New Year Pictures design to retain its cultural value in the innovation.

3.3.1 Cultural Gene Extraction

Based on the extraction method of traditional cultural genes and the extraction method of design factors in product design, combined with the principle of design innovation for research and using the relationship between primary and secondary as well as the functional attributes as the criteria for division, culture genes can be divided into three types: core genes, attached genes, and hybrid genes. Each core gene, attached gene, and hybrid gene plays an indispensable role, and together, they form a complete culture system. See Fig. 3.

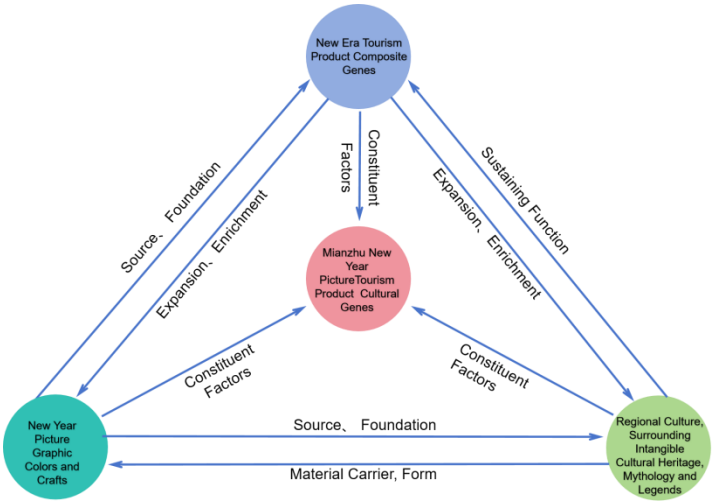


Fig. 3: Mianzhu New Year Picture Tourism Product Cultural Gene Model

3.3.2 Cultural gene translation

Finding the design elements of Mianzhu New Year Pictures tourism products through cultural genes, using a method similar to genetic reverse transcription (Yang et al., 2023), is called the "central dogma." Initially proposed by F. H. C. Crick in 1957, the central dogma is DNA • RNA • Protein. Professor Feng Peien(2002) introduced the idea of product gene extraction using reverse transcription and applied it to product design. This "reverse engineering" method allows researchers to derive core components by analysing known structures (Yang et al., 2023). For Mianzhu New Year Picture tourism products, this approach involves identifying cultural elements—such as imagery, structure and cultural symbols—aligned with user preferences. See Fig. 4

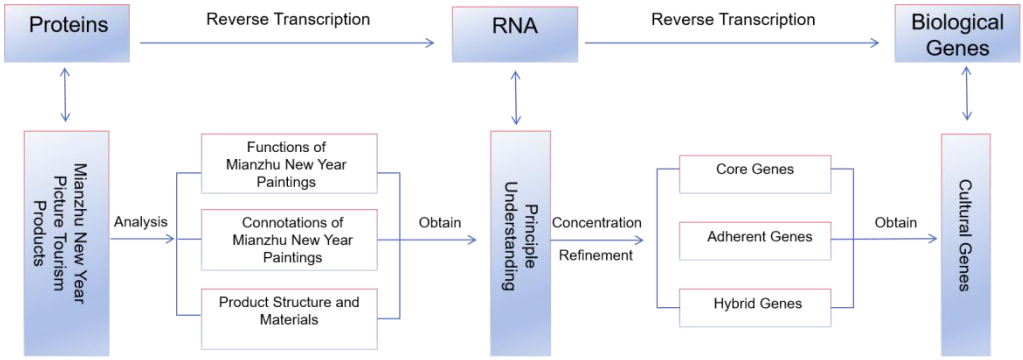


Fig. 4: Mianzhu New Year Picture tourism products gene transcription information

4.0 Findings

Data analysis primarily identified user preference patterns, with experiments yielding more stable cultural gene elements. This resulted in preliminary design prototypes, which were ultimately validated through multiple testing iterations to confirm the research's feasibility.

