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Research on Intelligent Design Systems of Intangible Cultural Heritage Combining Big Data and CAD Technology

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Abstract. This study first proposed and implemented an intelligent design system for intangible cultural heritage sites based on big data and CAD (computer-aided design) technology. They are utilizing advanced digital technologies such as 3D scanning and photogrammetry to collect comprehensive and high-precision data on intangible cultural heritage. Subsequently, the collected data was processed and modelled using CAD software to construct realistic virtual forms, laying a solid foundation for subsequent intelligent design. Integrate multiple data sources, such as historical documents, expert knowledge, and market trends, to form a massive database of intangible cultural heritage. Based on big data analysis technology, the system can automatically identify design elements and style features and intelligently match and make recommendations based on user needs, achieving rapid generation and optimization of design solutions. The system is tested through experiments, and the results show that the system can not only realize the digital extraction and automatic modeling of traditional technology but also carry out the digital simulation, digital simulation, and digital reconstruction of traditional technology.

Keywords: Big Data; CAD Technology; Intangible Cultural Heritage; Intelligent Design System
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1 INTRODUCTION

CAD technology, as a fundamental tool for product design, has witnessed a leap in its development from traditional 2D drawing to 3D modeling, and then to parametric design and simulation analysis. Nowadays, the addition of AI technology has endowed CAD systems with unprecedented intelligent features [1]. AI algorithms can learn and understand designers' intentions, automatically optimize design solutions, and improve design efficiency and accuracy. For example, through machine learning technology, CAD systems can analyze large amounts of historical design data, identify common design patterns and trends, and provide designers with innovative inspiration and decision support [2]. With the in-depth implementation of the "Made in China 2025" plan by the state, intelligent design, as an emerging intelligent manufacturing method, has been widely used in all aspects of the manufacturing industry and has become an effective way to improve product innovation and competitiveness [3]. Under the background of Industry 4.0, how to apply emerging technologies such as big data and cloud computing to traditional manufacturing fields and improve product innovation ability [4]. In the construction industry, AI-assisted architectural design software can simulate building performance under complex environmental conditions, detect potential problems in advance, and optimize design solutions. In the field of art and design, AI-generated artworks and design schemes are gradually breaking the boundaries of traditional creation and inspiring new creative inspirations [5]. However, most of these methods use specific knowledge units as knowledge units for storage and retrieval and rarely use semantic networks. As a result, the constructed intangible cultural knowledge map lacks semantic correlation and semantic reasoning functions [6]. More importantly, there is a lack of an effective reasoning mechanism to analyze the complex relationships and dynamic changes in the knowledge graph of intangible cultural heritage. The reasoning mechanism is a key bridge connecting knowledge and application, which can help us extract valuable information from massive data and discover hidden patterns and patterns. Furthermore, it provides a scientific basis for the protection, inheritance, and innovation of intangible cultural heritage [7]. Therefore, this paper combines big data and CAD technology, builds a knowledge base based on the intangible cultural knowledge map, and adopts the method of combining ontology and reasoning to realize the intelligent design of intangible cultural products [8].

Based on the data support provided by the big data platform, we can further integrate the advantages of CAD technology to build an intelligent design system for intangible cultural heritage. The system should be able to utilize the high-precision modelling and simulation capabilities of CAD to transform traditional elements, technical processes, cultural symbols, etc. of intangible cultural heritage into digital 3D models or 2D drawings. At the same time, by combining AI algorithms and machine learning technology, the system can automatically optimize design schemes, simulate the effects in different design scenarios, and provide designers with intuitive and convenient design tools and decision support [9]. By collecting, integrating, and analyzing massive amounts of historical documents, archaeological discoveries, environmental monitoring data, and high-precision 3D point cloud data obtained through modern technology, big data can construct a comprehensive and multidimensional cultural heritage information database. In addition, CAD technology also supports parametric design, allowing designers to simulate the effects of different protection schemes or restoration strategies by adjusting parameters, providing a scientific basis for the sustainable management of cultural heritage [10]. These data not only cover the physical form of building structures but also involve multiple aspects such as material properties, historical changes, cultural significance, etc., providing rich materials and a basis for intelligent design, by directly embedding various 3D model components. By converting 3D point cloud data, historical drawings, archaeological reports, and other information from big data into recognizable CAD formats, designers can reconstruct and optimize historical building models in a virtual environment while preserving their unique cultural features and complex details. HBIM is not only a 3D model but also an intelligent platform that integrates multiple sources of information, such as building information, historical data, and maintenance records. This intelligent design and management approach not only improves the efficiency and accuracy of cultural heritage protection work but also promotes interdisciplinary cooperation and knowledge sharing. Combined with intelligent object technology, HBIM can accurately replicate complex details in antique buildings while achieving dynamic updates and sharing of information.

