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Research on the Generation of Artificial and Digital Identification System for Shu Brocade Patterns

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Abstract:
As the top of China's Four Great Brocades, Shu brocade patterns carry profound cultural connotations and artistic value. However, there are still many disorders in the digital protection and market application of current Shu brocade patterns, and the problem that vulgar and inferior patterns flow into high-end scenarios is particularly prominent. Based on this, this paper proposes to construct a dual identification system combining artificial and digital methods. Combining the artistic characteristics of Shu brocade patterns, integrating AI large model technology with the experience of experts in the art field, this paper explores an efficient and accurate method for pattern screening and evaluation. This research can effectively standardize the application standards of Shu brocade patterns, improve the artistic quality of Shu brocade works, fill the research gap in the field of Shu brocade pattern identification, and provide practical theoretical support and practical reference for the digital protection and sustainable inheritance of Shu brocade, an intangible cultural heritage project.

Keywords:
Shu Brocade; Digital Protection; Pattern Identification; Artificial Intelligence; Intangible Cultural Heritage Inheritance

1. Introduction

1.1 Research Background

Shu brocade has a long historical inheritance. As a national intangible cultural heritage, it boasts exquisite craftsmanship and beautiful patterns, carrying the cultural memory and aesthetic pursuit of the Chinese nation, and occupying an important position in the history of Chinese textile art. With the acceleration of the marketization and digitalization of Shu brocade, the disorders in the application of patterns have become increasingly prominent. Driven by the profit motive, the production of digital culture is prone to alienation. Some related digital cultural products focus on interests while ignoring cultural quality, showing a tendency of low taste and poor quality. Some products are highly homogenized, and even infringement occurs. Low-level cultural products lacking artistic value also attract too many consumers' attention, satisfying consumers' short-term sensory enjoyment, but ultimately people's sense of gain will be gradually dispelled.

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These digital cultural products play a negative role to a certain extent in the inheritance and development of excellent traditional culture, and may even generate ideological risks.[1] Vulgar and inferior patterns are mixed into high-end display, collection and other scenarios, damaging the artistic style of Shu brocade; some patterns in creation are highly homogenized, with insufficient innovation vitality; the protection of traditional classic patterns is not enough, and distortion and tampering often occur in the process of digital transformation, affecting the effective inheritance of Shu brocade culture.

1.2 Research Significance

Theoretical Significance: At present, academic research on Shu brocade mostly focuses on craft inheritance, historical evolution, digital preservation of patterns, etc. There is a lack of systematic research on Shu brocade pattern identification. The artificial and digital dual identification system constructed in this paper can fill this research gap, enrich the theoretical system of digital protection of intangible cultural heritage, and provide a new idea for the integration of AI technology and traditional art evaluation.

Practical Significance: The identification method formed by the research has strong operability, which can provide support for the quality control of patterns in the links of Shu brocade production, collection, display, etc., and effectively standardize the order of the Shu brocade market; at the same time, it provides technical reference for the digital collection, storage and screening of Shu brocade patterns, helping the living inheritance and innovative development of Shu brocade intangible cultural heritage. For example, starting from the innovative development of Shu brocade patterns and the needs of the times, Shujiang Brocade Courtyard selects classic patterns from traditional Shu brocade patterns, breaks them up and reconstructs them using modern design techniques and color language, creating new Shu brocade patterns that meet the aesthetic needs of modern consumers. The patterns present young, lively and creative fashion elements.[2]

1.3 Overview of Research Objectives and Contents

The core objective of this research is to construct a scientific, efficient and feasible Shu brocade pattern identification system. Through the combination of artificial identification and digital technology, it realizes the accurate control of the quality of Shu brocade patterns, and provides support for the protection and innovation of traditional Shu brocade patterns.