4.1 Requirement Finding

By analysing the quality attribute indicators of Mianzhu New Year Picture tourism products, seven irrelevant indicators were eliminated, reducing the original 30 indicators to 23 essential, one-dimensional, and attractive indicators, thus establishing a demand evaluation system for tourism products. Based on an AHP analysis, the priority weights and preferences for product redesign requirements were determined. The results show that the secondary demand indicators, ranked by comprehensive weight, are as follows: traditional colour, traditional graphics, eco-friendly and non-toxic features, regional folk themes, digital 3D printing, 3D modeling, commemorative significance, mythical themes, interactive experience functions, innovative craftsmanship, innovative graphics, integration with other intangible heritage products, digital dynamic processes, display, and decorative functions, creative colour, 2D modeling, cost-effectiveness, integration with products of different eras, custom design, office gifts, convenient transportability, entertaining features and virtual imaging technology. See Fig. 5

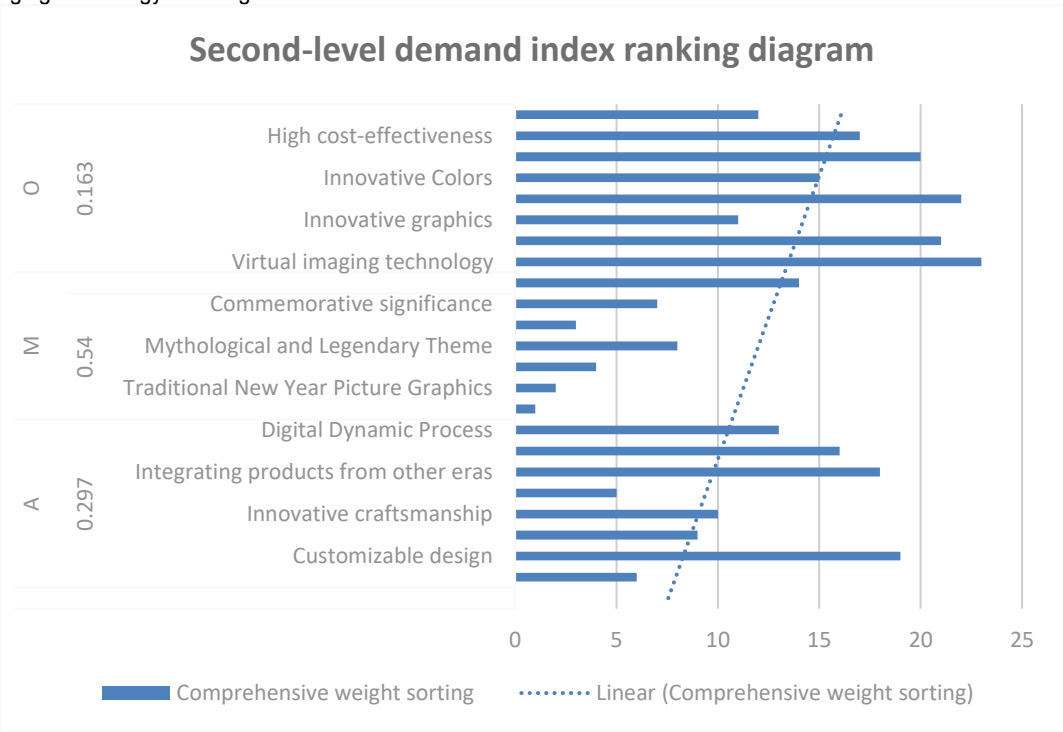


Fig. 5: Ranking of secondary demand index for Mianzhu New Year Picture tourism souvenirs

By analysing the combined weights of secondary demand indicators, it was found that essential quality indicators ranked higher than attractiveness quality indicators. The latter, in turn, generally had higher combined weights than one-dimensional quality indicators, though the differences were marginal. These results align with the study's objectives.

The findings support the initial hypotheses, confirming that users recognise the basic characteristics of traditional New Year pictures and expect innovations such as digital technology. Additionally, more specific user demand weights were obtained, leading to a

refinement of the original three hypotheses. Based on user needs, environmental protection and three-dimensionality were incorporated, resulting in five revised hypotheses for further experimentation.