2 RESEARCH STATUS AT HOME AND ABROAD

Currently, the inheritance and development of intangible cultural heritage are facing new challenges. How to transform traditional manual design into data-driven intelligent design is a problem that needs to be solved. Therefore, in recent years, Liang and Kim [11] have conducted a series of studies on how to introduce intelligent methods into the design process of intangible cultural heritage-related products, and have achieved certain results. For example, in the existing related cultural products, most of the products related to the innovative design of intangible cultural heritage are traditionally handmade, and the relevant data is processed through computer technology, achieving digital modelling. The efficiency of this modelling strategy is relatively low and its application scope is narrow. Although many scholars have conducted research on data-driven intelligent design methods, a unified standard has not yet been formed. In addition, Sipiran et al. [12] found that due to the diversity, complexity, and variability of intangible cultural heritage, there are significant difficulties in the digital modelling and simulation of intangible cultural heritage, resulting in high modelling costs. The rise of big data technology has provided new ideas and methods for the protection and inheritance of intangible cultural heritage. Yan et al. [13] used big data technology to digitally collect and model intangible cultural heritage sites, which not only preserves their original appearance but also allows the public to understand and experience these cultural heritages in a more intuitive and interactive way through technologies such as virtual reality (VR) and augmented reality (AR). Specifically, key elements and features of intangible cultural heritage can be extracted based on the results of big data analysis. Then, using CAD software for 3D modelling and simulation analysis, design cultural products that retain traditional charm while meeting modern aesthetic needs. In terms of combining intangible cultural heritage elements with the design, production, and processing of industrial products, some scholars have found that many industrial designers can effectively increase the added value of products by using intangible cultural elements. Some scholars have found that there is relatively little research on using big data technology for product design, and there are certain limitations in using big information technology to extract and innovate intangible cultural elements. The diversity and complexity of intangible cultural heritage require CAD technology to have higher flexibility and adaptability to meet the design needs of different cultural backgrounds. Yang et al. [14] integrated CAD technology into the design process of intangible cultural heritage sites, not only achieving modernization and intelligence of design methods but also opening up new paths for the inheritance and innovation of intangible cultural heritage.

With the support of big data, Yang et al. [15] collected and integrated a large amount of information from multiple channels, including but not limited to the chemical composition of pigments, historical usage records, the artist's creative background, and the preservation status of paintings. Combined with big data, CAD can not only achieve high-precision 3D modelling and simulation but also directly apply the results of machine learning analysis to the design process. Especially, the introduction of big data enables us to build more complex and comprehensive models, and more accurately simulate and predict the performance of pigments under different conditions, thereby optimizing protection strategies and repair plans. These data are deeply mined through advanced analysis techniques such as data mining and machine learning algorithms, providing unprecedented insights for intelligent design. For example, the pigment mixing ratio and distribution information predicted by deep learning models such as DNN can be seamlessly integrated into CAD systems to guide repairers in precise pigment mixing and drawing, ensuring that the repaired work is highly consistent with the original in colour and texture. In addition, the solution proposed by Yuan et al. [16] further demonstrates the advantages of combining big data and CAD technology in solving common problems of data imbalance and limited data in historical art analysis. The aggregation and preprocessing techniques of big data can effectively alleviate the problem of data scarcity. In order to balance the training set and improve the model's generalization ability. CAD technology provides an intuitive visualization platform that helps researchers and artists better understand the stories behind data, promoting interdisciplinary collaboration and knowledge sharing.

