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Computer-Aided Design AND APPLICATIONS

Optimization Strategy of Tourist Souvenir Design using Cloud-Based CAD Collaboration

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Abstract. This paper puts forward an innovative design optimization method by integrating the efficient resource sharing of cloud computing and the precise collaborative design of CAD (Computer Aided Design) technology in order to improve the design efficiency of tourist souvenirs. Firstly, the principles and objectives of the design optimization strategy are formulated, and the design resource sharing strategy based on cloud computing and design collaboration strategy based on CAD technology are expounded in detail. Subsequently, the optimization strategy is verified by simulation experiments. The results show that the design team adopting the optimization strategy has made significant improvements in design efficiency and quality. Specifically, the design cycle is shortened, the design error and rework rate are reduced, and the innovation and market competitiveness of products are also enhanced. These results fully prove the practical application value of the optimization strategy of tourist souvenir design based on cloud computing and CAD collaboration. The research in this paper not only provides a new design optimization idea and method for the field of tourist souvenir design but also provides useful references for other similar design projects.

Keywords: Cloud Computing; Computer-Aided Design; Tourist Souvenirs; Design Efficiency
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1 INTRODUCTION

Tourist souvenirs refer to the commemorative goods purchased by tourists in tourism activities, which can reflect the characteristics or culture of tourist destinations. Alkurdi et al. [1] analyzed the application of interactive media technology in virtual reality for tourism route marketing. Interactive media technology, with its high interactivity and personalized characteristics, has injected new vitality into virtual reality tourism experiences. By utilizing interactive media technology, tourism companies can construct highly realistic virtual tourism scenes, making consumers feel as if they are in a real tourism environment. Meanwhile, with the help of virtual reality devices, consumers can freely explore and experience various tourism activities in the virtual world, obtaining an immersive

feeling. By analyzing consumer behaviour and preferences, tourism companies can develop tourism routes and marketing strategies that better meet consumer needs, thereby improving marketing effectiveness. They are not only an important part of tourism consumption but also an important carrier for spreading regional culture and enhancing the tourism experience. The extraction and analysis of tourism information has become an important means to improve the quality of tourism services and user experience. Autoregressive methods, as an effective knowledge extraction technique, are playing an increasingly important role in tourism information extraction and analysis. Arun et al. [2] used autoregressive methods to extract trend information in the tourism market. Through the analysis of historical tourism data, it is found that there are seasonal changes in the tourism market, the rise of tourism hotspots, and changes in tourist consumption habits. These pieces of information have important reference value for tourism enterprises and policymakers, helping them develop more precise marketing strategies and policy planning. With the rapid growth of tourism, souvenirs have become pivotal in carrying forward regional culture and elevating tourists' experiences. As such, there's an escalating focus on innovating their design and bolstering market competitiveness. In the field of tourism product design, the combination of these two technologies provides designers with more efficient and flexible design methods. Chen [3] introduced a Chu embroidery tourism product design called "Cloud Weaving Dream" based on cloud computing and CAD virtual exhibition halls and explored its design ideas and practices. In order to better inherit and promote Chu embroidery culture, it has designed the "Cloud Weaving Dream" Chu embroidery tourism product. This product is supported by cloud computing and CAD technology, and through a virtual exhibition hall, it digitizes the history, culture, craftsmanship, product types, and other information of Chu embroidery, providing tourists with a brand-new travel experience. These products incorporate Chu embroidery as an element, incorporating modern design concepts and fashion elements while retaining the charm of traditional culture and meeting modern aesthetic needs. Nevertheless, conventional souvenir design methods, constrained by limited resource sharing and design coordination, struggle to cater to the market's diverse demands. The tourism product CAD three-dimensional modelling system is an innovative product that combines virtual reality and computer-aided design (CAD) technology. The system uses high-precision 3D modelling technology to realistically restore the terrain, architecture, vegetation and other elements of tourist attractions and display them to users through VR devices. Users can freely explore the virtual environment and enjoy an immersive travel experience. Deng et al. [4] used advanced rendering techniques to present high-definition visual effects of the model in VR devices. The system can provide strong support for tourism planning and design, helping decision-makers more accurately grasp the spatial layout and distinctive elements of scenic spots.

Enter cloud computing—a novel computing paradigm rooted in the Internet. It aggregates dispersed computing resources into a vast resource pool via virtualization, offering on-demand services to users. As an important carrier of tourism destination culture, the manufacturing technology and design level of tourism product souvenirs directly affect consumer purchasing intentions and brand communication effects. With the rapid development of the tourism industry, consumers have increasingly diversified demands for souvenirs, and their demands for product creativity, uniqueness, and personalization are also increasing. Therefore, introducing advanced manufacturing technology to enhance the quality and competitiveness of souvenirs has become an important issue in the tourism souvenir manufacturing industry. Dixit et al. [5] explored the application of contemporary bionic structure digital manufacturing technology in the manufacturing of tourism product souvenirs. For example, it is possible to imitate the shape and texture of animals and design animal image souvenirs with different shapes. Boasting flexibility, scalability, reliability, and cost-effectiveness, cloud computing has emerged as a prominent trend in information technology. As an important component of the tourism experience, the quality and innovation of tourism product design directly affect consumer satisfaction and brand attachment. Brand attachment refers to the emotional connection and loyalty of consumers towards a brand, which is the key to brand value and market competitiveness. Intrinsic motivation, as the driving force of individual behaviour, plays an undeniable role in the construction of the relationship between tourism product design and brand attachment. Gilal et al. [6] conducted a survey using CAD cloud computing