New hypothesis 1: Designs that retain the graphic and colour features of traditional Mianzhu New Year pictures can improve users' cultural identity and aesthetic satisfaction.

New hypothesis 2:The use of environmentally friendly materials enhances positive user perceptions of product and brand identity.

New hypothesis 3:The integration of regional cultures can enhance users' positive feelings about the product and their cultural awareness.

New hypothesis 4:3D modelling or interactive Design can improve users' haptic experience and satisfaction.

New hypothesis 5:The application of digital interactive features enhances the cultural understanding and aesthetics of the user.

4.2 Experimental process

This experiment focuses on 3D model design and 3D printing, aiming to create an innovative and culturally representative Mianzhu New Year Picture tourism product character intellectual property（IP）. By integrating traditional Mianzhu New Year Picture elements into modern 3D modelling, the experiment explores the preservation and innovation of traditional culture. It validates the feasibility of redesigning form and material for actual products.

Objectives: To validate Hypotheses 2, 3, and 4. (2. The use of eco-friendly materials can enhance users' favorability toward the product and brand recognition; 3. The integration of regional culture can increase users' favorability toward the product, and cultural cognition; 4. 3D modelling can enhance users' visual experience and overall satisfaction with the product.)

Experimental Product: IP character redesign-selecting Mianzhu New Year Picture character designs to demonstrate the transition from 2D to 3D using 3D modelling and 3D printing design blueprints.

4.2.1 Cultural Gene Extraction and Translation

The first step is redesigning the overall form. To meet the Mianzhu New Year Picture tourism users' needs for traditional graphic and colour inheritance and innovation, researchers selected dominant genes of overall form from the previously established cultural gene database for visual Design. Using design principles such as abstract geometry (Kandinsky, W., 1947) and colour composition (Itten, J., 1970), these genes were translated to create a new redesign form. See Fig. 6.

