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REGENERATION OF THE DESIGN OF WEAVING AND EMBROIDERY PATTERNS BASED ON ARTIFICIAL INTELLIGENCE TECHNOLOGIES

Purpose of this work is to determine the feasibility of using AIGC (Artificial Intelligence Generated Content) technology to restore the design of traditional Yao patterns in order to protect and preserve the culture of the Yao ethnic group, and at the same time contribute to the modernization of the application of traditional arts.

Methodology: In this study, based on the classification and combing through Yao weaving and embroidery patterns through literature research, the two selected design patterns are coded and extracted, and AIGC (Artificial Intelligence Generated Automatic Generation Contents) technology is cited to carry out regeneration design of the patterns.

Results: By studying the process of creation and evolution of Yao patterns, it was found that its unique cultural and aesthetic value warrants study and preservation. It was found that patterns created using AIGC technology not only retain the basic elements of traditional patterns, but also introduce various design innovations. These newly created templates have a high visual aesthetic and can be applied to the design of Yao derivative cultures.

Scientific novelty of the study consists in the identification of the main characteristics of the traditional patterns of the Yao people, and the proposed approach to their preservation and integration into modern design. By overcoming the limitations of traditional design, this study combines AIGC technology with national traditional culture.

Practical significance: This study is of great scientific significance because it not only provides a new method for digital preservation and innovative design of Yao patterns, but also contributes to the study of the application of artificial intelligence in pattern innovation. Research materials can be used both in educational courses and in project design practices.

Keywords: artificial intelligence; Yao culture; pattern regeneration; motifs-symbols, embroidery patterns; design.

Introduction: The Yao people in China are mostly gathered in the south, mainly distributed in Guangxi Province, Hunan Province and Guangdong Province. The Yao people are famous for their rich cultural traditions and unique costumes, reverence for nature and pluralistic beliefs. Yao patterns are an important expression of their culture and are commonly found in embroidery, clothing and daily necessities. Most of the patterns are taken from nature, including animal patterns, plant patterns, human patterns, word patterns and so on, reflecting the Yao people's reverence for nature and their desire for a better life. These patterns are unique to the Yao people and carry rich cultural connotations and symbolism.

AIGC (Artificial Intelligence Generated Content) refers to the use of artificial intelligence technology to generate various forms of content, including text, images, audio and video. At its core, it simulates the human creative process through machine learning and deep learning algorithms to automate the generation of content. AIGC has shown strong potential for application in a number of fields, such as news writing, art creation and advertising design. The benefits include increased productivity, reduced creation costs, and the ability to generate personalised and customised content. AIGC or Artificial Intelligence Generated Content has become a breakthrough force that is redefining digital creativity.

The regeneration design of Yao patterns refers to the use of modern technology and design concepts to innovate and transform traditional patterns to adapt to modern application scenarios while retaining their cultural connotations. Some researchers have pointed out that the current research perspective on Yao weaving and embroidery is relatively single, and it is necessary to expand the research scope and deepen the research content of studying Yao embroidery through multidisciplinary, multidisciplinary, and multifaceted entry cuts [1]. AIGC, as a more advanced automatic generation technology, is applied to the regeneration design of Yao patterns, which represents the deep integration of modern technology and traditional culture, and is conducive to the innovation and development of Yao traditional culture. AIGC technology is capable of analysing, learning, and generating highly complex and detailed patterns through deep learning algorithms and large-scale data training. This technology can not only extract design elements from a massive database of traditional weaving and embroidery patterns, but also generate innovative Yao patterns according to different cultural backgrounds and aesthetic demands. This design application attempts to extract some representative Yao patterns, form a text based on the symbolism of the patterns, and automatically generate innovative Yao patterns under AIGC by means of text-to-diagram and diagram-to-diagram.

