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Experimental research on innovative design of intangible cultural heritage products based on UCD and cultural gene theory

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Abstract: This study aims to explore how to achieve innovative design for intangible cultural heritage (ICH) tourism products through User-Centered Design (UCD) theory and the cultural gene approach. Using the national ICH of Mianzhu New Year Pictures as a case study, the research, guided by UCD theory, conducts an in-depth analysis of user needs, with a detailed investigation into users' aesthetic preferences and functional requirements to ensure that the design meets modern market demands. Additionally, the cultural gene approach provides theoretical support for extracting and transforming the core cultural symbols of Mianzhu New Year Pictures, allowing these symbols to be effectively integrated into contemporary products through symbolic design. This approach ensures that the design retains the cultural characteristics of Mianzhu New Year Pictures while enhancing users' cultural identity and overall experience. This study employs a mixed research methodology, with a primary focus on design experimentation, supported by KANO-AHP, ethnographic fieldwork, and iterative testing to analyze user needs and optimize the product. Initially, KANO-AHP is used to conduct a quantitative analysis of user requirements, identifying priorities in functionality, aesthetics, and emotional appeal to provide precise guidelines for product design. Next, ethnographic fieldwork is conducted through observation and interviews to gain deep insights into the cultural background, artistic features, and user contexts of intangible cultural heritage, enabling the extraction of representative cultural gene elements. Finally, the study employs design experimentation for multiple rounds of user testing and product iteration, incorporating feedback from focus groups to progressively enhance the product's functionality and aesthetic appeal, thereby increasing practicality and user satisfaction. This comprehensive experimental approach allows the researcher to dynamically adjust the product based on real-time feedback, ensuring continuous improvement in actual applications while effectively integrating cultural heritage with modern user needs. The results of the study show that the combination of UCD and cultural genetics methodology can effectively enhance the market attractiveness and cultural heritage value of NRM products. This study not only promotes the application of UCD and cultural gene method in the design of non-heritage products and provides practical guidance for the modernisation and innovation of non-heritage products, but also opens up a new way of thinking for the inheritance and development of non-heritage culture in modern society.

Keywords: *Cultural gene, Innovative design for tourism products, Intangible cultural heritage (ICH), Mianzhu new year pictures, User-centered design (UCD).*

1. Introduction

With the accelerated development of globalisation, intangible cultural heritage (e.g. traditional crafts, folk art, etc.) is facing the double challenge of cultural inheritance and innovative design. It is often difficult for traditional cultural products to attract the attention of the younger generation in the market, and the design of some products remains at the static level of inheritance, making it difficult to adapt to the needs of modern consumers. At the same time, the core of cultural heritage protection and

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inheritance is to make culture "live" in the life of contemporary users, and integrate it with the current consumer culture through product innovation. Therefore, how to innovate on the basis of respecting the cultural origin to meet the needs of users has become a key issue in the design of non-heritage products.

Against this background, this paper explores how to achieve its innovation in modern tourism product design through User-Centred Design Theory (UCD)（Donald Norman，1988） and Cultural Genetic Approach (Dawkins, 1976). In this paper, China's national intangible cultural heritage Mianzhu New Year's Pictures are selected as a research case. As a representative of traditional Chinese folk art, Mianzhu New Year's Pictures express a rich folk culture with its unique colours, craftsmanship and shapes, but with the changes of the times, its traditional forms of expression and craftsmanship have gradually lost their market attraction. Therefore, how to transform the core cultural and artistic elements of Mianzhu New Year's Pictures into a design that meets the needs of contemporary users by means of modern design methods has become an important issue in the inheritance and innovation of Non-material Cultural Products (NGPs).

This research process is based on user-centred design theory (UCD), which extracts and transforms the core cultural symbols in Mianzhu New Year's Pictures through the theory of cultural genes, and generates a prototype of a modern tourism product.The core concept of UCD is to design around the needs of users, and to integrate traditional cultural elements into modern product design through a deep understanding of users' aesthetic preferences and functional needs, so as to enhance the user's sense of cultural identity and product experience. The core concept of UCD is to design around the needs of users. At the same time, the cultural gene approach provides a way to extract key elements from non-heritage culture and symbolise them, so that Mianzhu New Year's Pictures can be revitalised through innovative design.

This study combines theory and practice, uses the design experiment method to test the research effect, generates a design prototype that meets the user's needs through cultural gene extraction and translation, conducts focus group testing on this basis, and carries out iterative optimisation of the product design, and ultimately realises the innovative design of non-heritage tourism products. This research can promote the application of UCD and cultural gene method in the design of intangible cultural heritage in academics, and also provide practical guidance for the modern design of non-heritage products, and provide new ideas to promote the inheritance and innovative development of non-heritage culture.

2. Methodology

2.1. Framework

This study adopts a mixed research methodology, with the overall research methodology being a user-centred design (UCD) approach. Donald Norman 1988, his groundbreaking book, The Design of Everyday Things, is a classic in the field of design. The UCD methodology ensures that the design process is always centred on the needs and experiences of the user, and helps you to understand the preferences, needs and habits of your target group of users to guide the direction of your product design. The UCD method helps you to understand the preferences, needs and habits of your target user groups, which can guide the direction of your product design.

This study is based on the User-Centered Design (UCD) research methodology, which is divided into three stages: requirements research, design prototyping, and development iteration. Each step is underpinned by both theoretical and technical foundations, and the data generated provides the basis for the next stage, ensuring continuity in design and systematic development. While requirements research helps create products that meet market needs, cultural genetics research ensures that product design is deeply rooted in cultural traditions, and experimental tests ensure innovation and practicality. (Figure 1).

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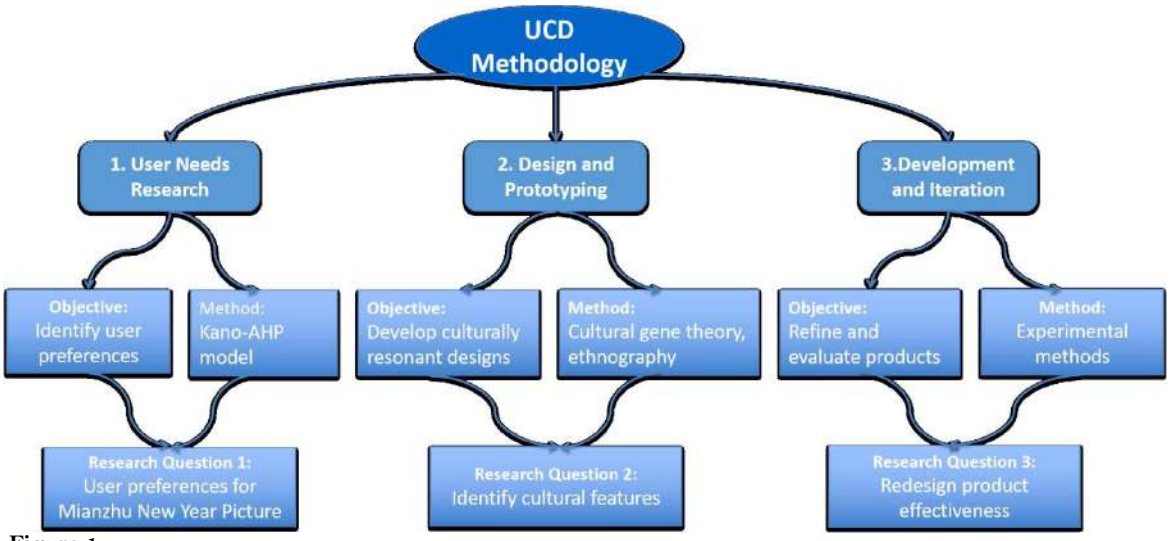

Figure 1.
Theoretical framework.

3. Method

3.1. User Requirements Research

The research objective of the first stage is to study the preference of tourism consumers, and to determine the experimental hypothesis by researching the user demand for tourism products based on the KANO-AHP combination model for New Year's picture in Mianzhu City.