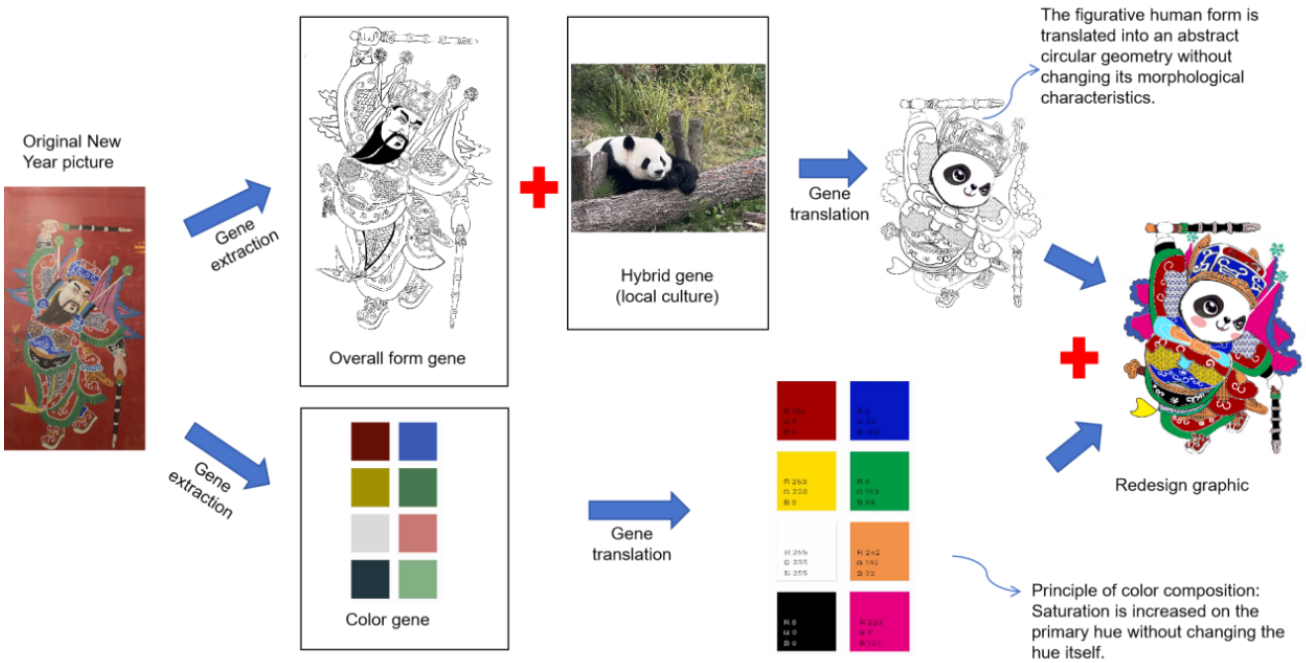


Fig. 6: Cultural Gene Translation Design Chart

4.2.2 Design of prototype drawings - medium fidelity prototype

In the second stage, the genetically translated 2D forms are designed into 3D modelling representations with corresponding colours. For this modelling process, we primarily use Maya, ZBrush, and Blender for 3D production, and finally, these designs can be converted into formats such as STL for 3D printing (Shahrubudin et al., 2019).In order to view the three-dimensional effect of the character, a medium-fidelity prototype design was chosen to facilitate the display of the effect and texture of the graphic in different materials and sizes of tourism products. See Fig. 7

Fig. 7: 3D colour rendering

4.3 Testing and Iteration

To evaluate the experimental outcomes, a focus group test was conducted following the approach of Krueger and Casey (2014). Participants were selected through purposive sampling to ensure relevant backgrounds, resulting in a group of six individuals—balanced by gender (three men and three women) and aged between 25 and 40. The sample comprised three key perspectives: a professional 3D designer, who assessed the model and printing results; tourism users, who reflected the views of cultural consumers; and design students, who provided insights into innovation and practicality. This diversity allowed a multidimensional evaluation of the 3D design's application in redesigning the Mianzhu New Year Picture character IP for tourism.

4.3.1 Focus group testing

The testing process was conducted online via Tencent Meeting, lasting 60 minutes, with test content available in Chinese and English versions, reviewed and approved by a product design professor. The session ensured that participants could engage smoothly in discussions, using screen sharing to display medium-fidelity prototype images of the 3D model and simulated 3D printing effects. Participants were allowed to ask questions and provide feedback in real time without interfering with others' responses.

Based on the participants' responses, the researcher identified the following three key themes through initial reading and labelling: 3D styling and visual appeal, cultural integration and brand identity and 3D printing texture expectations. The relevant discussion content for each theme was assigned specific open codes to facilitate in-depth analyses (Table 1).

Table 1: Table of Open Data Codes for Experiment

thematic	coding	descriptive
visual appeal	VA (Visual Appeal)	Involves participant feedback on the overall visual appeal of the 3D character IP image, including three-dimensionality, detailing, and colour palette .
Cultural fusion	CF (Cultural Fusion)	Involves participants' perception of the cultural elements of Mianzhu New Year Pictures incorporated in the design, especially the effect in enhancing product favourability and brand identity.
3D Printing Texture Expectations	TE (Texture Expectation)	Involves participants' texture expectations of 3D printed renderings, especially expectations and concerns about the texture of the finished product .

Data collation and statistics: The collected rating data were first collated through SPSS statistical software. The scores of each scoring dimension were analysed with descriptive statistics, and key statistical indicators such as mean and standard deviation were calculated to understand the overall feedback from the participants. These statistical results helped the research team assess the overall performance of the Design and provided a scientific basis for further design optimisation and improvement. (Table 2)

Table 2: Descriptive statistical analysis table for quantitative data.

Rating dimension	Mean	Standard Deviation	Analysis of results
visual appeal	4.3	0.67	The results indicate that participants were generally satisfied with the 3D character IP design, with the visual effect being highly recognized. The standard deviation of 0.67 suggests that participants' opinions were relatively consistent.
Cultural fusion	4.1	0.72	The results indicate that the cultural elements of Mianzhu New Year Pictures incorporated in the design were well recognized by participants, enhancing cultural expression. A standard deviation of 0.72 suggests that a few participants had differing opinions on the expression of these cultural elements..
3D Printing Texture Expectations	3.9	0.85	The relatively low ratings and large standard deviation (0.85) indicate that there is some uncertainty and concern among participants about the texture expectations of the finished 3D printed product. expectations of the finished 3D printed product.
Overall satisfaction	4.2	0.70	It shows that participants' overall satisfaction with the design was high and the overall effectiveness of the design was widely recognised.