Zhao [17] proposed a 3D digital cultural relic virtual restoration system and method based on a fuzzy logic algorithm. Through big data analysis, the system can identify potential correlations between fragments and provide clues for precise stitching. This information includes but is not limited to the fracture surface contour of the fragments, material properties, historical background, etc., laying a solid foundation for subsequent feature extraction and analysis. These feature vectors not only reflect the physical form of the fragments but also contain the cultural significance and historical value behind them. This system utilizes big data processing technology to mine and integrate key information from massive cultural relic fragment images, 3D scanning data, and historical documents. Multilayer perceptrons have powerful nonlinear mapping and self-learning capabilities, which can extract advanced feature representations from complex data and provide strong support for accurate matching and concatenation of fragments. This method deeply integrates big data processing, CAD technology, and multi-layer perceptron neural network and brings innovation to the field of cultural relics protection and intelligent design. In the feature extraction stage, the system not only focuses on traditional geometric features such as curvature, torsion, and left-right chord length but also combines multi-dimensional information such as material and colour changes in big data to construct more comprehensive feature vectors. Zhou et al. [18] used a multi-layer perceptron neural network for deep learning and feature vector fusion. By continuously optimizing the network structure and parameters, the system can automatically adjust the splicing strategy to adapt to the complex relationships between different segments. The high-precision modelling and simulation capabilities of CAD technology enable the system to simulate the actual effect of fragment splicing, providing intuitive visual feedback for maintenance personnel. In the splicing operation stage, the system combines CAD technology to convert the calculation results of multi-layer perceptrons into specific 3D model repair solutions.

3 DESIGN AND OPTIMIZATION OF INTELLIGENT DESIGN SYSTEM OF INTANGIBLE CULTURAL HERITAGE BASED ON BIG DATA AND CAD TECHNOLOGY

3.1 The Design Process of Intelligent Design System of Intangible Cultural Heritage

Intangible cultural heritage is a kind of living traditional culture, which has rich cultural connotations and is the crystallization of human wisdom. It not only contains valuable material wealth but also contains rich intangible cultural heritage. Common related products include shadow play, paper cutting, colour painting, etc. The typical representative shadow play works in its intangible cultural heritage are shown in Figure 1.

Figure 1: Shadow play works are typical representatives of intangible cultural heritage.

As the cornerstone of the system, this module is responsible for organizing, classifying, and storing various knowledge information related to intangible cultural heritage. These models not only restore the original appearance of cultural relics but also incorporate the designer's creativity and modern aesthetic elements, providing rich materials and sources of inspiration for design innovation. Relying on CAD technology, this database includes a wide variety of three-dimensional models of intangible cultural heritage. This layer is the core intelligent engine of the system, which utilizes advanced algorithms and models to intelligently reason, solve, and simulate intangible cultural heritage knowledge—including but not limited to historical background, production techniques, cultural connotations, etc. Through intelligent indexing and retrieval functions, designers can quickly acquire the necessary knowledge and provide solid support for design creation. Through precise analysis of design requirements, the system can automatically generate preliminary design solutions that meet the requirements and continuously optimize them to the best state, greatly improving design efficiency and creativity. This platform enables cloud-based sharing and real-time collaboration of design resources. Designers, scholars, craftsmen, and even the general public can use this platform to exchange ideas, share works, participate in discussions, and jointly promote the revitalization and inheritance of intangible cultural heritage. The specific functional process is shown in Figure 2.

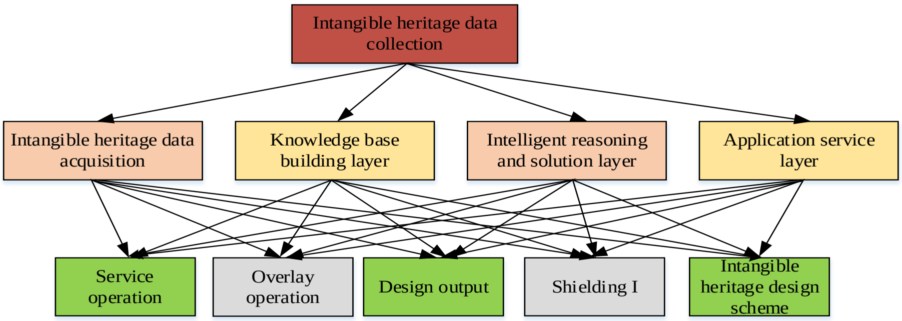

Figure 2: Based on big data and CAD technology, the function distribution of intelligent design systems for intangible cultural heritage is realized.