Understanding the needs of users is crucial in the process of product redesign. According to the User-Centred Design (UCD) methodology, design should be guided by user needs, preferences and behaviours to ensure that the product's features and functionality are aligned with user expectations. Through in-depth user research, designers can identify the pain points and needs that user encounter when using a product, which can inform the redesign process to better meet these expectations and needs. Jack Carroll (1995) also proposed a user-centred design process in his research, emphasising the importance of user research, prototyping and iterative feedback. Therefore, in order to conduct user needs research scientifically, this study applies the user needs of Mianzhu New Year's picture tourism products based on the KANO-AHP combinatorial model. The KANO (Kano, 1984) model is used to investigate the user needs and get the demand indicators, and the AHP (Saaty, 1980) weighted analysis is carried out according to the preliminary needs to get a more accurate combination of the combination of needs combination weighted. (Figure2)

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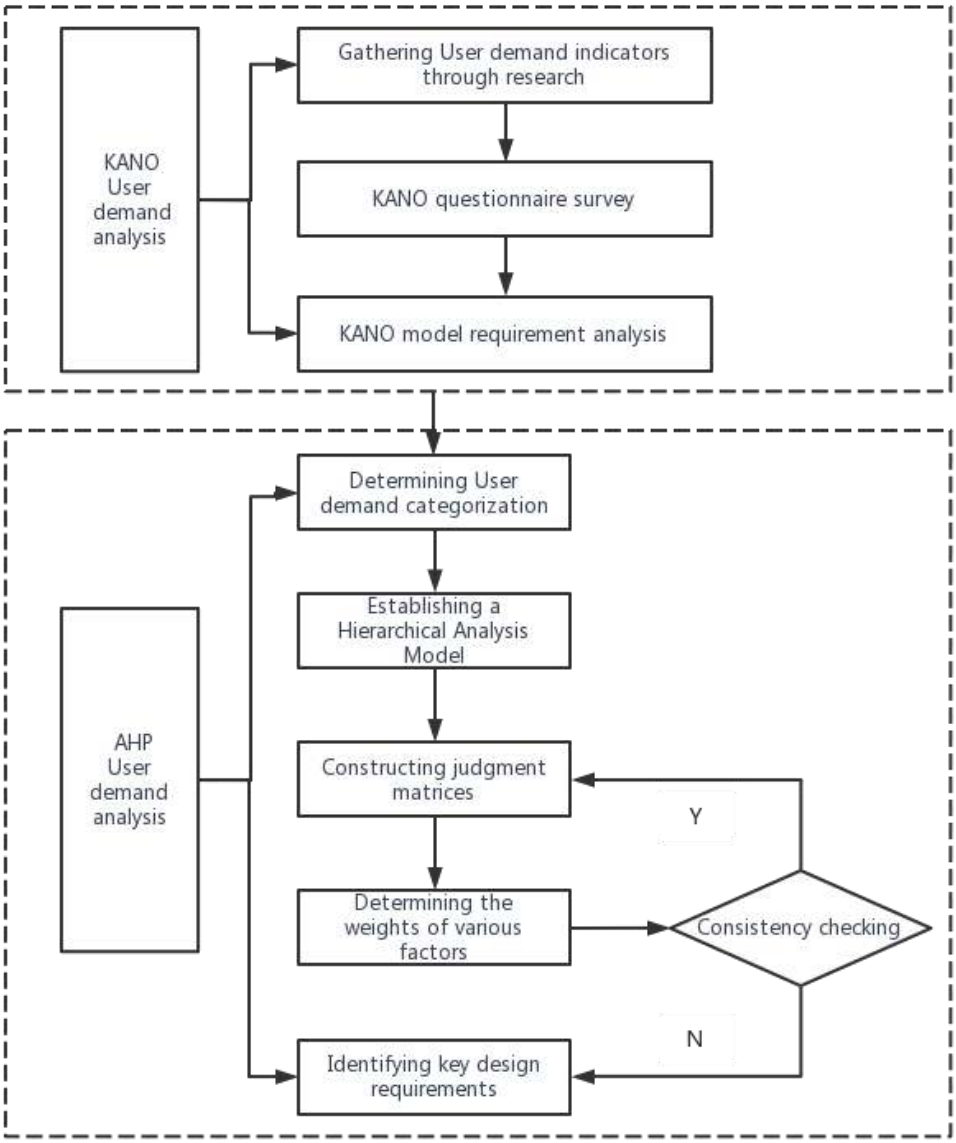

Figure 2.
User requirements research flowchart.

3.1.1. Questionnaire Research

Mianzhu New Year's Picture Tourism Product Needs Survey initially used the "kano" questionnaire model. The kano model, proposed by Tokyo Institute of Technology (1984), is a tool for classifying and prioritising user needs. The non-linear relationship between product performance and user satisfaction was investigated by analysing the impact of user needs on user satisfaction. Subsequently, consumer needs were classified into attribute categories based on the Kano assessment scale. After eliminating irrelevant requirements, the quantitative analysis continues: using the "relative customer satisfaction coefficient ratio" method proposed by Berger (1993), consumer requirements are filtered to select the most important priority requirements, i.e., the attribute requirements that must be met by the final design. Finally, this study will also incorporate the quantitative model AHP to improve the validity of Kano's model.

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Purposeful sampling was used for the study sample. According to the research data of Jiang Jing, Zhang Jie, and Jiang Yu (2022) who randomly sampled the population of Mianzhu New Year Picture tourism products in 2021, the consumer groups of Mianzhu New Year Picture tourism products include, for example, university educated youths, more educated individuals, and the cities around Mianzhu New Year Picture villages to learn about Mianzhu New Year Picture. In addition, 95.59 per cent of the respondents expressed their willingness to purchase Mianzhu New Year pictures tourism products, which indicates that although the consumer base of these products is limited, due to their willingness to purchasepurchase (Figure3).

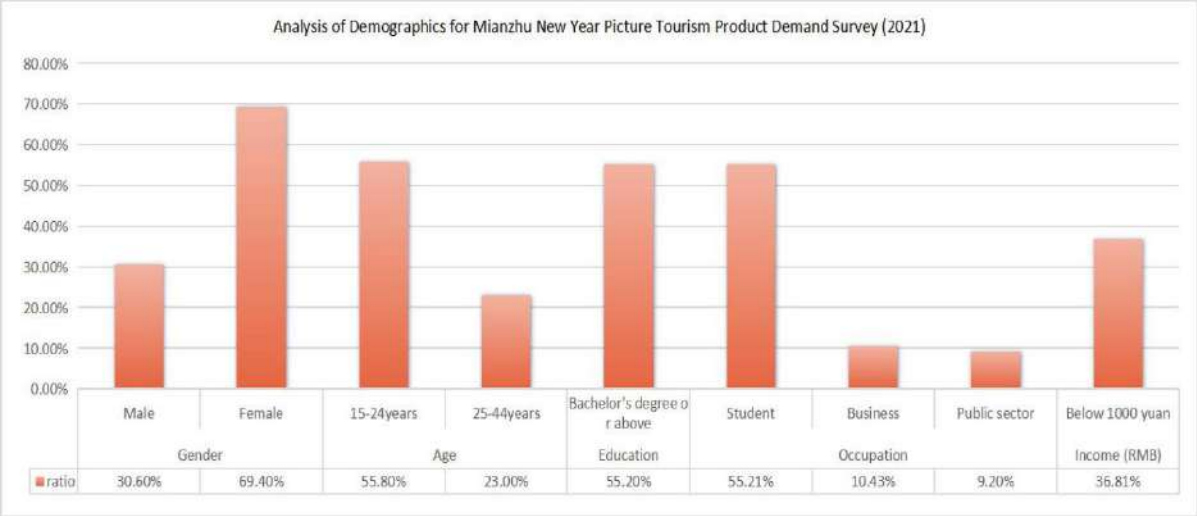

Figure 3.
Analysis of demographics for Mianzhu new year picture tourism product demand Survey (2021).

In the KANO questionnaire, unfolding under the principle of ethics committee approval, participants will be recruited to carry out the following process. Firstly, there will be an initial organisation of literature on New Year's pictures, followed by comprehensive guidance from experts in tourism, culture and art. Based on the redesign needs of the tourism and cultural creative products of the Mianzhu New Year pictures, it will be determined that the redesign needs to focus on exterior design, functional design and feature design. The basic characteristics of Mianzhu New Year pictures, tourism consumption preferences and cultural exchange functions were taken as design attributes. These were further refined to obtain 30 design indicators, which were then used to design the KANO questionnaire (Figure4). The KANO questionnaire was designed with 30 demand indicators, using a 5-point scale questionnaire and determining the demand attributes of each indicator based on KA, KO, KM and KI.

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KANO investigation questionnaire

Please tick the box below the option that matches your opinion for the question	I really like it	It should be	indifferent	settle for	Not acceptable
Mianzhu New Year Picture Tourism Cultural and Creative Product, Preserving Traditional New Year Picture Colors: If you have this function, your evaluation is:					
If you don't have this feature, your rating is:					

Figure 4.
Mianzhu new year's pictures tourism product innovation design user requirements research questionnaire template.

The survey will be primarily distributed through the standardized questionnaire platform https://www.wjx.cn/, and participants will take part in the survey by answering questions online. The use of the online survey facilitates wider geographical coverage, particularly in the New Year's Picture village of Mianzhu and the surrounding Sichuan region. The region covers an area of approximately 485,000 square kilometres and has a population of approximately 83 million (National Economic and Social Development Statistical Bulletin of Sichuan Province, 2023), including a diverse range of cultural experience seekers and potential tourism users. The choice of an online survey methodology effectively mitigates the limitations of data collected face-to-face over such a vast area. The survey will be distributed primarily through the standardised platform 'Questionnaire Star' (https://www.wjx.cn/), a widely used online survey tool that provides easy questionnaire design and data collection capabilities. This platform allows participants to respond online, eliminating time and space constraints and significantly improving the efficiency and scope of the data. A total of 120 questionnaires were returned.