Analysis of previous researches: With the rapid development of globalisation and modernisation, the elements of traditional patterns of ethnic minorities are at risk of disappearing. Advanced digital technology provides a new way for the regenerative design of such patterns, recording, editing and outputting innovative traditional patterns through high-tech means to promote their inheritance and dissemination in modern society. Currently, the research on innovative design of Yao patterns focuses on digital design, mainly on the construction of intelligent classification

pattern system and digital display platform. The research on AIGC has been on the rise in the past two years, firstly, it is the theoretical research on AIGC, which explores its connotation, mechanism, development trend and reflection from different perspectives; and secondly, it is the research on the application of AIGC in various fields, which has great practical significance and provides a different way for this research to be conducted. The second is the research on the application of AIGC in various fields, which is of great practical significance and provides different ideas of reference for this study.

In order to solve the problem of cumbersome and time-consuming manual classification methods, Kong Qian et al. used artificial intelligence technology to intelligently classify Yao pattern symbols, which not only reduces the time-consuming process, but also effectively improves the accuracy of classification, thus promoting the dissemination of ethnic minority folk culture [2].

Chen et al. found that the emergence of programmable robotic embroidery machines can greatly improve the productivity of embroidered textiles and promote the development of e-textiles, and that artificial intelligence based on deep learning technology brings significant benefits to the creation of embroidery aesthetics, and that the digitisation of embroidery has become a research hotspot in the textile field [3].

Wu et al. comprehensively summarise and reveal the current research status of AIGC technology in the field of design from the perspective of combining AIGC and design, analysing the bibliometric data, theoretical foundations and technological dependencies of the existing research, and gaining insights into the evolutionary trends of the combination of AIGC and design. Deficiencies in current research are identified and new directions for future research are proposed [4].

Lou Yongqi discussed the key competencies of creative workers in the AIGC era, emphasising that meaning-making is a unique human strength. To strengthen this

advantage, we need to focus on six areas: humanistic values, creative models, holistic experience, cultural awareness, contextual relevance and narrative reasoning (Fig. 1). AIGC should make machines more mechanical and humans more human, which requires a cultural renaissance and a breakthrough in computational rationality [5].

Hu Yang et al. study the digital continuation of traditional decorative patterns of ethnic minorities, especially those on the verge of disappearing, by AIGC technology from the perspective of cultural preservation. This technology not only passes on cultural heritage, but also personalises and fashions it by incorporating modern elements through innovative designs [6].

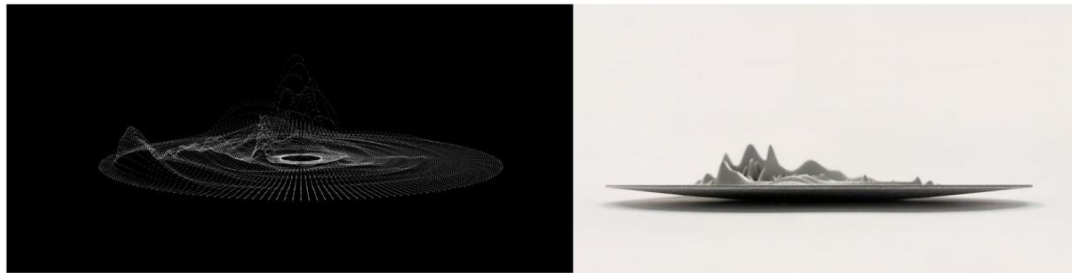


Fig. 1. A sculpture generated from the sound of engine of Aston Martin db11 by Zheng Kangyi in 2018. Human Creativity in the AIGC Era, China, 2023 [5]