CAD technology plays a crucial role in intelligent design systems for intangible cultural heritage. The CAD technology integration module seamlessly integrates CAD software with professional databases, achieving a perfect fusion of design creativity and traditional cultural elements. It is not only used for precise 3D modelling and visualization display of intangible cultural asset data but also for deep processing and optimization of cultural resource data through its powerful data processing and analysis capabilities. In addition, the module also has intelligent design assistance functions, which can automatically generate preliminary design schemes based on design requirements and continuously improve design quality through algorithm optimization. Secondly, the intangible cultural heritage model library of this system is mainly composed of a model material library, a model intelligent reasoning solution library, and an intangible cultural intelligent design application service library. Among them, the model material library is used to store and manage intangible cultural heritage data, the model intelligent reasoning solution library is used to reason and analyze intangible cultural heritage data, and the application service library is used to provide users with various intangible cultural design schemes.

3.2 Efficiency Improvement Process of Big Data Analysis Technology in Intelligent Design System of Intangible Cultural Heritage

To further improve the work efficiency and operation quality of the intelligent design system of intangible cultural heritage, this study combined big data analysis technology to build and train a big data analysis model based on the existing intangible cultural design data set. The overall data processing process is shown in Figure 3.

In the interface design of the intelligent design system for intangible cultural relics, the application of big data analysis technology greatly enhances the intelligence and personalization level of user interaction. At the same time, the modular design of the system architecture enables each functional module to be both independent and closely collaborative, facilitating subsequent maintenance and upgrades. In addition, in response to the particularity of intangible cultural heritage data, the system has adopted specialized data processing and storage strategies to ensure the integrity and security of the data. This personalized design based on big data not only improves user efficiency and satisfaction but also promotes the popularization and dissemination of intangible cultural heritage knowledge.

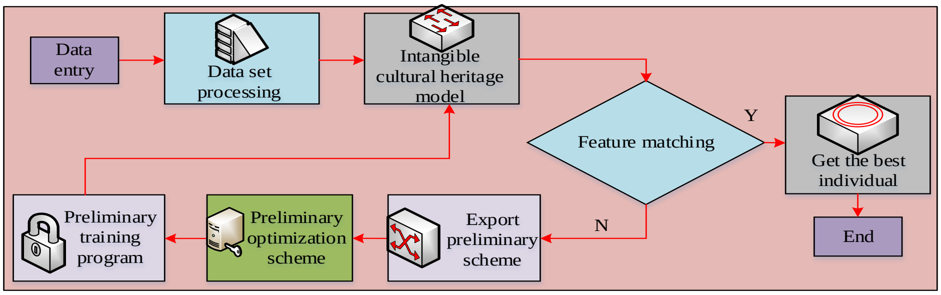

Figure 3: Data processing process of big data analysis technology in intelligent design system of intangible cultural heritage.

The system can integrate and analyze massive amounts of intangible cultural data, identify user preferences and design needs through intelligent algorithms, automatically adjust interface layout and functional display, and achieve accurate information push and efficient screening. The calculation process required in this process is shown in the following formula, and the corresponding classification function and degree value function are

$$Q(m) = \frac{\sum_{i=1}^{n} \gamma m_i + \partial m_{i-1}}{\eta\mu} \tag{1}$$

$$K(m) = \sum_{i=1}^{n} \left\{ \frac{m_i - \varphi m_{i-1}}{m_{i-1} + n m_{i+1}} \right\} \tag{2}$$

After the knowledge graph training, the expressions of the knowledge training function and the feature comparison function are respectively

$$W(m) = \gamma m^{\gamma} + \ \partial - 2 \ m^2 \tag{3}$$

$$H(m) = \frac{m^3 - \partial m^{\eta}}{n + \varphi m^2 + 3} \tag{4}$$

Secondly, in the user interface of the intelligent design system of intangible cultural heritage, the intelligent design system of intangible cultural heritage based on big data analysis technology can realize the analysis of user needs. Specifically, the system can determine the type of user needs through the analysis of user needs, classifying them, and then making personalized recommendations to users according to different demand types. For example, when analyzing user needs, this study can divide users into two categories: one is the needs directly related to product design, including the extraction of intangible cultural heritage elements and the selection of design methods; The other category is the needs unrelated to product design, including the selection of intangible cultural elements extraction methods, the choice of design style. Then, users are personalized and recommended according to different users' demand types. The simulation analysis results in this process are shown in Figure 4.