3.1.2. Questionnaire Analysis

In the second step, after the KANO questionnaire was analysed, the AHP (Analytic Hierarchy Process) model was used for hierarchy calculation. The Analytic Hierarchy Process (AHP), abbreviated as AHP, was proposed by Thomas L, an American operations researcher. Saaty in the mid-1970s, proposing it as a systematic and hierarchical method of analysis that combines qualitative and quantitative aspects (Saaty, 1987). Based on the highly weighted design factors, the goal layer is proposed as the best redesign solution for the Mianzhu New Year Picture tourism product. The criterion layer consists of basic attributes, desired attributes and attractive attributes, and the comprehensive weights of each design factor are designed. By constructing a scientific and reasonable judgement matrix, the weights of the criterion layer and sub-criterion layer were calculated using the geometric mean method. Based on the highly weighted design factors, a final redesign proposal for the Mianzhu New Year picture tourism product was proposed.

This phase consists of analysing the attributes of demand for the redesign of the New Year's picture tourism product in the Mianzhu City Questionnaire Evaluation System. It entailed filtering out the essential, desired and appealing attributes of the user's needs, thus eliminating the need for undifferentiated and reverse attributes. This led to the construction of a needs assessment system and the design of an AHP questionnaire (based on the KANO questionnaire, which retains the questions after weight-based filtering). The final composite weight ranking was obtained by Delphi method expert assessment (Delphi method, Helmer, 1967), with a 1-9 scale weight comparison assessment. (Figure 5)

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Questionnaire for necessary demand indexes

Please compare the relative importance of the two indicators mentioned in the questionnaire. And hit "√" under the corresponding number										
index	1	2	3	4	5	6	7	8	9	index
Regional Folk Theme										Traditional New Year Picture Colors
Regional Folk Theme										Traditional New Year Picture Graphics
Regional Folk Theme										Mythological and Legendary Theme
Regional Folk Theme										Environmentally friendly and non-toxic
Regional Folk Theme										Commemorative significance
----										----

Figure 5.
AHP1-9 weighting scale.

After AHP hierarchical data analysis, the combined weights of the secondary demand indicators for the redesign of Mianzhu New Year picture tourism products are, in order: traditional Mianzhu New Year picture colours, traditional Mianzhu New Year picture graphics, environmentally friendly and non-toxic features, regional folk themes, digital 3D printing, 3D modelling, commemorative significance, mythological and legendary themes, interactive and experiential features, innovative processes, innovative graphics, integration with other intangible cultural heritage products, digital dynamic processes, display and decorative features, innovative colours, 2D modelling, high cost-effectiveness, integration with products from other eras, customised design, office etiquette, easy and convenient transportation, interesting entertainment features, and virtual imaging technology. (Figure 6)

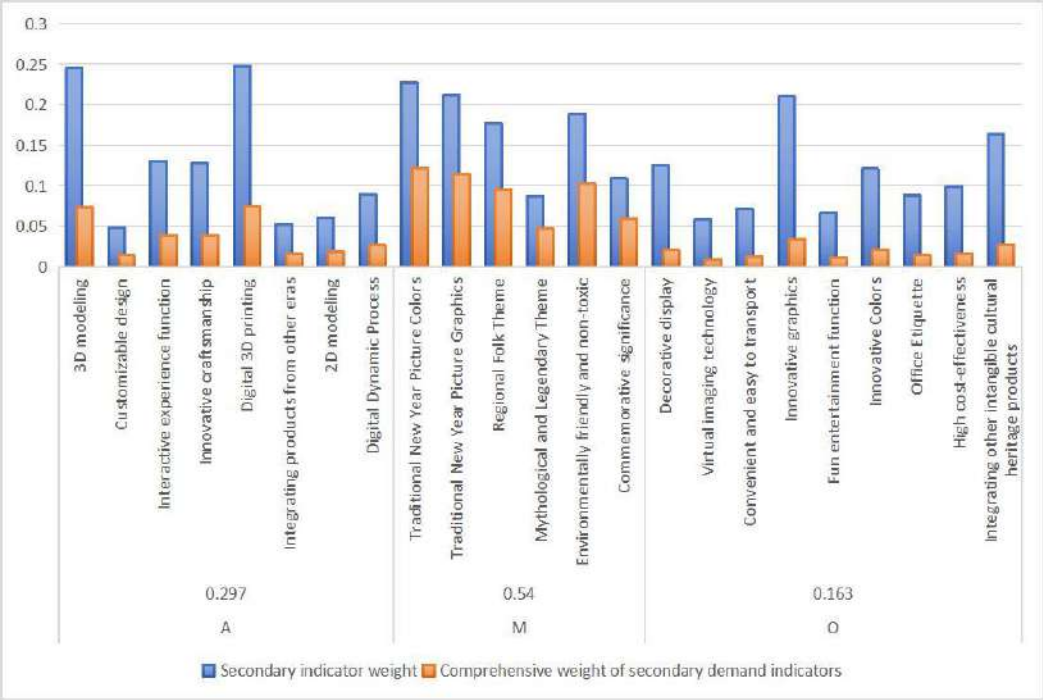

Figure 6.
Ranking of secondary demand index for Mianzhu Nianhua tourism souvenirs.

In order to clearly demonstrate the impact of requirements between expected and attractive attributes on user satisfaction, attractive requirements and expected requirements are integrated for

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comprehensive priority ranking. With the support of the secondary demand index ranking data and considering the actual context of Mianzhu New Year picture tourism product development, the product redesign was optimised based on the first 12 requirements in Table 16 through expert discussion, focusing mainly on Mianzhu New Year picture attributes. These 12 indicators include 6 essential requirements, 4 attractive requirements and 2 one-dimensional requirements, specifically including traditional Mianzhu New Year's picture colours, traditional Mianzhu New Year's picture graphics, environmentally friendly and non-toxic features, regional folk themes, digital 3D printing, 3D modelling, commemorative significance, mythological themes, interactive experiential functions, innovative craftsmanship, innovative graphics, integration with other intangible cultural heritage products, and digital dynamic process.

3.2. Design & Prototyping

In the second phase, the second stage of User Centred Design (UCD) will be examined in detail, focusing on design and prototyping to identify innovative elements of the product design and to propose design solutions and prototype concepts.

This phase was conducted in the context of cultural gene theory (Dawkins, 1976). context, an ethnographic research methodology is employed to facilitate in-depth data collection and analysis aimed at identifying the cultural and artistic aspects of Mianzhu New Year pictures. Ethnographic research emphasises the observation and recording of users' authentic behaviours and cultural traits in their natural environment, aiming to capture individuals' interactions and experiences in their everyday environment, thus providing a more holistic understanding of users' needs (Creswell, 2013). Through fieldwork, the researcher will visit the Mianzhu New Year Picture Village and its surrounding areas to collect pictorial data of paintings and record the daily lives and cultural activities of local residents and tourists to ensure the authenticity and diversity of the data collected.

The concept of cultural genes has its origins in modal theory, also known as modalism, which is a doctrine that examines the content of ideas from a perspective similar to Darwin's theory of evolution. The concept was introduced by British biologist and author Richard Dawkins in his 1976 book The Selfish Gene. Innovative design of Mianzhu New Year pictures tourism products needs to inherit the characteristics of the main body of Mianzhu New Year pictures and inject new creative impetus to meet the cultural needs of the new era.

This study will firstly use the cultural gene theory to identify the, epiphenomenal and implicit cultural genes related to the innovative design of Mianzhu Nianhua tourism products. The ontology of these cultural genes is Mianzhu New Year's Pictures, followed by regional cultures related to it and so on. The epigenetic genes will be identified by visual cultural symbols, colours and shapes, while the implicit genes will contain deeper cultural traits such as customs, social identities and emotional values. By analysing the image data and observation records, this study will identify the key cultural elements associated with the New Year's Day pictures of Mianzhu City and code these elements for subsequent analysis. This process will not only provide foundational data for product redesign, but will also lay the groundwork for understanding the cultural context of users. Finally, this study will translate these cultural elements based on cultural gene theory to identify innovative redesign solutions. The translation process involves refining and reproducing cultural elements to combine traditional culture with modern design.

By systematically analysing the relationship between exogenous and implicit genes, the study will propose product redesign solutions that meet user needs and cultural contexts. This process will take into account user experience, market demand and sustainability, and ultimately realise the innovative design of Mianzhu New Year's picture tourism products, thereby increasing their competitiveness in the cultural tourism market. Through this systematic ethnographic research methodology, ideas and prototyping solutions are provided for the experimental design testing of the innovative design of Mianzhu New Year pictures.