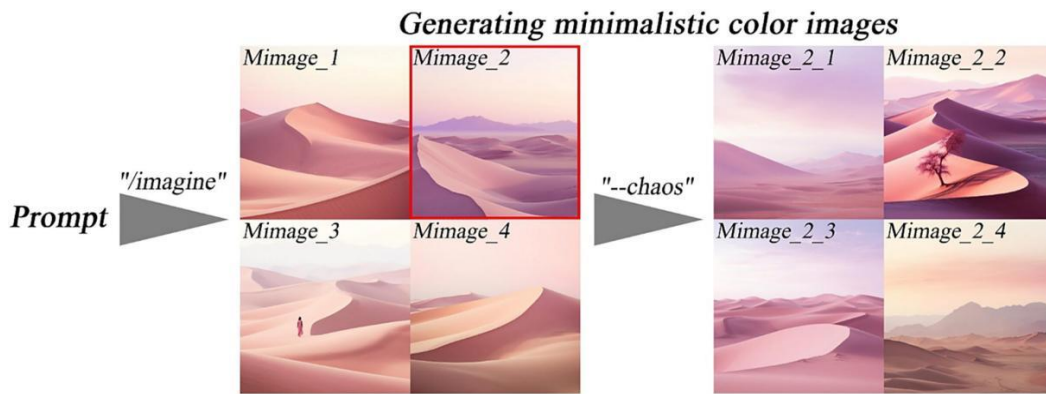


Fig. 2. Intelligently generated colour scheme map under AIGC, Netherlands, 2024[11]










Animal Pattern	Botanical Pattern	Other Patterns
 Bird	 Tree	 Human Figure
 Fish	 Octagonal	 Characters
 Butterfly	 Floral Pattern	 The King's Seal

Fig. 3. General Classification Chart of Yao Patterns

Jiewen Lai et al. provide new ideas for customisation services for streetwear fashion brands by integrating the Big Five personality psychology test and Artificial Intelligence Generated Content (AIGC) technology. Based on the results of the psychological test, an algorithm is used to intelligently generate graphic designs that match the user's personality traits, providing a personalised visual experience for customers with different personalities. Each user can find graphic elements in the application that are relevant to his/her personality, thus enhancing emotional resonance and engagement, which in turn increases purchase desire and brand bonding [7].

Lin Yanjun et al. found that the AIGC tool can rapidly generate a large number of creative concepts and design drafts, providing designers with more sources of inspiration, stimulating creative thinking, and making it easier for them to experiment with different design styles and combinations of elements. This study provides a deep understanding of the application of AIGC in the field of graphic design and offers valuable insights for future research and practice [8].

Xin Jin et al. proposed Aesthetic Language Guidance (ALG) for images under the AIGC technology, which provides guidance for photography through the three attributes of colour, light and composition, and ALG-T and ALG-I provide aesthetic language guidance for two types of input images, horizontal and vertical, which results in a significant improvement in the aesthetic quality of the photographs [9].

Wu et al. present the application of AIGC to the key stages of fashion design, including inspiration, design, manufacturing and marketing. Demonstrating the need for advanced AI model training to improve the accuracy of apparel pattern generation, a bridge approach from design to manufacturing, and the importance of objective evaluation methods [10].

Wu Fan et al. proposed a product colour matching design method based on AIGC. Target images were generated by ChatGPT, Midjourney constructed a shape sample database, extracted the primary colours and applied the colour harmony theory to generate a colour scheme (Fig. 2). The validity of the method was verified using AHP expert evaluation and consumer perception evaluation, with the example being a household Hoover. The results of the study demonstrate the potential of AIGC to innovate the design of traditional product colour schemes and highlight its potential to collaborate with traditional design tools [11].

The above research reflects the current research status of Yao patterns and the application of AIGC in various fields, but the research on combining AIGC with Yao patterns and regenerating pattern design is still in a blank stage, which needs more researchers and designers to carry out more in-depth research and design practice.

Statement of the Problem: Focusing on Yao weaving and embroidery patterns, this study attempts to generate new pattern patterns under AIGC based on the extracted plant patterns, encoded with the cultural connotations they contain. Since the automatically generated patterns will change according to the text and pictures, it is necessary to integrate and optimise the multiple generated patterns in combination with human-guided modifications, thus obtaining the final regenerated design innovative patterns.

Results of the research: In the regeneration design of Yao patterns, AIGC visualises the compliant parameter designs through algorithms or rules, and the designer modifies the generated scheme by adjusting the parameter values. Its working principle is based on semantic analysis, deep learning and intelligent algorithms. As a smarter design assistance technology, AIGC reorganises the design process. In manual design, the innovative design of the pattern is completely

dependent on the designer's own ideas, aesthetics and perspectives. Intelligent generation extends the design behaviour from a single "design" to evaluation and decision-making, where the designer needs to evaluate, modify and redesign the intelligently generated pattern, and continuously guide the algorithm to achieve the regeneration of the final pattern.