The specific research contents are to systematically sort out the artistic characteristics of Shu brocade patterns. Taking traditional patterns as examples, in the Pre-Qin period, the patterns on brocade were mostly geometric-style two-sided continuous patterns. On the basis of the geometric skeleton, animal, plant, human and other patterns were added. The geometric skeleton mostly presented the composition rules of repetition and symmetry, which were more orderly, such as "Fugui Jixiang Brocade", "Changle Mingguang Brocade", "Deng Gaoming Wang Sihai Brocade", etc.[3] Clarify the core standards of pattern identification; build a standardized Shu brocade pattern resource library to provide basic support for identification work; design AI identification model and manual review mechanism to form a complete identification process; verify the effectiveness and practicality of the system through specific case simulation; analyze the limitations existing in the research process and put forward subsequent optimization directions.

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1.4 Research Methods

Combining the research content and research objectives, this paper mainly adopts four research methods: literature research method, which systematically sorts out the research results related to Shu brocade, digitalization of intangible cultural heritage and AI image recognition; case analysis method, which draws on the practical experience of digital protection of patterns of similar embroidery intangible cultural heritage; technology simulation method, which builds an AI identification model and carries out simulation application; comparative experiment method, which compares the efficiency and accuracy between system identification and traditional artificial identification.

2. Literature Review and Theoretical Basis

2.1 Artistic Characteristics and Evolution of Shu Brocade Patterns

Traditional Shu brocade patterns have rich themes, mainly divided into flower and bird patterns, landscape patterns, auspicious patterns, figure patterns, etc. In terms of craftsmanship, they focus on the texture beauty of warp and weft interweaving, and the color matching is both gorgeous and elegant, which not only reflects the regional cultural characteristics of the Bashu area, but also carries people's yearning for a better life. The evolution of Shu brocade patterns is closely related to the development of the times, and the patterns of different dynasties show different characteristics of the times: Shu brocade patterns in the Han Dynasty were simple and elegant, mainly cloud patterns and animal patterns; patterns in the Tang Dynasty were magnificent, with bright colors and full composition; patterns in the Ming and Qing dynasties were more refined and had a wider range of themes. Since modern times, Shu brocade patterns have gradually integrated modern aesthetics and design concepts, achieving innovation on the basis of tradition, but they also face the problem of imbalance between innovation and tradition.

Current innovations in Shu brocade patterns mainly focus on theme expansion and style rejuvenation, trying to attract the attention of more young groups. However, some innovative works ignore the traditional artistic characteristics of Shu brocade, leading to the loss of the original style of the patterns; at the same time, the quality of some Shu brocade patterns on the market is uneven, which further restricts the inheritance and development of Shu brocade.

2.2 Current Situation and Trend of Digital Protection of Intangible Cultural Heritage

As an information processing technology, digital technology is the basis of computer technology, multimedia technology, intelligent technology and information dissemination technology, which provides various technical supports for the protection of intangible cultural heritage. On the one hand, as an external technology, it ensures the vitality of intangible cultural heritage by optimizing measures such as filing, publicity, research, preservation, inheritance and utilization of intangible cultural heritage protection; on the other hand, as an internal element, it ensures the vitality of intangible cultural heritage by internalizing into the existence and inheritance practice of intangible cultural heritage.[4] With the rapid development of digital technology, digital protection has become an important means of intangible cultural heritage inheritance. Its core technologies include digital collection technologies such as high-precision scanning and professional photography,

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digital storage technologies such as cloud databases, and digital display technologies such as virtual exhibition halls and digital museums. The application of these technologies has effectively solved the problems of "easy damage, difficult preservation and limited dissemination scope" in the inheritance of intangible cultural heritage. In the field of embroidery intangible cultural heritage, similar projects such as Su embroidery and Xiang embroidery have carried out practical exploration on the digital protection of patterns. By building pattern resource libraries and developing digital identification tools, they have realized the effective protection and rational application of traditional patterns. These practical experiences provide useful reference for the digital identification of Shu brocade patterns. From the perspective of development trend, the digital protection of intangible cultural heritage has gradually transformed from "simple digital storage" to "digital application and innovation". The integration of AI technology, big data technology and intangible cultural heritage protection is becoming increasingly in-depth. Realizing the precise protection, efficient dissemination and innovative development of intangible cultural heritage through intelligent means has become the core direction of the digital protection of intangible cultural heritage in the future.