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3.2.1. Identification of Cultural Genes

This phase is based on the theory of cultural genes and uses ethnographic methods to collect data, aiming to gain an in-depth understanding of the cultural genes of the Mianzhu New Year's pictures according to user needs, so as to provide a theoretical basis for the design and production of these artefacts. The data collection process will begin with a field survey in the village of Mianzhu New Year's Eve Pictures and the surrounding area. The researchers will use a variety of methods, including field surveys, literature reviews, photography, interview transcripts, and online searches, to collect Mianzhu New Year pictures and artefacts related to these visual and cultural contextual data related to cultural practices, as well as Mianzhu New Year images documenting community interactions and activities.

At this stage, both exogenous and implicit cultural genes will be identified. Episodic genes originate from visual elements such as symbols, colours, and shapes, while implicit genes include cultural practices, social identities, and emotional values associated with the artwork (Bai, 2021; Zhao, 2021). The researcher systematically analysed the collected images and observations to identify the key cultural elements of the New Year pictures in Mianzhu City, and coded these elements to further explore their cultural back significance in the landscape (Zhang, 2022).

After identifying the cultural and artistic genes, the cultural gene extraction of Mianzhu New Year Pictures tourism products needs to analyse the graphics, structure and culture of Mianzhu New Year Pictures that meet the user's needs, and obtain the cultural elements with different functions. In other words, the "principle understanding" of culture (equivalent to RNA in bioengineering), followed by the concentration and extraction of culture elements (equivalent to reverse transcription in bioengineering), in order to obtain usable culture genes. Ultimately, the results of this phase will inform the design process, ensuring that the products developed resonate with user needs and cultural significance, and supporting the creation of innovative designs that reflect the traditional characteristics of Mianzhu New Year's Eve pictures while appealing to contemporary user preferences. (Figure7)

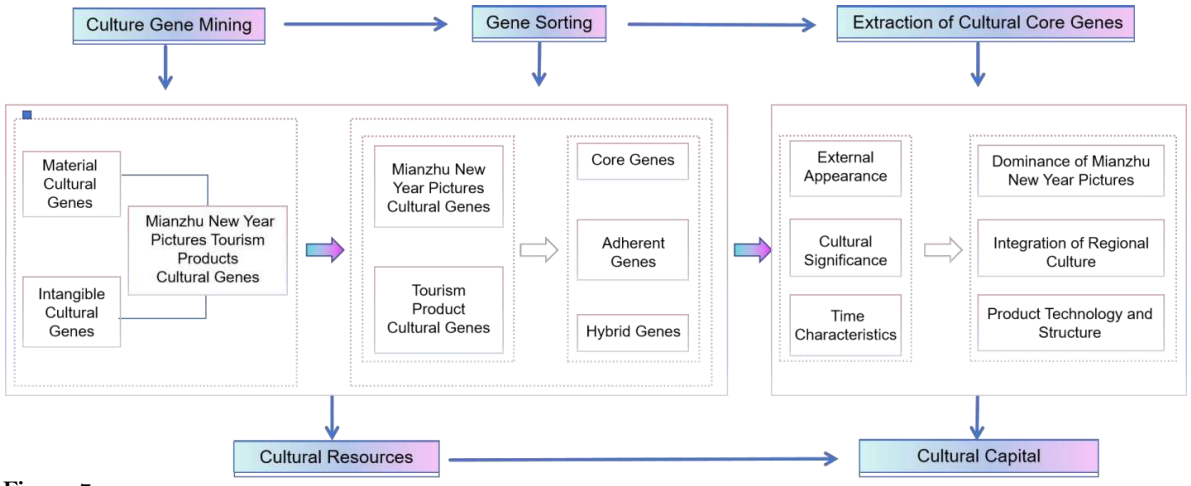

Figure 7.
Mianzhu new year pictures cultural gene extraction framework for tourism product design.

3.2.2. Translation of Cultural Genes

Finding the design elements of tourism products of Mianzhu New Year pictures through cultural genes is called "central dogma" using a method similar to gene reverse transcription (Yang et al., 2023). In this study, the core cultural elements of Mianzhu New Year pictures were abstracted as "cultural genes". These cultural genes were then symbolically translated, a process similar to gene reverse transcription in biology, to extract the basic cultural elements and artistic essence from the specific expressions (e.g. patterns, colours, themes, etc.) of the Mianzhu New Year pictures. These cultural genes not only include specific patterns, colour combinations and story themes, but also delve into deeper cultural meanings and emotional expressions that form the basis of heritage and innovative design.

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Using the principle of reverse gene transcription, similar to the process of reverse transcription in biology, these cultural genes are 'transcribed' from their original cultural and artistic forms, and then 'recombined' and 'transformed' in the context of modern design. Transcription" from their original culture and art forms. This means that we are not just copying traditional elements, but reinterpreting and innovating them to suit modern design needs and market trends. (Figure8)

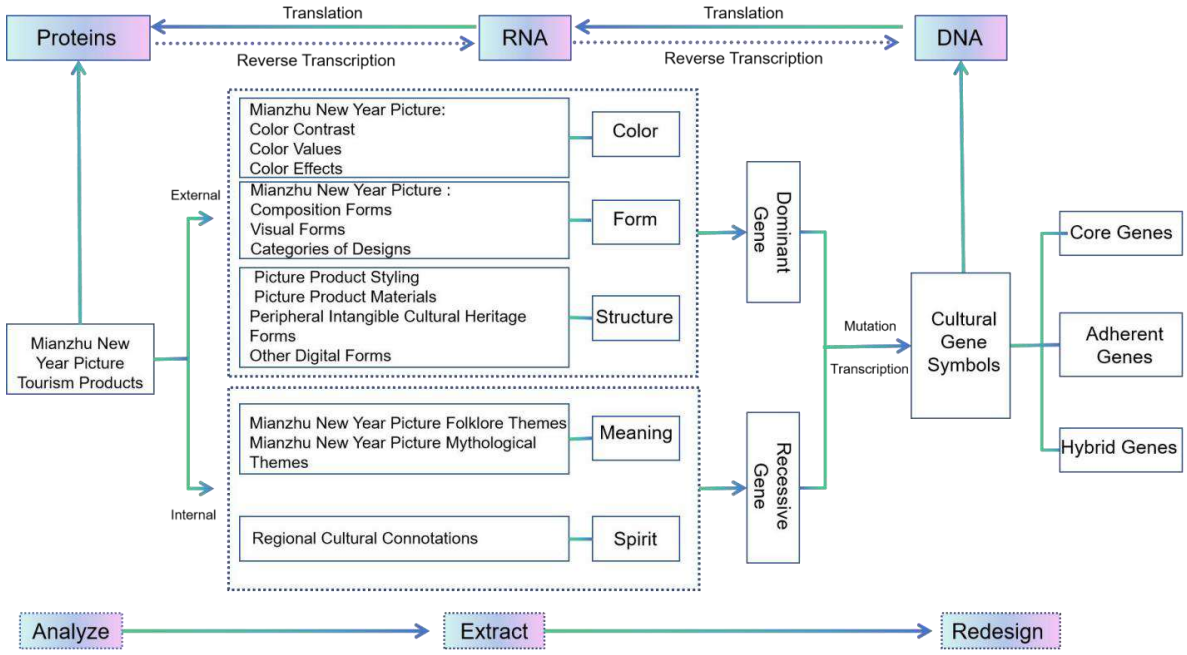

Figure 8.
The transliteration process of Mianzhu New Year Picture cultural genes.

Based on the initial identification of the cultural genes of Mianzhu New Year's picture tourism products, the recoding and reorganisation of these cultural genes using a method similar to genetic reverse transcription can create new design elements and forms (Zhang et al., 2023). This means that we are not just copying or imitating the traditional elements of the Mianzhu New Year pictures, but transforming them into creative ideas and concepts for the redesign of new tourism products. In doing so, while retaining the essence of tradition, fresh blood was injected into the modern design.

3.2.3. Experimental Process

In the third phase, the development and iteration phase of the ucd theory, this study tested the effectiveness of the cultural gene translation programme through experimental tests to provide feedback on user needs.

The experimental method is a research method that examines causality by controlling and manipulating variables (Geng & Zhang, 2021). It can be traced back to Galileo Galilei (17th century), who proposed the scientific method of verifying causality by controlling variables through experiments on natural phenomena (Galileo, 1638). Galileo laid the foundation of modern scientific experimentation and emphasised the importance of experimentation in testing hypotheses. In the experimental method, this study contains specific components of research hypotheses, cultural gene extraction and translation, design prototyping, focus group testing, and product iteration.

By constructing the cultural gene data, we have explored the cultural and artistic characteristics of Mianzhu New Year's Pictures, and we have explored the inheritance and innovation of the cultural elements of Mianzhu New Year's Pictures in the modern product design, and these researches have laid a solid foundation for our study. In the session of designing experiments, the researcher will further verify

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how the translation of cultural genes can obtain better artistic effects in the process of innovative design, and will explore the rationality of the research hypotheses.... This phase also incorporates will such design theories as deconstructionism, abstract geometry, and shape syntax to support the cultural gene translation experimental process. The application of these theories will enable the traditional cultural elements of Mianzhu New Year's Pictures to be expressed more effectively in modern design.