1. Extraction of Yao weaving and embroidery patterns. The Yao people often live in mountainous areas, so they worship nature, especially mountains and rivers, and this belief is fully reflected in their art works. There are many kinds of Yao patterns, such as human pattern, animal pattern, character pattern, flower and grass pattern (Fig.3). This design selects the more representative flower and grass pattern and tree pattern as the basis for regeneration design.

The octagonal pattern originates from the Pan Wang Seal, which is also a form of expression of the floral pattern, and is an important element in the culture of the Yao people. Octagonal pattern is not only a decorative pattern, but also contains rich cultural connotation and symbolism. The octagonal shape symbolises good luck, peace and prosperity. The number eight has a special status in Yao culture, symbolising completeness and harmony. In addition, the octagonal pattern is related to the legends and religious beliefs of the Yao people, and they are believed to be able to drive away evils and protect the clan from disasters. The octagonal shapes in Pan Yao embroidery patterns are mainly divided into two forms, the first one is composed of a square and eight right-angled triangles, and the second one is composed of eight parallelograms. It is characterised by a central symmetrical style, expanding from the centre outwards into eight identical parts with a high degree of symmetry, which fully reflects the Yao people's observation and understanding of geometrical shapes in nature, as well as their pursuit of symmetrical beauty.

Tree pattern is a common type of Yao pattern, which is called tree of life pattern by

local people. Yao Pine Nut Tree Pattern shows the harmonious coexistence of man and nature, which is a true portrayal of the life scene of Pangu Yao. The Yao people mainly live in the mountains and forests of southern China, and pine trees are very common in their living environment. The Yao people revere nature and believe that the pine tree can bring good luck and protection, in which the pine tree is often regarded as a symbol of longevity, health and resilience, while the pine cone represents prosperity and new life. The basic form of the pine cone pattern is a pine tree, usually shown in the form of a trunk, branches and pine needles. The pine cones are an important part of the pine tree, and their full shape and neat arrangement symbolise abundance and prosperity. The pine cone tree pattern often adopts symmetrical layout, and the overall pattern is balanced and harmonious. This symmetry reflects the Yao people's pursuit of beauty and respect for the laws of nature. The Yao pattern originates from the imitation and association of natural things, reflecting the profound insight into the life of the Yao people, their praise for beautiful things and their good expectations for the future life. It is not only an important part of the material culture of the Yao people, but also an important carrier of their spiritual culture.

2. Pattern coding and generation. AIGC is highly customisable in the regenerative design of pattern. Designers input specific requirements and preferences, such as colour, pattern, size, etc, according to the connotation of the pattern as well as the aesthetic needs, and AI is able to generate diversified design solutions instantly, which greatly improves the design efficiency and flexibility. In this case, the extraction for the octagonal pattern and tree pattern not only includes the visual representation of the pattern, but also its symbolic meaning and historical inheritance in Yao culture. Using advanced computer vision techniques, key features such as geometry, symmetry, and colour matching of the pattern were identified and extracted, and this information was converted into machine-

readable form. In the stage of picture generation and model training, select AIGC software Midjourney (MJ) for pattern intelligent generation, through the Midjourney in the input "/imagine" and select the "prompt" command, the picture link input. According to the pattern regeneration design needs to enter the relevant instructions (such as style, composition effect, design method, connotation description, etc.), and then finally enter the parameter part, in order to improve the accuracy of the language text control image generation. MJ learns the unique features and styles of Yao patterns through

training, and undergoes multiple rounds of iterative optimisation during the training process. Through adversarial training or encoding-decoding interactions, the model gradually improves the quality and diversity of the generated images. Constant adjustment of the model parameters and structure can optimise the generation effect to a certain extent, and ensure that the generated patterns not only retain the traditional cultural elements, but also fit in with modern design requirements. Finally, after continuous learning and improvement, the Yao pattern regeneration design is completed (Fig. 4).