4.3.2 Product Iteration

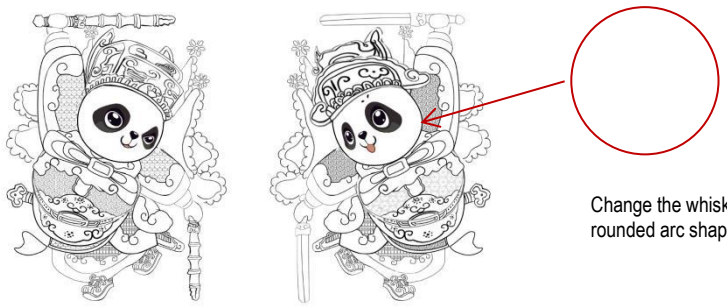
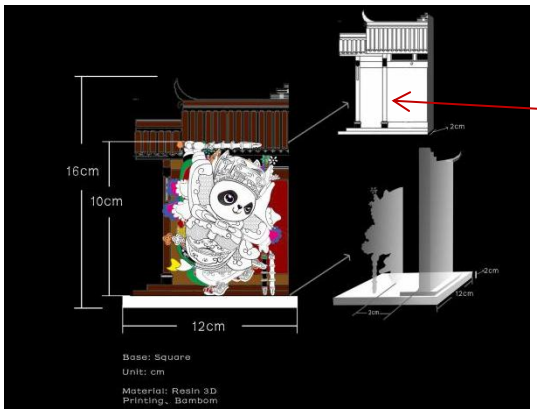
Through focus group testing, researchers summarised design modifications and organised them into guiding opinions for product design iterations. (Table 3)

Table 3: Product iteration modification comment form

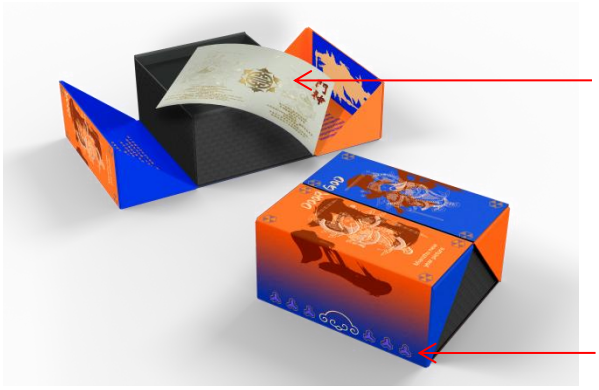
Summary of modifications	Improvement programme
Enhanced visual impact: more innovation in colour and detailing.	Consider reverse thinking to reduce detail and enhance blockiness of colour and shape
Deepen the cultural expression: more innovative and modern designs can be tried on the costumes and decorative details of the characters.	Make contrasting characters, keep the ones with lots of detail, and then design a set of clean, brightly coloured and shaped
Manage texture expectations:Clearly communicate any potential differences between the rendering and the actual finished product to manage user expectations effectively and avoid discrepancies in texture between the final product and user expectations.	Increase the sense of atmosphere of the rendering to improve the user's visual experience
Reasonable integration of regional culture: Reasonable integration of regional cultural elements to make them more representative and attractive in the character IP image, further enhancing the user's cultural identity and brand loyalty to the design.	Not imposing regional cultures, highlighting cultural priorities, retaining characteristic cultures, and improving character selectivity by adding characters and creating contrasts

Re-adjusting the shape and local details from the sketch stage, the drawings have been comprehensively revised, focusing on the facial structure, practical functions, interactive experience, and other aspects, aiming to provide a complete blueprint for Design and production. According to user feedback, the form of the Mianzhu New Year picture tourism product has been modified. The panda's facial features have been adjusted by removing the whiskers and turning it into a rounded single arc. The Panda Door Guardian is designed as a desktop bookshelf with a Sichuan-style door as the supporting structure. This reflects the relationship between the door guardian and the door and incorporates local cultural connotations. The product is planned to be 16cm high and 12cm wide. The panda door guardian in the foreground will be created using 3D technology. In contrast, the background door will be made of Sichuan bamboo material and presented as a whole with packaging to improve the quality of the rendering. (Table 4)