Test case: cultural goods (environmental bags, bookmarks, notebooks, etc.) As seen in the analysis of the original related products, these are relatively common in tourism products, but their design effects are often overlooked. Simple stickers and crude printing are common, and they lack the inherent characteristics of intangible culture, making them easy to homogenise.

i. Validation of Hypotheses 1, 2 and 3 (Hypothesis 1: A design that retains the graphic and colour features of traditional Mianzhu New Year pictures can enhance users' cultural identity and aesthetic satisfaction. 2: The use of eco-friendly materials can enhance users' positive feelings towards product and brand identity. 3: The integration of regional culture can enhance users' positive feelings and cultural awareness of the product). This hypothesis is based on the weighting of user needs in the first stage.

ii. Cultural gene extraction and translation. The first step of the experiment, the innovative design of Mianzhu New Year pictures cultural products, will use a variety of design theories as theoretical support. In order to meet the needs of Mianzhu New Year pictures tourism users for the inheritance and innovation of traditional Mianzhu New Year pictures graphics and colours, firstly, in the cultural gene pool, the advantageous genes of the overall shape will be selected for the visual design and the genes will be translated using the design principles of deconstructivism and colour composition, obtaining a new form of re-design. Deconstructionism (Derrida, 1967) will guide us in deconstructing and analysing the overall form, local forms and colours of traditional New Year's Eve pictures in order to create a modern visual experience. This approach allows us the flexibility to deconstruct and reorganise graphic elements during the design process, thus breaking the mould and giving new life to traditional patterns (Figure 9).

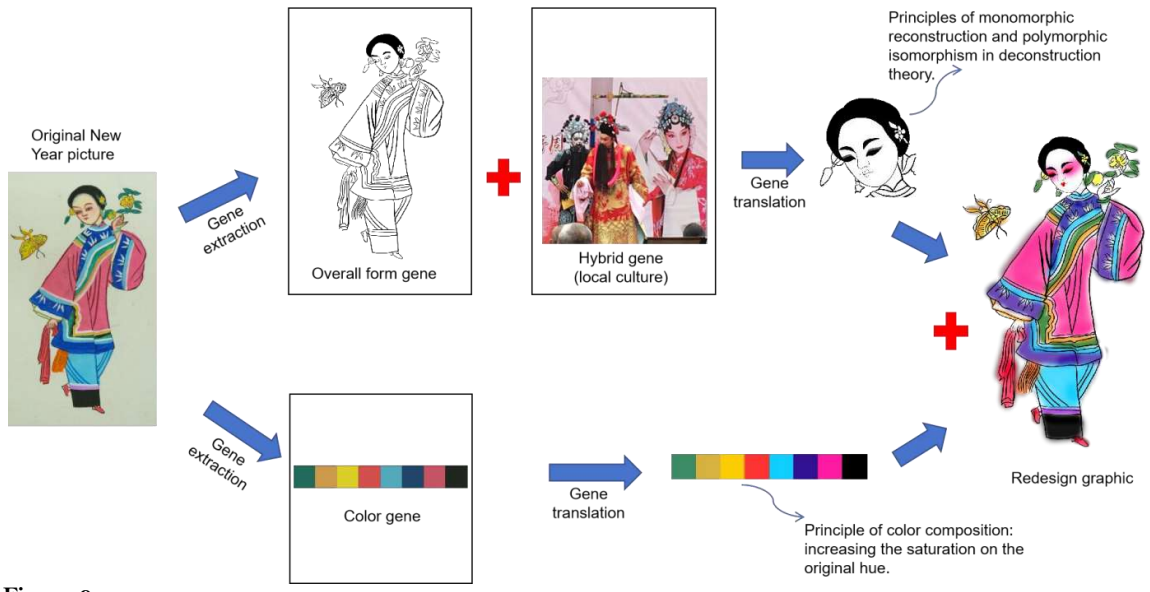

Figure 9.
Graphic overall shape redesign flowchart.

Following the design process described above, the experiment was conducted by choosing pictures that featured Mianzhu New Year, a lady riding a bicycle, a warrior god of the door, a boy bringing wealth, a boy holding a "Ruyi", and a boy with a "Ruyi".and Mouse Marrying Daughter, as a design case, and redesigned the shape and colour of Mianzhu Mianzhu New Year Picture, preserving the

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graphic characteristics of Mianzhu New Year's Pictures in accordance with the cultural genes and the user's need for colour and overall form. (Figure10)

Figure 10.
Graphic overall shape redesign typical legend.

The overall shape was then redesigned. Subsequently, the dominant genes of the partial shapes were selected for visual design, and the genes were translated using design principles such as deconstructionism and shape grammar to obtain new forms of the redesigned partial shapes (Figure11).

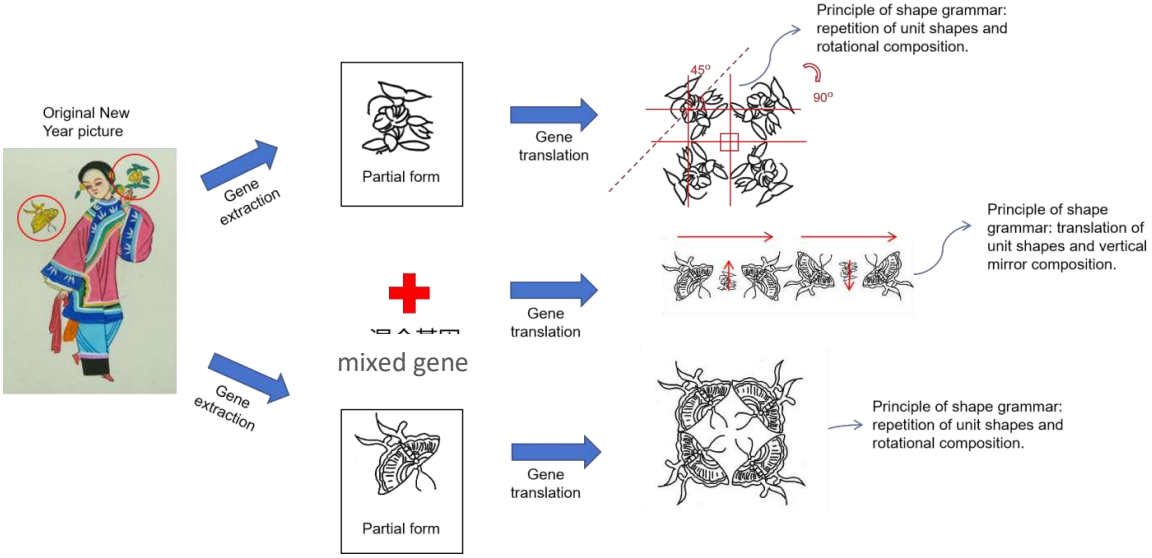

Figure 11.
Graphic partial modelling redesign flowchart.

According to this local cultural extraction and translation method, representative local patterns from Mianzhu New Year pictures, such as the sagging dragon pattern of the door god, the dewy dragon pattern and the narrative pattern of the children's figures, and the bat pattern of the auspicious pattern, were selected as design cases, and the local shapes and colours of the Mianzhu New Year pictures were re-designed, (Figure12).

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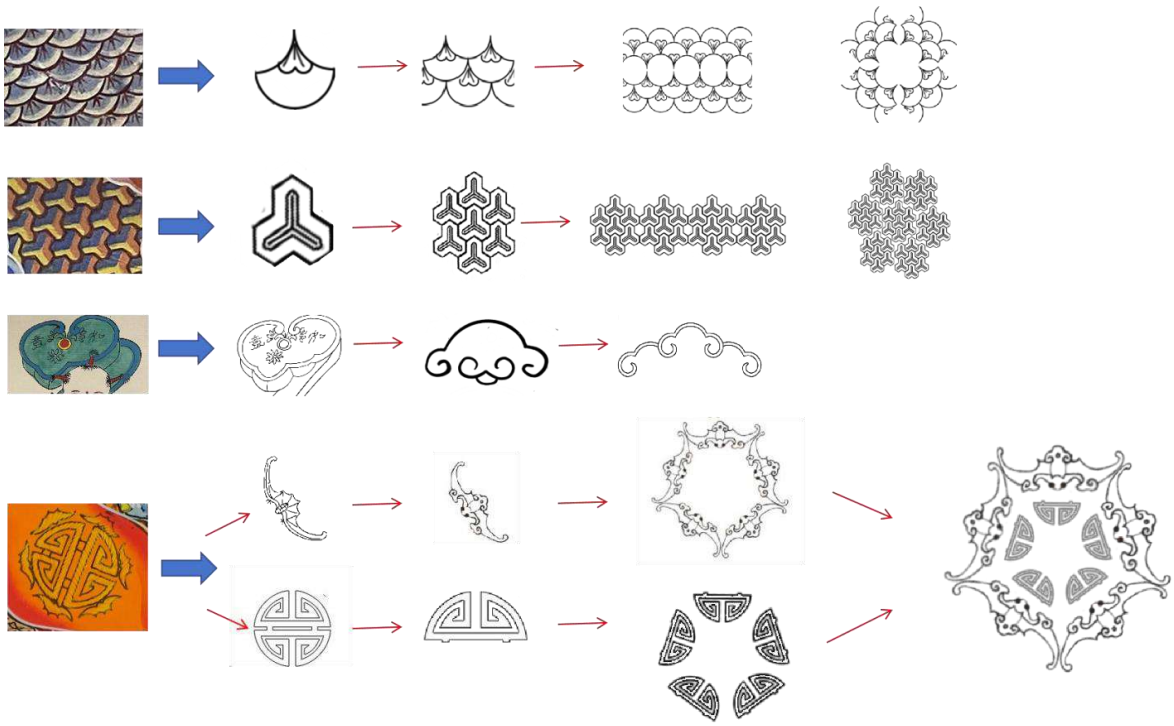