2.3 Application of Image Recognition and AI in the Field of Art

In recent years, the application of AI large models in the field of image analysis has become increasingly mature. Taking Qianwen Qwen3-VL-plus as an example, this model has strong capabilities in image feature extraction, classification and evaluation, which can quickly identify the core elements in images, make a preliminary judgment on the quality and style of images, and provide technical support for the identification of traditional art images. At present, AI technology has gradually been applied in the field of traditional art image identification, and has achieved certain research results in the authenticity identification and quality evaluation of works of art such as calligraphy, painting and embroidery. However, due to the strong subjectivity and diversity of art evaluation, the application of AI technology in the style evaluation of traditional art patterns is still insufficient, and it is difficult to completely replace manual evaluation.

The evaluation of art patterns is mainly based on the principles of artistic form beauty such as composition, color and lines. Converting these qualitative evaluation indicators into quantitative ones and constructing a scientific calculation model is the key to realizing the effective application of AI technology in Shu brocade pattern identification, and also one of the core difficulties of this research.

3. Construction Ideas of Shu Brocade Pattern Identification System

3.1 System Design Objectives and Core Principles

Combining the needs of Shu brocade pattern identification and the reality of digital protection of intangible cultural heritage, the design objectives of this system are mainly two: first, to build a standardized Shu brocade pattern resource library and establish a scientific pattern screening mechanism to provide a foundation for identification work; second, to realize the dual identification process of "AI initial screening + manual review", which can improve the identification efficiency and ensure the accuracy of identification results, providing technical support for links such as Shu brocade creation and market application. In the process of system construction, four core principles should be followed: scientific principle, ensuring that the system design is in line with the artistic rules and identification standards of Shu brocade; practical principle, simpli-

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fying the operation process to ensure that the system can adapt to the actual application scenarios such as Shu brocade production and collection; compatibility principle, reserving expansion space to facilitate the update and optimization of the system according to actual needs in the future; accuracy principle, minimizing the misjudgment rate of identification through AI model optimization and manual review.

3.2 Construction of Shu Brocade Pattern Resource Library

A high-quality pattern library is the foundation of the system's identification work, mainly collecting and sorting out three types of Shu brocade patterns: first, traditional classic Shu brocade patterns, including representative patterns of different dynasties and styles; second, Shu brocade patterns designed by famous modern and contemporary artists, reflecting the innovative achievements of Shu brocade patterns; third, Shu brocade patterns with Bashu regional characteristics, highlighting the cultural characteristics of Shu brocade. At the same time, each pattern is detailedly labeled, clarifying its theme, style, craftsmanship, age and other information, and establishing a standardized database. The digital processing methods are basically divided into effective text extraction, image processing, information visualization, virtual model construction and other methods. Extract and compare the most valuable text information from various literature materials and massive online materials, and in the collection process, some pictures and photographs are affected by different light and environments, resulting in uneven image quality. The collected images are digitally processed through software such as Adobe Photoshop to make the patterns and colors clear and visible. Some complex or distorted images are processed by information visualization into clear vector image elements for reference. [5]

The low-quality pattern library mainly collects inferior Shu brocade patterns circulating in the market, including vulgar theme patterns, patterns with unbalanced composition and messy colors, as well as works that plagiarize, counterfeit and tamper with traditional patterns. At the same time, the specific judgment standards of low-quality patterns are clarified to provide sufficient negative samples for the training of AI models, ensuring that AI models can accurately identify inferior patterns. To ensure the timeliness and completeness of the resource library, it is necessary to establish a regular update mechanism, continuously supplement new pattern samples, timely optimize pattern annotation information, and conduct daily maintenance of the resource library to ensure the security and availability of data.

3.3 Implementation Path of AI Identification Mechanism

Combining the characteristics of Shu brocade patterns and the application status of AI technology, this paper selects the Qianwen Qwen3-VL-plus large model as the basic model. According to the core characteristics of Shu brocade patterns such as texture, color and composition, the model is fine-tuned and optimized to improve the recognition accuracy of the model for Shu brocade patterns, so that it can better adapt to the identification needs of Shu brocade patterns.