Table 4:Experiment Product iteration design (a)

Category	Design drawings
Facial structure	 Change the whiskers to a rounded arc shape.
Practical functionality	 Sichuan (Mianzhu) traditional residential door facade. Material: Bamboo Function: Desktop bookshelf

Packaging design



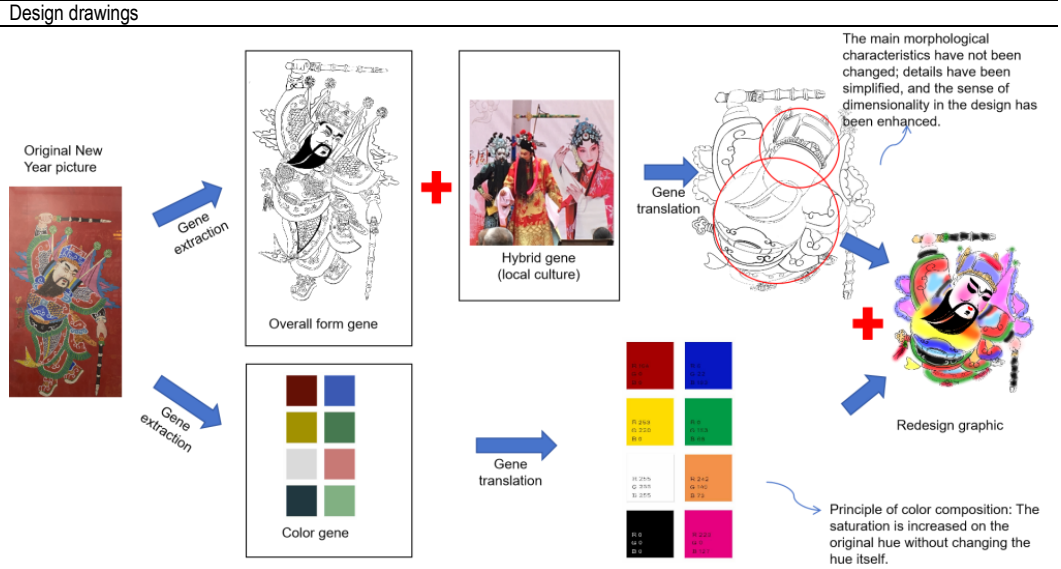
Packaging lining: New Year Picture rice paper 、 Gold foil printing、 Door god elements

Packaging box: Door god elements, Armour patterns, Waistband cloud patterns

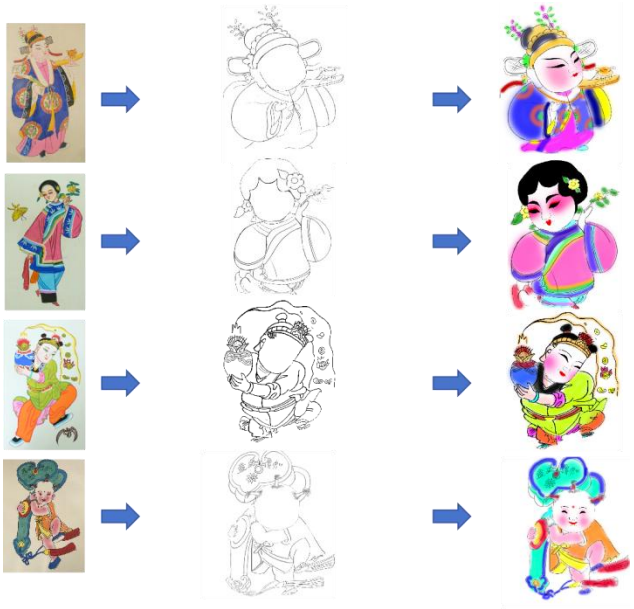
Comprehensive effect

Increase the form of character design, with more serialised effects, to form a contrast, using different character images to show the image characteristics of Mianzhu New Year Pictures. The overall shape of the form is closer to the ground, product design for the image of a non -tumbling, face along the cultural characteristics of the experiment, the integration of the Chinese Sichuan region of the theatre face, more cultural connotations of the characteristics of the details of the product using a minimalist style, with a large trait instead of a small local, more people remember the characteristics of the same time, at the same time, in the later stage of the 3D printing, to reduce the difficulty of the printing, better portrayal of the texture of the product finally presented! The effect is the IP character blind box product effect diagram. (Table 5)