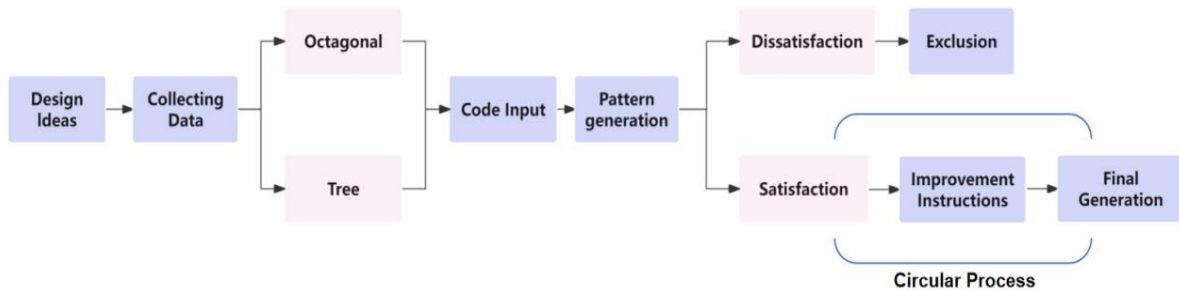


Fig. 4. Design flowchart for pattern regeneration under AIGC (Author's production)

3. The regeneration of the octagonal and tree patterns. Firstly, the octagonal pattern and tree pattern are drawn into the form of line drawing, and then according to the cultural connotation embodied in the octagonal pattern and tree pattern, they are refined and summarised into key words and presented in the form of text. As the main visual elements of the pattern code, the octagonal pattern and tree pattern should be considered as the main visual elements of the pattern code, and at the same time the modelling should also be inclined to the connotation of the octagonal pattern and the tree pattern in the Yao culture, so as to avoid the generation of errors in the pattern. In order to expand the designer's thinking and further improve the innovation of the pattern, the two patterns were iterated ten times. During the iteration process, the

instructions were constantly modified, and the images that met the requirements were selected, and finally the key elements were extracted and formed into a brand new, uniquely mysterious Yao pattern (Fig.5-6).

4. Problems with in preserving Yao patterns. However, there are some problems. Firstly, due to the limitations of the designer's own skills and depth of understanding of Yao culture, the rich meanings of the patterns cannot be accurately expressed, and the regeneration of patterns is also affected to a certain extent. Secondly, a large amount of training data is required to develop effective AI models, and digitisation of AI-generated patterns may create technical difficulties for the actual weaving and embroidery operations.