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The core of the AI identification mechanism is pattern feature extraction and classification. The model extracts the core features of Shu brocade patterns such as composition rationality, color coordination, line fluency and texture clarity, and combines the sample data of high-quality and low-quality pattern libraries to construct a classification model, realizing the preliminary screening of Shu brocade patterns and distinguishing high-quality and low-quality patterns. As shown in the figure.

(Note: The figure shows the digital identification system of Shu brocade patterns of Chengdu Textile College. The system displays: "This painting has bright colors and overlapping peonies, but the brushwork is slightly redundant, lacking an elegant and implicit artistic conception. Although it is neat, it cannot stand careful appreciation and has not reached the level of literati painting. Grade: 68 points." The system interface includes functions such as "select picture to submit", "history record", etc. Copyright © 2025 Wang Ning, Huang Xinkuang. All Rights Reserved. School of Art Design and Creativity, Chengdu Textile College.)

On the basis of preliminary screening, combined with the principles of artistic form beauty, the qualitative evaluation indicators such as elegance and cultural fit are quantified, and a Shu brocade pattern style evaluation model is constructed to further evaluate the screened patterns, providing reference for manual review and improving the scientificity and accuracy of the identification system.

3.4 Supplementary Role of Artificial Identification and Process Design

Due to the strong subjectivity and diversity of art evaluation, AI models are difficult to completely replace manual evaluation. After comparison, there are also works with low artistic style that receive high scores from AI. Therefore, manual identification plays an important supplementary role in the entire system. Its core role is mainly reflected in three aspects: first, reviewing the results of AI initial screening and correcting the misjudgment of AI models; second, making accurate judgments on complex patterns, such as innovative Shu brocade patterns and incomplete traditional Shu brocade patterns, combined with artistic rules and form beauty principles; third, collecting AI misjudgment cases and continuously optimizing AI models to improve the identification accuracy of the models. The manual identification process needs to be standardized and orderly. An identification team composed of Shu brocade art experts, craft inheritors and scholars in related fields should be set up, the division of labor and review standards of team members should be clarified, and

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a detailed review process should be formulated to form a closed-loop mechanism of "AI initial screening → manual review → result feedback → model optimization", ensuring the accuracy and authority of identification results.

4. System Application and Case Analysis

4.1 Application Scenarios of the System in Shu Brocade Creation and Market Application

In the Shu brocade creation link, the system can be used as an auxiliary tool for pattern design and finalization. After completing the pattern design, designers can screen the patterns through the system. The system will give quality evaluation and optimization suggestions, helping designers improve the quality of patterns, avoid the generation of vulgar and inferior patterns, and at the same time help designers find a balance between tradition and innovation, creating Shu brocade patterns with both cultural connotation and artistic value.

In the market circulation link, the system can provide pattern identification services for Shu brocade production enterprises, collection institutions, display platforms, etc., helping relevant entities quickly identify inferior patterns, standardize the order of the Shu brocade market, prevent vulgar and inferior Shu brocade from flowing into the market, protect the legitimate rights and interests of consumers and collectors, and improve the overall quality level of the Shu brocade industry.

In the link of intangible cultural heritage protection, the system can provide support for the digital sorting and restoration of traditional Shu brocade patterns. Through the system, classic patterns with important protection value are selected to provide reference for the digital restoration and preservation of patterns, and at the same time help the living inheritance of traditional patterns, so that Shu brocade culture can be better continued and developed.

4.2 Case Simulation Analysis

To verify the effectiveness and practicality of the identification system, this paper selects gongbi painting-style Shu brocade patterns as the research object. Such patterns have both traditional artistic characteristics and modern aesthetic elements, are widely used in Shu brocade creation, and have obvious quality differences, which are suitable as identification cases. A total of 30 gongbi painting-style Shu brocade patterns are selected for this simulation, including 15 high-quality patterns (including traditional gongbi flower and bird patterns and modern excellent gongbi landscape patterns) and 15 low-quality patterns (including vulgar theme patterns, patterns with unbalanced composition and messy colors).