technology. By collecting a large number of tourism product design cases and user feedback data, data analysis and mining were conducted. Its application in souvenir design promises centralized resource management, efficient utilization, and improved design quality. Hoang et al. [7] proposed a deep learning method for tourism souvenir classification and retrieval based on global point features and deep wide residual networks, aiming to achieve efficient and accurate souvenir classification and retrieval. Global point features are a feature representation method that can describe the overall shape and structure of an object. These point features can reflect the overall shape and structural information of souvenirs, providing strong support for subsequent classification and retrieval. In the testing phase, the model is applied to souvenir classification and retrieval tasks in practical scenarios, and comparative experiments are conducted with other methods. The experimental results show that the souvenir classification and retrieval method based on global point features and deep wide residual networks has achieved significant advantages in accuracy, recall, and F1 value.

CAD technology, meanwhile, is a staple in engineering design, renowned for its robust graphic processing and precise data analysis capabilities. Against the backdrop of the rapid development of big data and artificial intelligence, the tourism industry is undergoing unprecedented changes. As an important bridge connecting tourists and tourism resources, the improvement of operational efficiency and user experience of tourism websites has become an industry focus. Among them, tourist sequence pattern prediction is one of the key links to improve the operational efficiency of tourism websites. Hybrid deep learning technology, as an advanced prediction method, provides new ideas and methods for predicting tourist sequence patterns on tourism websites. Kanjanasupawan et al. [8] combined the advantages of various deep learning models to capture complex features and patterns in tourist sequence patterns accurately. It uses a trained hybrid deep learning model to predict the sequence patterns of tourists. When applied to souvenir design, CAD enables accurate modelling, rapid rendering, and design optimization. Its support for collaborative workflows with other design tools fosters seamless communication among designers. Online tourism evaluation has become an important reference for tourists when choosing tourism destinations and products. However, there is a large amount of noise and useless information mixed in the massive online evaluation. Li [9] solved this problem by using multimodal feature fusion for effective online evaluation of tourism.

Our comprehensive approach begins with analyzing the current souvenir design landscape and its challenges and defining optimization goals and principles. We then delve into the collaborative potential of cloud computing and CAD, constructing an optimization framework. Through simulation and case studies, we empirically evaluate the framework's effectiveness, culminating in practical implementation and performance assessment.

2 RELATED WORK

As an efficient design tool, 3D CAD (computer-aided design) systems are gradually playing an important role in the field of tourism industry product design. Liu [10] discussed the method and application of rapid tourism industrial product design based on 3D CAD systems. Through rendering functionality, 3D CAD systems can simulate the true appearance and texture of products, providing designers and customers with an intuitive visual experience. In addition, the system also supports multiple output formats, facilitating communication and exchange between designers and other team members or clients. Taking the design of a tourist souvenir as an example, the designer first uses a 3D CAD system for modelling and parametric design, quickly constructing the basic form of the product. Then, use the simulation analysis function to optimize the structure and verify the strength of the product. Lorusso et al. [11] explored the conceptual modelling of innovative design for tourism products in virtual reality environments, aiming to provide new ideas and methods for the development of this field. In tourism product design, virtual reality technology can simulate the real scenes of tourist destinations, allowing tourists to feel the charm of the destination before they arrive. Meanwhile, virtual reality technology can also provide interactive experiences, allowing tourists to freely explore and interact in the virtual environment, enhancing the attractiveness and fun of tourism products. It utilizes virtual reality technology to construct three-dimensional virtual scenes of

tourist destinations, including natural landscapes, cultural landscapes, architectural facilities, etc. By finely modelling and rendering, virtual scenes are made as close as possible to real scenes, providing tourists with a realistic visual experience. Lu et al. [12] proposed a user evaluation data-driven optimization design method for tourism commemorative products. This method combines computer-aided design with cloud computing technology to achieve precise optimization of souvenir design. Based on the results of user demand analysis, designers use CAD-assisted design software to perform 3D modelling and rendering of souvenirs. Taking the optimization design of a tourist souvenir as an example, it demonstrates the specific application process of an optimization design method driven by user evaluation data. By collecting and analyzing user evaluation data, we have identified the focus and direction of design optimization and conducted multiple rounds of iteration and optimization using CAD-assisted design and cloud computing technology. The final designed souvenir has significantly improved in appearance, functionality, and user experience and has received widespread praise from consumers.