Figure 12.
Graphical partial styling redesign typical legend.

iii. Prototyping. In the second step of the experiment, this step was the application of the cultural genetic design solution to the product prototyping, choosing a medium fidelity prototype drawing. The medium fidelity prototype was designed to facilitate the modification and reorganisation of the graphics and to facilitate the demonstration of how well the graphics could be applied to different materials and sizes of travel products.

a) Application Experiment 1. Mianzhu New Year pictures were redesigned for eco-bags. Mianzhu New Year pictures were redesigned and applied to the design of eco-bags. According to the environmental requirements, paper or non-woven fabric was chosen as the main packaging material. The design uses the whole new shape of the cultural door god and women pictures and part of the new shape of the sagging dragon pattern, using cut and paste technique to break the flat visual effect and create a sense of semi two-dimensional space. The colours mainly use strong contrasting complementary colour relationships to enhance the visual appeal of the colours (Figure13).

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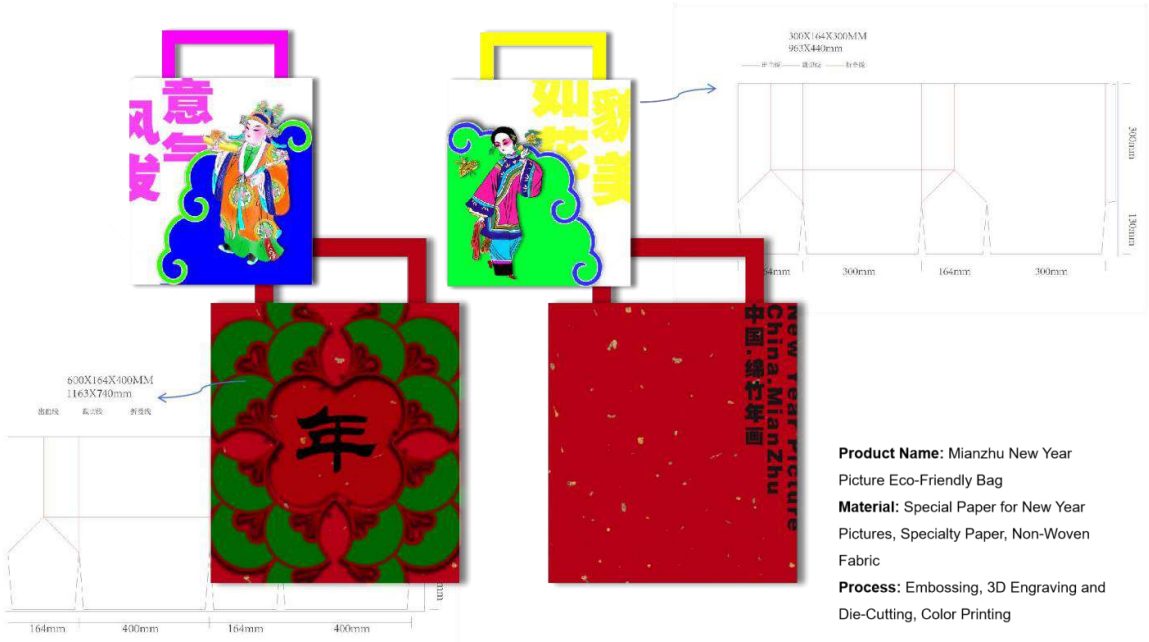

Figure 13.
Mianzhu new year picture design project figure.

b) Application Experiment 2: Redesign of Mianzhu New Year Picture Travelling Notebook. Apply the graphic design of Mianzhu New Year pictures to the design of travelling notebook. According to the need of environmental protection, special paper is chosen as the main material. The graphic design adopts the overall shape of new types of door gods, ladies, children, etc. The paper sculpture technique is used to break the flat visual effect and create a two-dimensional sense of space. The colours mainly use strong contrasting complementary colour relationships to enhance the visual appeal of the colours Figure 14.

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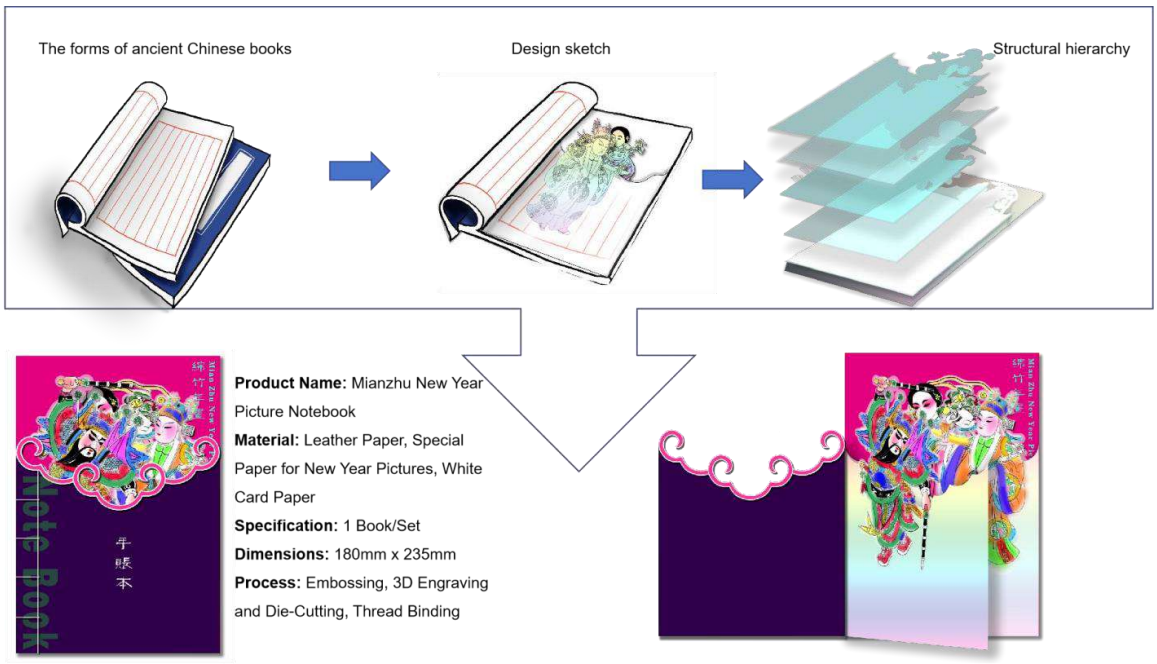

Figure 14.
Mianzhu new year picture travel diary design project illustration.

c) Application experiment 3: Innovative design of Mianzhu New Year picture bookmark. Apply the graphic design of Mianzhu New Year picture to bookmark design. According to the needs of environmental protection, the material is mainly based on special paper, which is matched with metal materials to form a series. The graphic design adopts new overall shapes of door god, lady, children and other types, and uses the paper sculpture process to break the visual effect of the plane, creating a sense of semi-two-dimensional space. The colours enhance the overall brightness and purity of the product and raise the level of colour. Figure 4.39

Figure 15.
Mianzhu new year picture bookmark design proposal.

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Vol. 8, No. 6: 5388-5410, 2024
DOI: 10.55214/25768484.v8i6.3198

iv. Product Testing. In order to test the effectiveness of the experiment, a focus group user test was conducted (Krueger & Casey, 2014), in which the sample was selected following a purposive sampling methodology with the aim of ensuring that the participants were representative of the diversity and relevance of the target user group. In particular, the sample consisted of six participants, four of whom were tourists from the Mianzhu New Year Picture Village and two of whom were design professors. The sample of tourist users was selected based on the actual experience of Mianzhu New Year Picture Village and interest in cultural and artistic products. The age range was set from 20 to 50 years old to ensure coverage of tourist users of different ages with a balanced gender ratio (3 males and 3 females). In addition, the sample included two art and design experts with extensive experience in the design field who were able to provide valuable input on the product design from a professional perspective. Through the combination of these two art and design experts, this study was able to explore the use of Mianzhu New Year pictures in modern tourism product design from multiple perspectives and at multiple levels.