Table 5:Experiment Product iteration design (b)

Category	Design drawings
Design Ideas	

Character Showcase



Three-dimensional Program

Name: Mianzhu New Year Painting Blind Box
Material: Resin
Dimensions: 8 x 6.5 x 16 cm
Process: 3D Printing
Note: A size deviation of 0-2 cm is within the normal range

Comprehensive effect

5.0 Discussion and Implications

A key challenge in designing innovative intangible cultural heritage products is balancing traditional elements with modern needs. Represented by Mianzhu New Year Pictures, this heritage combines rich cultural value and unique artistry. This study uses 3D character design to transform these elements into tourism products suited to modern markets, exploring user needs, cultural genes, and iterative improvements to validate research hypotheses.

5.1 The importance of User-Centred research

In the Design of Mianzhu New Year Picture tourism products, user needs are essential, encompassing visual experience, emotional interaction, and cultural perception. User-Centred Design (UCD) can deeply explore user needs, ensuring that the Design aligns with modern aesthetics while evoking cultural resonance and emotional connection. For 3D character design based on Mianzhu New Year Pictures, users expect visual appeal and wish to perceive the cultural essence through interaction. Therefore, the design process must

incorporate user research and feedback to understand their needs fully, ensuring the product conveys cultural value and enhances user experience and satisfaction.

5.2 The centrality of cultural genes in Design

The cultural gene approach extracts core symbols from Mianzhu New Year Pictures, such as colours, lines, and patterns, transforming them into design elements that align with modern aesthetics and applying them to 3D character design. This symbolic extraction and transformation ensure that the cultural essence of Mianzhu New Year Pictures is preserved and innovated within modern products, allowing them to carry the historical heritage of intangible cultural heritage while building cultural connections with contemporary consumers and enhancing their sense of cultural identity.

5.3 The need to design experimental iterations

In the design process, conducting multiple rounds of prototype iteration through experimental methods helps designers continuously refine the product based on user feedback. Focus group testing provides direct user feedback, identifying character design shortcomings and user experience pain points. The Design can continuously improve aesthetics, functionality, and cultural expression through repeated iteration, ensuring that the final product meets user needs while conveying the essence of intangible cultural heritage.

5.4 Limitations

This user survey is limited to Mianzhu New Year Painting Tourist Village. Purposeful sampling was used to provide in-depth feedback, but the lack of broad sample diversity and representativeness affected the generalizability of the results. Secondly, the UCD has effectively guided the design process; the diversity of user needs and market changes has brought new challenges, especially in cross-cultural applications, where the effectiveness of UCD needs to be verified through diverse means. Finally, due to the limited number of iterations for focus group testing, increasing the frequency of testing and iterations will help achieve more comprehensive optimisation, ensuring that the design better meets user needs and conveys the value of intangible cultural heritage.

6.0 Conclusion& Recommendations

In summary, this study combines UCD theory with the cultural gene method. It employs iterative design experiments to provide an innovative research framework for intangible heritage tourism product design, particularly the 3D character design of Mianzhu New Year Pictures. The study demonstrates that UCD effectively integrates user needs with cultural heritage.

The cultural gene method offers theoretical support for cultural extraction and transformation in Design, and iterative design experiments ensure continuous product optimisation. This approach shows that in-depth user research can secure the practical application of traditional cultural elements in products while meeting modern market demands, offering innovative insights for the sustainable development of intangible heritage products.