In this process, the calculation process of relevant data is as follows, and the corresponding system decision function is

$$E(m) = \frac{\varphi m^{n} + \ \partial - 2 \ m^2}{W(m) + W(2m)} \tag{5}$$

In this case, the corresponding feature-matching function is

$$R(m) = \frac{E(m) + Q(m) + \mu H(m)}{n + \varphi m^2 + 3} \tag{6}$$

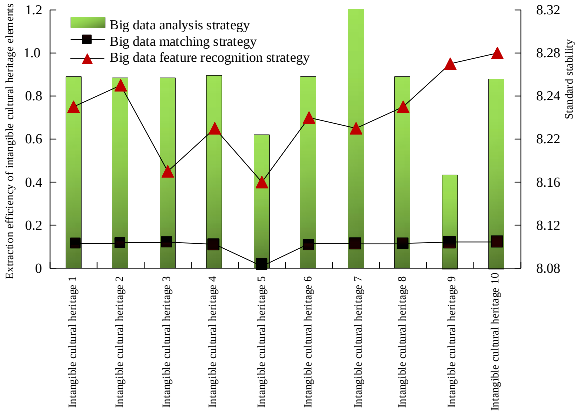

Figure 4: Simulation analysis results of big data analysis technology in intelligent design system of intangible cultural heritage.

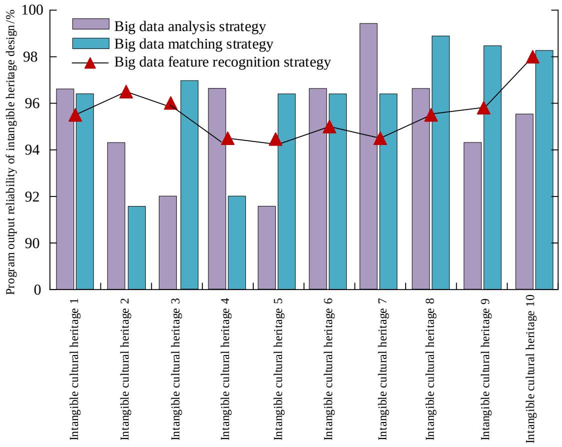

Figure 5: Demand analysis and matching results of intelligent design system of intangible cultural heritage based on big data technology.

The expression of the optimization function can be solved after the equivalent change

$$T(m)=\frac{Q(2m)+Q(m+2)+\mu H(2m)}{nK(2m)+\varphi W(m^2)}+\frac{n+m}{\varphi} \tag{7}$$

If the corresponding non-posthumous degree is satisfied, the following relationship is established

$$T(m)\le=\frac{nK(m)+\eta W(m)}{\gamma} \tag{8}$$

The factors in the relevant formulas presented in this study all represent the same mathematical significance, where, representing the intangible cultural heritage data source, φ,∂ representing classification characterization parameters, γ,n representing the knowledge graph dimension parameter, μ representing the database training degree, η and representing the solving factor.

In the output process of the design scheme of the intelligent design system of intangible cultural heritage, the intelligent design system of intangible cultural heritage based on big data technology can conduct a secondary test of the scheme by analyzing user needs and combining the types of user needs with the human-computer interaction information in the product design process, which can greatly reduce the possibility of error output of the scheme. The relevant simulation analysis results of this stage are shown in Figure 5. As can be seen from Figure 5, during the output of the design scheme of the intelligent design system for intangible cultural heritage, a secondary test will be carried out based on big data technology. This is because, in this process, the intelligent design system of intangible cultural heritage designed by this research institute will analyze user needs and user feedback with the help of big data technology and use big data analysis technology to test the feasibility of the scheme again, and determine the best design scheme by comparing the results of the secondary test with the results of feasibility analysis.