The testing process utilised a live conference test in a meeting room, which took 60 minutes and was available in both English and Chinese, and was checked and approved by experts consisting of one professor and two associate professors. The testing process ensured that participants were able to participate in the discussion without any problems, and a projector displayed media fidelity design drawings during the session, allowing participants to ask questions and give real-time feedback and counter-questions without interfering with the answers to others' questions.

3.3. Qualitative Analysis

Based on the participants' responses, through field notes, initial readings and labelling, the researcher identified the following four key themes:AT (Aesthetic Taste) relates to feedback on the overall aesthetics of the design, such as attractiveness, colour palette, modernity and visual impact. Cultural Identity CR (Cultural Identity) relates to participants' feelings about the expression of cultural elements such as cultural heritage and increased cultural identity.EM (Environmental Materials) The naturalness and aesthetics of environmentally friendly materials and their impact on brand identity. CRI (Cultural Regional Integration) Regional cultural integration. The relevant discussion elements for each theme were assigned specific open codes to facilitate in-depth analyses, categorised as follows (Table1). :

Table 1.
Table of open data codes for experiment.

Thematic	Coding	Descriptive
Esthetic perception	AT (Aesthetic taste)	Involves feedback on the overall aesthetics of the design, such as attractiveness, colour palette, modernity and visual impact.
Cultural identity	CR (Cultural recognition)	Involves participants' feelings about the expression of cultural elements, such as cultural heritage and increased sense of cultural identity.
Environmental awareness and beauty	EM (Environmental material)	The naturalness and aesthetics of environmentally friendly materials and their impact on brand identity.
Regional cultural integration	CRI (Cultural region integration)	The extent to which regional cultural elements are represented in the design, and suggestions for improvement.

3.4. Quantitative Analysis

Data collation and statistics: The collected rating data were first collated through SPSS statistical software. The scores of each scoring dimension were analysed by descriptive statistics, and key statistical indicators such as mean and standard deviation were calculated to get a comprehensive understanding of the overall feedback from the participants. These statistical results not only helped the study to assess the overall performance of the design, but also provided a scientific basis for further design optimisation and improvement. (Table 2).

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Vol. 8, No. 6: 5388-5410, 2024
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Table 2.
Descriptive statistical analysis table for quantitative data.

Rating dimension	Mean	Standard deviation	Analysis of results
Overall aesthetics	4.2	0.75	It shows that participants were generally satisfied with the aesthetics of the design, but the standard deviation of 0.75 shows that some of the participants expressed disagreement with the visual impact of the design. It shows that participants were generally satisfied with the aesthetics of the design, but the standard deviation of 0.75 shows that some of the participants expressed disagreement with the visual impact of the design.
Cultural expression	4.0	0.80	It shows that the design performs well in conveying the cultural elements of the Mianzhu New Year Pictures, but some participants felt that the depth of cultural expression needs to be strengthened. It shows that the design performs well in conveying the cultural elements of the Mianzhu New Year Pictures, but some participants felt that the depth of
User experience	4.1	0.70	It indicates that the design is better in terms of functionality and user experience, with a standard deviation of 0.70, which shows a more consistent opinion. opinion.
Materials and Textures	3.8	0.85	The relatively low ratings and large standard deviation (0.85) suggest that the texture of the EcoMaterials needs further improvement.
Overall satisfaction	4.0	0.78	showed that participants' overall satisfaction with the design was high, but there was still room for improvement.

Finally, to further explore the interrelationships between the rating dimensions, the researcher calculated the Pearson correlation coefficients between the dimensions, which is a statistical measure of the linear relationship between two variables (Pearson, 1896). The purpose of the analysis was to understand which design factors had the greatest impact on overall satisfaction and whether there was a significant correlation between the different dimensions (Table 3).

Table 3.
Correlation analysis for a certain amount of data from the experiment.

Correlation between dimensions	Pearson's correlation coefficient	Data analysis
Overall aesthetics and overall satisfaction	0.82	suggests that overall aesthetics have a significant positive effect on participants' overall satisfaction, with higher visual appeal typically suggests that overall aesthetics have a significant positive effect on participants' overall satisfaction, with higher visual appeal typically increasing overall user satisfaction.
Cultural expression and overall satisfaction	0.76	shows that effective communication of cultural elements plays an important role in improving users' cultural identity and overall satisfaction.
User experience and overall satisfaction	0.85	is the highest of all dimensions, indicating that the functionality of the design and the user experience largely determine overall user satisfaction.

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Vol. 8, No. 6: 5388-5410, 2024
DOI: 10.55214/25768484.v8i6.3198

Material and texture vs. overall satisfaction	0.70	Although lower than the other dimensions, it still shows some positive correlation. This suggests that material choice and texture have an impact on user satisfaction, but not as significant as the other dimensions. This suggests that material choice and texture have an impact on user satisfaction, but not as significant as the other dimensions.

3.5. Qualitative and Quantitative Data Synthesis Conclusions and Recommendations

The combined recommendations for improvement focus on, first and foremost, the visual impact of the design, combining qualitative and quantitative data as a priority area for improvement. More innovation in the use of colours and graphics is recommended to improve the overall aesthetics. Secondly, further enrichment of the expression of cultural elements to enhance the layering of culture and depth of expression. Thirdly, consider the use of higher quality, environmentally friendly materials in the design to improve the texture of the product and to satisfy users' needs for aesthetics and convergence. Finally, the expression of regional cultural elements was enhanced through bolder graphic and colour variations to make them more representative and attractive in the product.

3.6. Product Iteration

3.6.1. Iteration of Eco-Friendly Bag Product

Colour increased colour contrast, complementary colour matching for the handheld part of the colour and the pockets, and increased use of local graphics in the graphic part. Deepen the cultural expression by adding more hidden genetic elements to express the cultural semantics. Improve the texture of environmentally friendly materials to strengthen the expression of regional culture: use the traditional Chinese "Golden Scraps Rice Paper" instead of paper, which is also the special paper for New Year's Picture, to match the culture of the New Year's Picture, and more environmentally friendly textures and details to strengthen the expression of regional cultural elements Figure16.

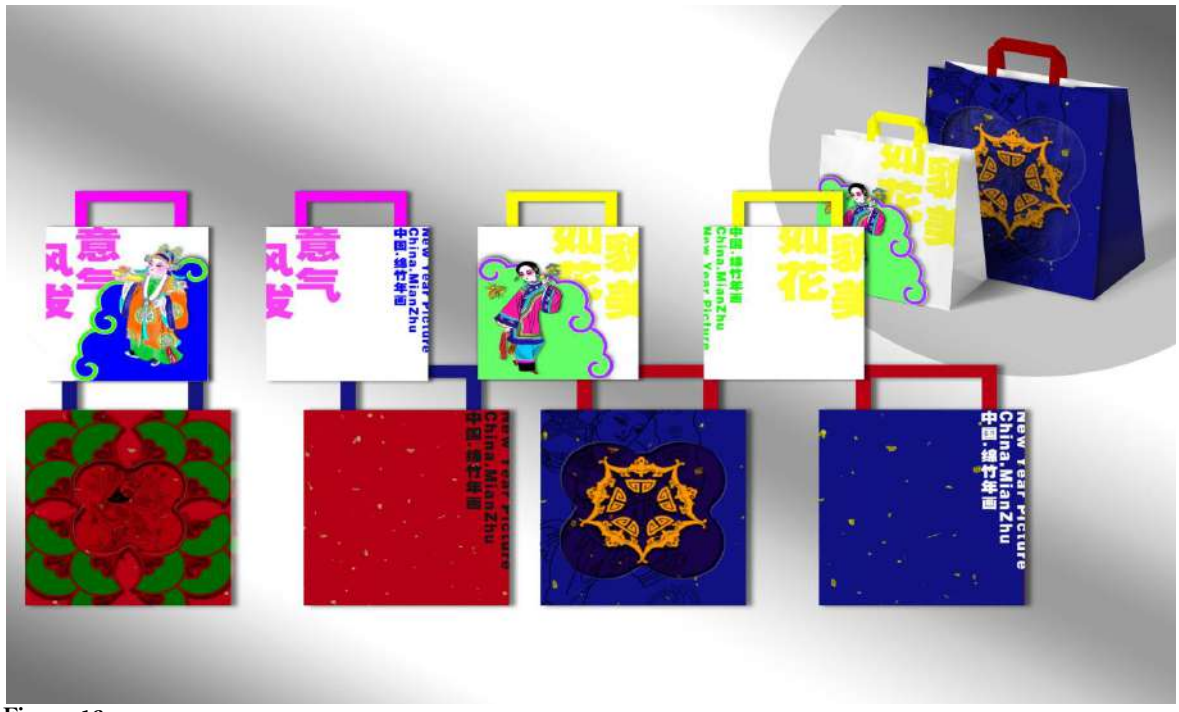

Figure 16.
Iterative effect of eco-bag products.