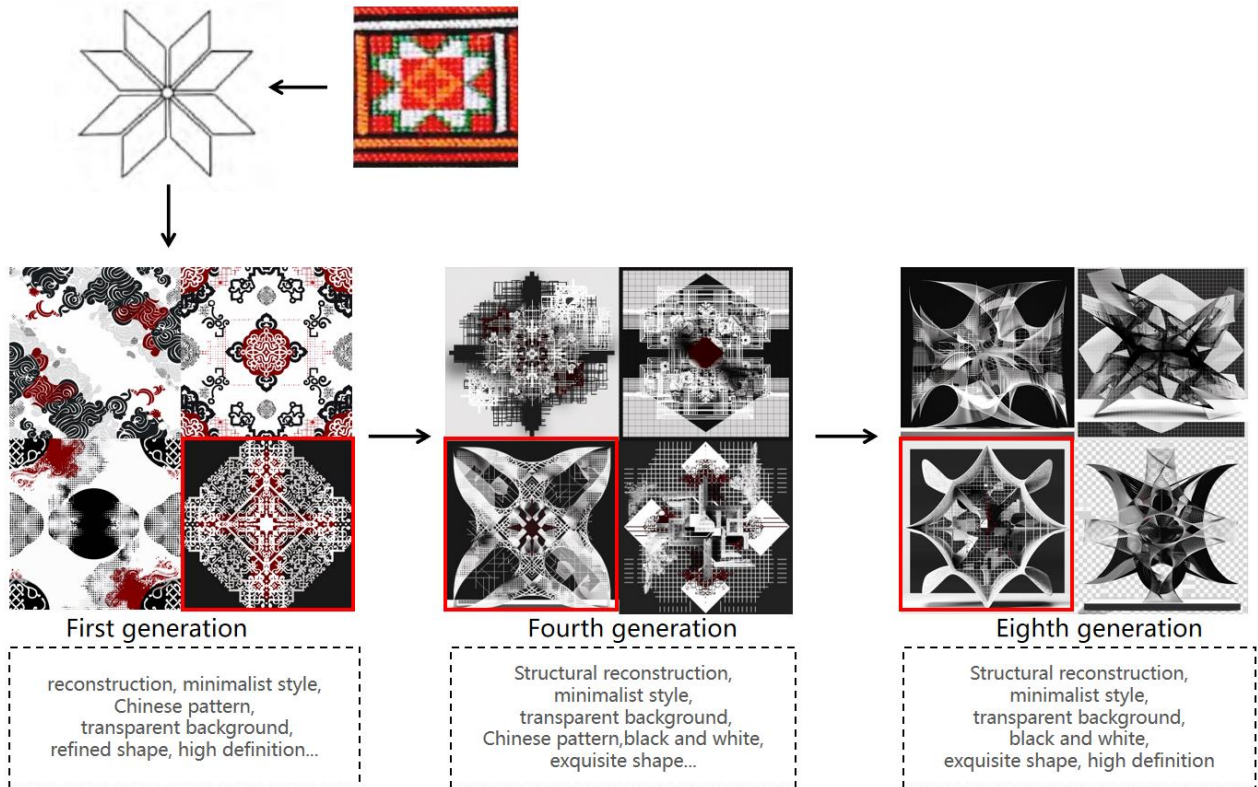


Fig. 5. Octagonal pattern regeneration flowchart (Author's production)