3.3 Application Analysis of CAD Design Technology in Intelligent Design System of Intangible Cultural Heritage

CAD design technology has many advantages, such as real-time observation of the three-dimensional shape of the product, to a certain extent, reducing the labour cost in the process of product design, improving the efficiency of product design, and also effectively improving the accuracy of product design. In order to further improve the visualization effect and design efficiency of the intelligent design system for intangible cultural heritage, this study uses CAD technology and computer technology to design and develop CAD standardized models for design schemes related to intangible cultural heritage. The corresponding parameters are shown in Table 1.

Intangible cultural heritage design	*Parameter value of intangible heritage image quantization*	*Intelligent parameter value of intangible heritage image*	*Visual parameter values of intangible cultural heritage*
AA	1	0.8	1.1
AB	1.2	0.9	1.2
BB	0.9	0.9	0.9
AC	0.8	1.1	0.8
CC	0.7	0.8	0.9
BC	0.9	0.8	0.8

Table 1: Corresponding parameter values of design schemes related to intangible cultural heritage.

At this time, the CAD modelling standard degree function and CAD three-dimensional space function are, respectively:

$$Y(m)=\frac{\gamma m^{\gamma}}{n}+\frac{\partial-2\ \ m^{2}}{\eta} \tag{9}$$

$$U(m)=\frac{1+m^{\gamma}+\ \partial-2\ \ m^{2}}{\varphi+1} \tag{10}$$

Then, the corresponding modular value expressions are

$$\left\|Y(m)\right\|=\sqrt{\left(\frac{\gamma m^{\gamma}}{n}\right)^{2}+m\left(\frac{\partial-2}{\eta}\right)^{2}} \tag{11}$$

$$\left\|U(m)\right\|=\left\|\frac{1+m^{\gamma}+\ \partial-2\ \ m^{2}}{\varphi+1}\right\| \tag{12}$$

In the process of building standardized CAD models, the generation and optimization of graphic files are key steps to ensure accurate communication of design schemes. Texture, as an important means of enriching the texture and layering of design works, also plays an important role in the CAD standardized model construction of intangible cultural heritage-related design schemes. Meanwhile, utilizing computer technology to optimize graphic files, such as removing redundant data, improving graphic accuracy, and enhancing graphic expressiveness, can further enhance the visual effect and practicality of design schemes. The graphic elements in intangible cultural heritage often contain rich cultural connotations and symbolic meanings. Therefore, in the process of generating graphic files, it is necessary to fully respect and preserve the original forms and characteristics of these elements. And the construction of a CAD-standardized model. When the above steps are completed, the corresponding elements are shown in Table 2.

CAD model categories	*CAD model element values*	*CAD three-dimensional space element value*	*CAD color element value*
1	8.9	7.8	9.1
2	7.6	7.9	9.2
3	8.6	7.9	9.3
4	5.9	8.1	9.8
5	8.2	8.6	8.9
6	8.9	8.7	8.8

Table 2: Element experiment of CAD standardized model.

Through computer technology, designers can create various texture files with traditional cultural characteristics, such as textures of traditional handicrafts and natural scenery, and cleverly integrate them into design models. The deep integration of texture and model not only enhances the artistic appeal of the design work but also makes the elements of intangible cultural heritage more vivid and three-dimensional. The simulation analysis results at this time are shown in Figure 6.

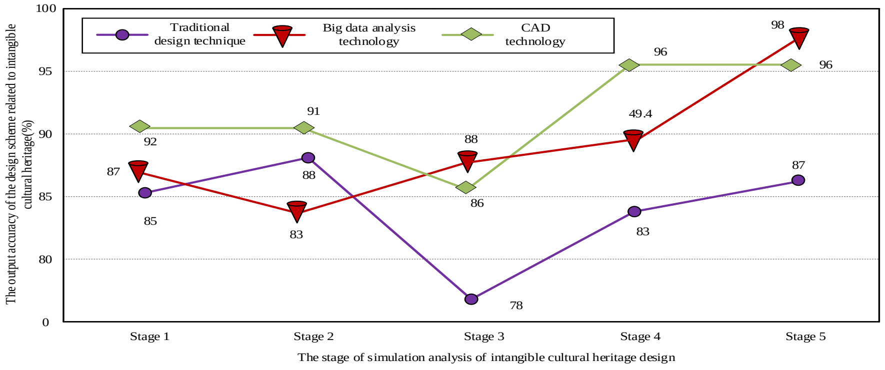

Figure 6: Results of simulation analysis on the feasibility of design scheme related to intangible cultural heritage.