Acknowledgments

The authors are faithfully grateful to Universiti Pendidikan Sultan Idris (UPSI) for providing the resources and platform to conduct this research, to the expert professors who guided the study, to the participants who participated in the study, and to the Mianzhu New Year Picture Museum.

Paper Contribution to the Related Field of Study

This study not only verifies the process and development mode of innovative tourism product design at Mianzhu New Year Pictures, reflecting the innovation of theory and practice, but also proposes feasible strategies for integrating and developing intangible culture and the tourism industry.

References

Atlason, R. S., Stefansson, A. S., Wietz, M., & Giacalone, D. (2018). A rapid Kano-based approach to identify optimal user segments. Research in Engineering Design, 29(3), 459-467. https://doi.org/ 10.1007/s00163-018-0282-y

Dawkins, R. (1976). The Selfish Gene. Oxford University Press. https://doi.org/10.1093/0192860925.001.0001

Dai, Y., & Zhang, S. (2023). Research on the construction of industrial product design and service platform based on KANO-AHP model. Applied Mathematics and Nonlinear Sciences, 8(1), 1-10. https://dx.doi.org/10.2478/amns.2023.2.01531

Hartawan, M. (2022). PENERAPAN USER CENTERED DESIGN (UCD) PADA WIREFRAME DESAIN USER INTERFACE DAN USER EXPERIENCE APLIKASI SINOPSIS FILM. jeis, 2(1). JEIS, 2(1). https://doi.org/10.56486/jeis.vol2no1.161

Itten, J. (1973). The art of color : the subjective experience and objective rationale of color.https://archive.org/details/artofcolorsubjec00itte

Krueger, R. A., & Casey, M. A. (2014). Focus Groups: a Practical Guide for Applied Research (5th ed.). SAGE Publications.

Kandinsky, W. (1947). Point and Line to Plane. Kandinsky: Complete Writings on Art, 527–699.https://archive.org/details/kandinsky-wassily-1866-1944-point-and-line-to-plane

Olalere, F. E. (2019). Intangible cultural heritage as tourism product: The Malaysia experience. African Journal of Hospitality, Tourism and Leisure, 8(3). 1-10.

Natsir, F., & Sihombing, R. A. (2022). Penerapan Metode User Centered Design pada Rancangan User Interface Marketplace Pemasaran Produk Olahan Perikanan. JPCS, 2(2). https://doi.org/10.37366/jpcs.v2i2.1472

Saaty, R. W. (1987). The analytic hierarchy process-what it is and how it is used. Mathematical Modelling, 9(3-5), 161-176. https://doi.org/ 10.1016/0270-0255(87)90473-8

Shahrubudin, N., Lee, T. C., & Ramlan, R. (2019). An overview on 3D printing technology: technology, materials, and applications. Procedia Manufacturing, 35, 1286-1296. https:// doi.org/10.1016/j.promfg.2019.06.089

Saaty, T. L., & Vargas, L. G. (2012). Models, methods, concepts & applications of the analytic hierarchy process (2nd ed., Vol. 175). Springer. https://doi.org/10.1007/978-1-4614-3597-6

Sylvain, F., & Chaniaud, N. (2023). Multi-user centered design: acceptance, user experience, user research and user testing. https://doi.org/10.1080/1463922x.2023.2166623

Yang, S., Yi, L., Guan, H., & Li, Y. (2023). A meme-based approach for knowledge mining, organisation, and presentation of traditional Chinese settlement culture. Heritage Science, 11(1), 1 Heritage Science, 11(1), 1 -17. https://doi.org/10.1186/s40494-023-01052-w

Yuan, B., & Jian-min, Z. (2022). Research on modelling design of agricultural machinery based on Kano model and AHP∗. Journal of Machine Design, 1-7. https://doi.org/10.13841/j.cnki.jxsj.2022.04.021

Yang, W., & Seo, E. (2021). The aspects of modern Korean architectural discourses observed by applying MEME theory. DOI:10.1080/13467581.2021.1941981500

Zhu, Y., & Teng, C. (2020). Construction and Application of the Design Method of Cultural Products Based on the Meme of Liao dynasty ceramics. https://doi.org/10.1051/e3sconf/202017902016