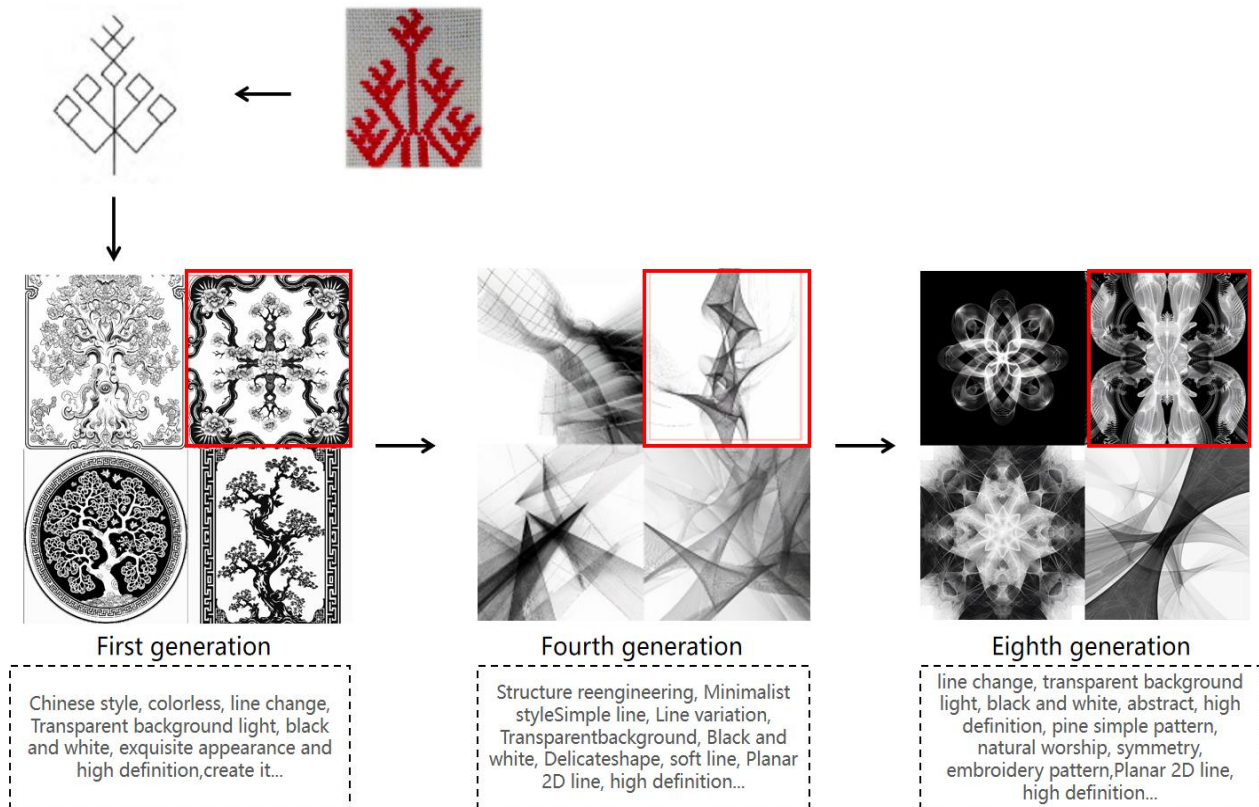


Fig. 6. Tree pattern generation flowchart (Author's production)

Conclusion. Having analyzed the patterns of the Yao people, we can state that aesthetics and deep meaning have always accompanied the works of Chinese masters in this region. It has been established that the currently discovered samples of traditional weaving and embroidery include a variety of patterns, the most characteristic being natural motifs, images of mountains, grass, pine cones and octagonal ornamental compositions. It has been revealed that patterns of patterns have not only aesthetic value, but also a deep cultural meaning, and therefore the traditional patterns of the Yao people need not only to be preserved as valuable historical material, but also to be rethought by modern designers. Artificial Intelligence Generated Content (AIGC) is capable of digitally preserving and regenerating Yao's endangered patterns, and by creating new pattern designs, Yao can gain

new fame in modern society. During the research process, it was found that this not only promotes the integration and development of traditional craftsmanship and modern technology, but also opens up a new path for innovation and heritage in the art of weaving and embroidery. This technology-driven approach to design will greatly enrich the expression of the art of weaving and embroidery and enhance its cultural value and market competitiveness. Thus, it was revealed that artificial intelligence allows designers to co-create with intelligent systems to explore new design paradigms. The entire design process provides a theoretical basis for the research on Yao pattern regeneration, and also lays a practical foundation for the innovative design of artificial intelligence and Yao patterns in the future.

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НА ОСНОВІ-ТЕХНОЛОГІЙ ШТУЧНОГО ІНТЕЛЕКТУ**

Метою цієї роботи є визначення доцільності використання технології AIGC (Artificial Intelligence Generated Content) для відновлення дизайну традиційних візерунків Яо, щоб захистити та зберегти культуру етнічної групи Яо, і в той же час сприяти модернізації застосування традиційного мистецтва.

Методологія: у цьому дослідженні, заснованому на класифікації та аналізі візерунків плетіння та вишивки Яо за допомогою дослідження літератури, вибрані шаблони дизайну кодуються та вилучаються, а для виконання регенерації дизайну візерунків застосовується технологія AIGC (Artificial Intelligence Generated Automatic Generation Contents).

Результати: Вивчаючи процес створення та еволюції візерунків Яо, було виявлено що його унікальна культурна та естетична цінність вимагає ретельного вивчення та збереження. Було констатовано, що візерунки створені за допомогою технології AIGC, не тільки зберігають основні елементи традиційних візерунків, але й впроваджують різноманітні дизайнерські інновації. Ці новітньо створені шаблони мають високу візуальну естетику та можуть бути застосовані до дизайну похідних культури Яо.

Наукова новизна дослідження полягає у виявленні головних характеристик традиційних візерунків народу Яо, та запропонованому підході щодо їх збереження та інтеграції в сучасний дизайн. Долаючи обмеження традиційного дизайну, це дослідження поєднує технологію AIGC з національною традиційною культурою.

Практична значущість. Дослідження має вагоме наукове значення, оскільки воно не тільки забезпечує новий метод цифрового збереження та інноваційного дизайну візерунків Яо, але й сприяє вивченню застосування штучного інтелекту в інноваціях у шаблонах. Матеріали дослідження можна застосовувати як в навчальних курсах, так і в проєктних дизайнерських практиках.

Ключові слова: штучний інтелект; культура яо; регенерація візерунка; мотиви-символи, узор вишивки; дизайн

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