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DOI: 10.55214/25768484.v8i6.3198

3.7. Iteration of Bookmark Product

Colour contrast is increased and the brochure is made into three books with different colour combinations, each book is equipped with a complementary colour. The dark lines of the Mianzhu New Year pictures were used as decoration to deepen the cultural expression and the visual impression of the culture. Improve the texture of the environmentally friendly material, along the paper material, but replace it with special paper, and add the texture of the paper with the hot stamping process of the dark colour lines Figure 17 Add character image redesign.

Figure 17.
Traveller's handbook product iteration effectiveness map.

3.8. Iteration of Tourism Brochure Product

The use of calligraphic black characters and special rice flour raises the level of colour and paper. The calligraphy text deepens the cultural expression, quoting the semantic symbols of the hidden genes in Mianzhu New Year's Pictures, which can convey beautiful cultural symbols. Improving the texture of environmentally friendly materials, applying special rice flour and calligraphy text can enrich the visual level and improve the advanced sense of materials. Regional cultural integration, using bamboo materials instead of metal materials, bamboo is bamboo bamboo art is also a local intangible cultural heritage, the application of bamboo materials can better reflect the local cultural characteristics, Figure 18

Edelweiss Applied Science and Technology
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Vol. 8, No. 6: 5388-5410, 2024
DOI: 10.55214/25768484.v8i6.3198

Figure 18.
Bookmarks product iteration effectiveness chart.

4. Discussion

In the design and research of intangible cultural heritage (NCH) tourism products, it is of great practical significance to explore how to effectively integrate traditional culture and modern user needs. The user-centred design (UCD) methodology provides valuable perspectives in promoting the innovative design of Mianzhu Nianhua products in terms of NCH product innovation and user needs satisfaction, while user needs analysis, extraction and application of cultural genes, and the user testing and iterative process in the experimental methodology all play a key role in the enhancement of the quality of product design and cultural preservation. In the following discussion, from the design application of UCD method in Mianzhu New Year's Pictures tourism product, we deeply analyse the driving effect of user demand on product design, the unique value of cultural genes in non-heritage protection, and explore the practical effect of the experimental method in verifying design assumptions and optimising the product, so as to provide comprehensive theoretical and practical guidance for the design of non-heritage tourism products.

4.1. The Role of UCD in Tourism Products

User-centred design (UCD) methodology plays a key role in the design of Mianzhu New Year's Pictures tourism products. This UCD methodology improves the user acceptance and satisfaction of products by deeply exploring users' cultural preferences, experience expectations and functional needs, and by integrating the user perspective into the whole process of design. In the design of the Mianzhu New Year's Pictures tourism product, the UCD method pays particular attention to preserving the traditional characteristics of the New Year's Pictures while meeting the aesthetic needs of modern users. The method ensures that the unique cultural connotations of Mianzhu New Year paintings can be matched with the needs of contemporary users, so that the designed tourism products not only have the value of cultural heritage, but also practicality and aesthetic experience. For example, through the user

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study, the researcher was able to determine how the images, colours, materials and other elements of the New Year's Pictures would be expressed in the product, thus enhancing the market attractiveness and competitiveness of the product while promoting the culture of the non-heritage.

4.2. The Importance of User Requirements for Product Design

User demand analysis is the cornerstone of product design, especially in the design of non-heritage cultural products has a special importance. The design of non-heritage cultural products should not only display traditional culture, but also meet user needs in terms of product functionality and emotional connectivity. The investigation and analysis of user needs can help designers understand the functional needs and emotional demands of users, so as to make targeted optimisation in the design. In the tourism product design of Mianzhu New Year's Pictures, users may expect interactivity and a sense of engagement, which means that the design can incorporate digital interactive features or use environmentally friendly materials to match contemporary user preferences. In addition, user needs analysis can help identify which elements of the New Year's Pictures are most emotionally resonant for users, so that these elements can be emphasised in the design to enhance users' sense of cultural identity and aesthetic satisfaction. The user demand analysis also reconfirms the pre-assumptions, provides direction for subsequent product iterations, ensures that the design process is always centred on user needs, and ultimately enhances the market appeal and user satisfaction of the Mianzhu New Year's Pictures tourism product.

4.3. The Significance Ofcultural Genes for the Preservation of Cultures

The concept of cultural genes has important theoretical and practical significance in the protection of non-heritage culture. Cultural gene refers to the basic elements or symbols of culture, which is a kind of cultural expression that transcends time and space and has unique value. Through the extraction and transformation of cultural genes, designers can integrate the core elements of non-heritage culture into modern product design, so as to realise the effective inheritance and innovation of culture. For non-heritage tourism products, the extraction and application of cultural genes can make the products not only retain the essential features of non-heritage culture, but also adapt to modern consumer demand, and promote the dissemination and protection of culture. For example, in the experiment of Mianzhu New Year's Pictures tourism product design, the study of patterns, colours and forms in Mianzhu New Year's Pictures culture, the researcher applies the modern design language to re-interpret the non-heritage culture on the basis of the original cultural connotation without losing the original cultural connotation, so as to make the Mianzhu New Year's Pictures tourism products have a higher attraction and cultural value. At the same time, the extraction of cultural genes provides the basis for the digitisation, symbolisation and inheritance of non-heritage culture, and plays a vital role in the protection and continuation of non-heritage culture.

4.4. Practicalities of User Testing and Iteration in Experimental Methods

In the design of Mianzhu New Year's Pictures tourism products, the user testing and product iteration processes in the experimental method are highly practical for improving product quality and verifying research hypotheses. User testing can directly verify the effectiveness of the design scheme, collect real user feedback, reveal the deficiencies in the design, and help the researcher make precise adjustments. With the accumulation of feedback, the researcher optimises the function, visual effect and user experience of the product through repeated iterations, so that the product gradually reaches the ideal state, which not only preserves the cultural characteristics of Mianzhu New Year's Pictures, but also meets the needs of modern users. In addition, user testing is crucial to validate research hypotheses. The study may assume that incorporating traditional cultural elements into Mianzhu New Year's Pictures products can enhance users' sense of cultural identity, and the data from user testing can be used to support or refute this assumption, thus providing empirical evidence of the rationality of the design. This process not only enhances product quality, but also provides reliable support for subsequent design improvement and theoretical research, making the design solution more complete in terms of

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science and practicality, and making Mianzhu New Year's Pictures tourism products more competitive in the market while maintaining cultural heritage.

4.5. This Study Also Has Some Limitations

Although this study has achieved some useful conclusions regarding the design of intangible cultural heritage tourism products, it also has the following limitations. Firstly, the limitation of the research object makes it difficult to extend this study to the design and development of other intangible cultural heritage. This study only takes Mianzhu New Year's Pictures as the research object and selects some cultural products as experimental products, while Mianzhu New Year's Pictures are only one of the rich intangible cultural heritages in China, whose cultural characteristics and application scenarios are unique. Therefore, the applicability of the experimental results to the design of other non-heritage tourism products has certain limitations and lacks the basis for general promotion. Second, there are limitations in the research technique. The design experiments of this study mainly focus on graphic design, and do not involve a wider range of digital technology means, such as augmented reality, virtual reality or interactive display. These technologies are becoming increasingly important in modern tourism product design, and their introduction may significantly affect the user experience and the cultural expression of the product, but this study fails to cover them, thus limiting the technological breadth of the study. Finally, the product testing process was relatively inadequate. Only 1 focus group discussion and product iteration were conducted in this study, and the sample size and testing frequency were limited to adequately validate the long-term effects of the design solutions and the changing trends of user feedback. More frequent user testing and iterations may reveal the scope for product optimisation more comprehensively. Therefore, these limitations suggest that the conclusions of this study should be treated with caution when promoting and applying them, and future research could further improve the reliability and applicability of the conclusions by expanding the scope of the NRM sample, introducing more digital technological tools, and increasing the frequency of testing.

5. Conclusion

This study is based on the user-centred design (UCD) theory, combined with the cultural gene approach, and adopts the design experiment and iterative approach, Mianzhu New Year's Pictures of environmental bags, bookmarks, and travel brochures product design, for the experimental process of non-heritage tourism product design, to provide an innovative research framework and practice path. The study shows that the UCD theory can effectively combine user needs and cultural heritage, the cultural gene approach provides solid theoretical support for the refinement and transformation of cultural elements in design, and the design experiment and iteration process ensure the continuous optimisation of the products in practical application. Through this method, it can be seen that in-depth user demand research can ensure the reasonable application of traditional cultural elements in products, while meeting the aesthetic and functional needs of the modern market, opening up new research ideas and methods for the sustainable development of non-heritage products in contemporary society.

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