It can be seen from the results in Figure 6 that the CAD standardized model has a good optimization effect because. In the process of establishing and managing these four types of knowledge base models, this article focuses on the accuracy and timeliness of knowledge. By constantly updating and supplementing, we ensure that the knowledge base can keep up with the pace of the times and reflect the latest developments in intangible cultural heritage. At the same time, we also utilize modern information technology methods such as database management systems and data mining techniques to deeply mine and analyze the data in the knowledge base, providing designers with more accurate and personalized design suggestions and inspiration.

3.4 Optimization Strategy of Intelligent Design System of Intangible Cultural Heritage Based on Big Data and CAD Technology

In order to better combine the two advantages of big data technology and CAD technology and further improve the intelligence of the intangible cultural heritage design system, this study designed an optimal combination scheme and mainly conducted research on how to achieve the acquisition, processing, storage, sharing, and utilization of knowledge related to intangible cultural heritage. The relevant calculation process in this stage is as follows, in which the expression of deductive function and inductive function is:

$$A(m) = \frac{\varphi m^3 + \gamma m^2 + \eta m}{n} \tag{13}$$

$$O(m) = \sqrt{\varphi m^3 + \gamma m^2 + \eta m + n} \tag{14}$$

In the process of constructing the intelligent design system of intangible cultural heritage based on big data and CAD technology, it is also necessary to choose according to the results of these two forms of reasoning and apply them to the design process of specific intangible cultural heritage products. In this process, the intangible cultural heritage design system needs to deal with relevant knowledge reasonably and scientifically, which can be judged according to the following inequalities

$$\frac{A(2m)}{O(m)} \geq \frac{A(m) + O(m)}{2} \tag{15}$$

In order to better combine big data technology and CAD technology, this study establishes a corresponding intelligent design system of intangible cultural heritage on the basis of fully studying the advantages of both and optimizing its design. At the same time, in order to improve retrieval efficiency further, it also needs to be optimized. In the specific optimization process, a semantic similarity algorithm (such as the KNN algorithm) is adopted for retrieval so that the retrieval speed of the system will be further improved. After double optimization of the intangible cultural heritage design system, the output case results are shown in Figure 7.

Figure 7: The case results of the output of an intelligent design system of intangible cultural heritage.

4 EXPERIMENTAL DESIGN AND RESULT ANALYSIS

4.1 Experimental Design Process and Experimental Results

The intelligent design system of intangible cultural heritage is based on big data and CAD technology, so it is necessary to design related experiments to test the system. The test environments are Matlab6.0, TensorFlow2.0, Apache Kafka3.0, Hadoop, and other programming environments. The database uses SQL Server 2008, and the format of data records in the database is an HTML file. Before the test, it is necessary to add the knowledge base built into the intelligent design system of intangible cultural heritage to the system. Since the knowledge base built in this study belongs to the category of semantic web, it is described in OWL language. The quantitative values of intangible cultural characteristics in the experiment are shown in Table 3.

Experimental group	*Characteristic value of intangible cultural heritage elements*	*Characteristic value of intangible cultural image*	*Characteristic value of intangible cultural heritage design*
1	98	96	99
2	96	98	97
3	91	99	93
4	89	97	98
5	93	98	91
6	92	91	92

Table 3: Quantified values of intangible cultural features during the experiment.

To verify the system's design effect, the method proposed in this study was compared with several other intelligent design methods of intangible cultural heritage during the experiment. Under the same data acquisition method, the experimental results of different methods are compared and analyzed, as shown in Figure 8.

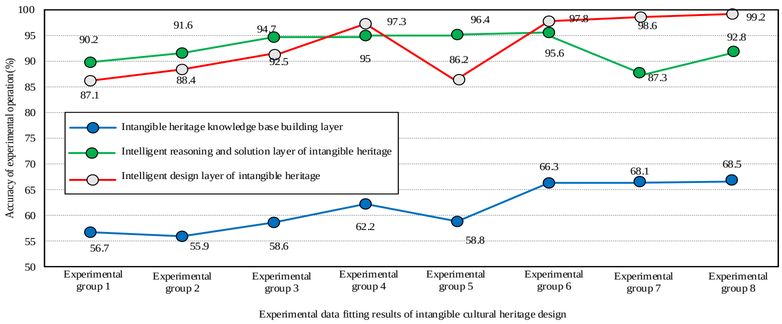

Figure 8: Experimental results of experimental data under different analytical operations.