In the case simulation process, the entire identification process is presented in detail: first, the AI identification model is used to conduct initial screening of 30 patterns, extract the core features of the patterns, classify and initially evaluate them, and score and screen out suspected high-quality and low-quality patterns; then the identification team conducts manual review of the AI initial screening results, makes accurate judgments on each pattern combined with artistic rules and identification standards, corrects the misjudgment of the AI

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model, and finally determines the identification results.

The system identification results are compared and analyzed with the traditional manual identification results, focusing on comparing the time consumption (efficiency) and accuracy (correctness) of the two identification methods. Through comparison, it is found that the dual identification system of "AI initial screening + manual review" greatly shortens the identification time under the premise of ensuring the accuracy of identification, and the efficiency is significantly improved compared with traditional manual identification, fully reflecting the advantages of the system. At the same time, the problems existing in the application of the system are analyzed, such as the insufficient evaluation accuracy of the AI model for some complex innovative patterns and the need to improve the efficiency of manual review, and targeted improvement suggestions are put forward.

5. Conclusions and Prospects

5.1 Research Summary

Focusing on the core issue of Shu brocade pattern identification, combined with the background of digital protection of intangible cultural heritage, this paper systematically sorts out the artistic characteristics and identification standards of Shu brocade patterns, builds a standardized Shu brocade pattern resource library, designs a dual identification system of "AI initial screening + manual review", and verifies the feasibility and practicality of the system through case simulation, forming a scientific and efficient Shu brocade pattern identification method.

Through this research, it can be concluded that the combination of artificial identification and digital technology can effectively make up for the deficiencies of a single identification method: AI technology can improve identification efficiency and solve the problems of long time consumption and heavy workload of traditional manual identification; manual identification can make up for the limitations of AI models and ensure the accuracy and authority of identification results. The identification system can provide strong support for the digital protection, quality control, inheritance and development of Shu brocade, and has strong theoretical and practical significance.

5.2 Research Limitations

At the data level, although the Shu brocade pattern resource library built in this research has collected various types of patterns, the number of samples still needs to be further expanded, and the types and styles of patterns covered are not comprehensive enough; at the same time, the data used for AI model training is insufficient in diversity, which may affect the identification accuracy of the model for different styles and types of Shu brocade patterns.

At the technical level, the AI pattern style evaluation model constructed in this research is still in the initial stage. Due to the strong subjectivity of art evaluation, the evaluation accuracy of the model for some complex innovative patterns and traditional patterns with profound cultural connotation needs to be improved, and it is difficult to completely replicate the professionalism of manual evaluation.

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At the level of evaluation standards, the artistic evaluation of Shu brocade patterns has strong subjectivity and diversity. Different experts may have different evaluations on the same pattern. How to further quantify the evaluation indicators, balance the subjectivity and objectivity of evaluation, and make the identification standards more scientific and unified still need in-depth research.

5.3 Future Prospects

In view of the limitations of this research, the follow-up will focus on system optimization: further expand the number of samples in the Shu brocade pattern resource library, enrich the types and styles of patterns; continuously optimize the AI identification model, and improve the evaluation accuracy of the model for complex patterns by combining more sample data and expert experience; improve the manual review mechanism, optimize the review process, improve the review efficiency, and realize the dynamic update and improvement of the identification system.

In terms of application expansion, the follow-up will try to extend the identification system to other embroidery intangible cultural heritage projects such as Su embroidery and Xiang embroidery, and draw on the ideas and methods of this research to provide support for the pattern identification and digital protection of similar intangible cultural heritage projects, promoting the large-scale and standardized development of digital protection of intangible cultural heritage.

In the future, we will also promote the in-depth integration of AI technology with Shu brocade creation, teaching and dissemination. Based on the identification system constructed in this research, we will develop more digital technology-based inheritance and innovation applications of Shu brocade, such as intelligent design tools for Shu brocade patterns and digital teaching resources, helping the living inheritance and innovative development of Shu brocade intangible cultural heritage, and making traditional Shu brocade culture radiate new vitality in the new era.

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