As can be seen from the results in Table 1 and Figure 8, under the same experimental environment, the system proposed in this study has higher accuracy for digital data collection of intangible cultural heritage, faster model construction speed, higher model construction efficiency, higher accuracy of intelligent design results of intangible cultural heritage, and shorter time spent in the process of intelligent design of intangible cultural heritage. Therefore, the system proposed in this study has high efficiency and accuracy.

4.2 Analysis of Experimental Results

In order to further analyze the above experimental results and information mining, this study also carried out a secondary calculation and analysis of the experimental results, taking the results of the first calculation as the initial value, using the traditional method and the calculation results of this research method to compare. After the comparative analysis of the two calculation results, the statistical table of the data is shown in Table 4.

Experimental group	*Stability calibration value*	*Error rate calibration value*
1	99	0.001
2	96	0.005

3	99	0.003
4	99	0.005
5	97	0.004
6	98	0.002

Table 4: Analysis table of experimental results.

After analyzing the data table, the relevant results are shown in Figure 9.

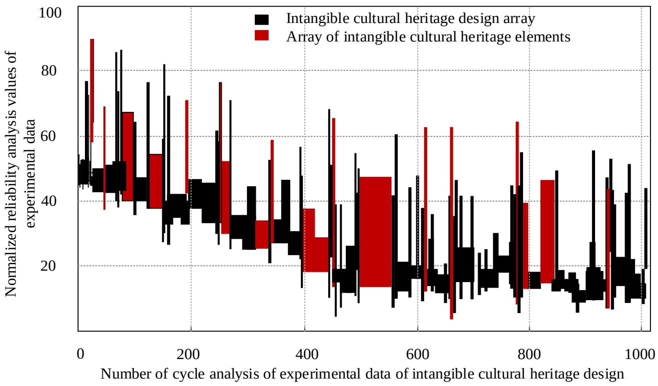

Figure 9: The results of normalized reliability analysis of experimental data.

As can be seen from the results of Figure 8 and Figure 9, in the intelligent design system of intangible cultural heritage in this study, the calculation accuracy is not very high when there is a small amount of data in the design scheme of intangible cultural heritage. However, with the increasing amount of data, the accuracy of the traditional method has been significantly improved. This is because when the data set is small, the processing method adopted by the big data computing model uses feature vectors for feature matching, so the number of feature vectors used is small and the calculation time is longer. However, with the increase in the amount of data and the intervention of CAD technology, the number of feature vectors used in the design method has gradually increased, and the calculation time has also increased, so the calculation accuracy has also been significantly improved. Therefore, it is feasible and effective to adopt a big data computing model and CAD technology in the intelligent design system of intangible cultural heritage.

5 CONCLUSIONS

In order to achieve systematic management and efficient utilization of intangible cultural heritage knowledge, this system introduces semantic web technology and constructs an intangible cultural heritage knowledge base. This knowledge base not only contains basic information, historical evolution, cultural connotations, etc., of cultural heritage but also closely connects different knowledge points through semantic association, forming an organic whole. At the same time, the system also pays attention to the dynamic updating and supplementation of knowledge, ensuring the timeliness and comprehensiveness of the knowledge base. The construction of this knowledge base provides designers with strong knowledge support and inspiration sources, enabling them to accurately grasp the spiritual essence and cultural characteristics of cultural heritage in the process of innovative design. Based on the CAD model database, this system has constructed a rapid-design function module. This module not only supports designers in efficient 3D modelling and editing but also achieves automatic optimization and adjustment of design schemes through the integration of intelligent algorithms. In the process of intelligent design, the system will automatically infer design elements and styles that conform to the characteristics of cultural heritage based on the information in the knowledge base, and call the CAD rapid design module for implementation. This process not only improves design efficiency but also ensures the cultural connotation and artistic quality of the design work. In future work, the system will continue to be deeply studied and explored, and it will be applied to practice.

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