With the advent of the digital age and the continuous development of virtual information technology, research on the digital and virtual protection of intangible cultural heritage tourism commemoration has emerged. In practice, digital museums have been built in many places by utilizing networks and digital technologies to fully present the various functions of physical museums in a digital way on the internet. Theoretical research on the establishment of digital museums for intangible cultural heritage has also achieved corresponding results. Qian and Luo [13] believe that in today's constantly developing information technology, it is a trend to study the development of intangible cultural heritage tourism products from the perspective of virtualization and digitization. In addition, with the development of information technology, research on the development of intangible cultural heritage tourism from the perspective of digitization and virtualization not only effectively solves some of the problems and contradictions that arise in traditional tourism products. Meanwhile, the dissemination advantages and powerful functions of the internet itself have opened up more effective new models for the protection and inheritance of intangible cultural heritage. This is of great significance for the protection and inheritance of intangible cultural heritage. Currently, research on the development of intangible cultural heritage tourism from a digital perspective focuses on the construction of digital museums, with a greater emphasis on the digital storage and information retrieval of intangible cultural heritage. Its participation, entertainment, and fun are poor, and it lacks attractiveness to the audience. Therefore, Qiuxia et al. [14] need further research on the tourism development of intangible cultural heritage from the perspective of digitization and virtualization. It has explored tourism products that are more attractive, interesting, participatory, and entertaining.

Hotel travel photos have become an important medium for tourists and hotel managers to share and showcase their travel experiences. These photos not only reflect the service quality and environment of the hotel but also reflect the satisfaction and expectations of tourists. Ren et al. [15] used deep learning techniques to analyze the content of hotel travel photos, which can more accurately reveal the concerns and preferences of tourists and hotel managers. By comparing the photo content in different categories and groups, we can gain a deeper understanding of the preferences and concerns of tourists and hotel managers. For example, some tourists may pay more attention to the comfort and convenience of the hotel, while others may pay more attention to the cultural atmosphere and experience of the hotel. As an important product of tourism activities, travelogues record tourists' travel experiences, feelings, and experiences and are an important source of information for understanding the differences in tourist attractions. Ruan et al. [16] collected, analyzed, and mined travelogue data based on network cloud computing technology, using Nanjing as an example to explore the differences in tourist attractions. It has collected a large amount of travel data about Nanjing from various tourism websites, social media platforms, and other channels through web crawler technology. These data include tourist evaluations, descriptions, images, and other information about various scenic spots in Nanjing. By exploring information such as itinerary arrangements and travel times in travelogues, it was found that there are differences in the behaviour of tourists in different scenic areas. For example, historical and cultural scenic spots often require tourists to spend more time and energy to understand and appreciate. Commercial tourist attractions are more suitable for tourists to engage in short-term leisure and entertainment.

The previous design of tourist souvenirs often had a disconnect between design and production, making it difficult to translate the design scheme into actual products. The design of tourism souvenir products based on computer-aided design can achieve seamless integration between design and production. Saleh et al. [17] directly imported CAD models into production equipment and quickly completed product production through advanced manufacturing technologies such as CNC machine tools and 3D printing. This highly integrated design and production not only improves production efficiency but also ensures consistency between products and design, reducing production costs and risks. Based on the theory of semiotics, starting from the study of its expression mechanism. Through the analysis and interpretation of a large number of excellent design cases and the exploration of their regional characteristics, this paper proposes the structural composition of regional cultural symbols. Elaborate on the recognition and application of regional cultural symbols in tourism souvenir design from four perspectives: expression media, system generation, and transmission channels. This provides theoretical support for further research in the following text. Staszak [18] explained the methods that can specifically apply regional culture to the design of tourism souvenirs. Firstly, classify according to the attributes of regional culture, and discuss from three levels: surface material layer, middle social layer, and deep spiritual layer. Thus proposing practical methods for constructing regional culture and a systematic design method that integrates regional culture with tourism souvenir design. Provide a practical and feasible theoretical basis for the design practice of tourism souvenirs.

Wang et al. [19] conducted a survey and analysis using the Western Tang Dynasty and Baoji Bronze Museum as regional research objects. By analyzing, extracting, and visualizing their regional cultures, combined with the innovative design method for tourism souvenirs proposed in this article, the design verification of tourism cultural souvenirs for the two regions is carried out separately. In addition, expert review and user research can be combined to verify and optimize the identification results. As an important component of tourism services, the selection and recommendation of hotels are crucial for improving tourist satisfaction and travel experience. Traditional hotel recommendation methods are often based on simple user preferences and hotel attribute matching, ignoring the complexity and correlation of multidimensional information. Therefore, the intelligent recommendation of tourism hotels based on multidimensional information has become an urgent research problem. The deep neural network model, as a powerful data processing and feature extraction tool, provides a new solution for intelligent recommendation of tourism hotels. Xia et al. [20] used this method to automatically learn and extract deep features from data, thereby more accurately capturing complex relationships between multidimensional information.

3 OVERVIEW OF TOURIST SOUVENIR DESIGN

The design of tourist souvenirs involves many elements, including shape, colour, material, and technology. These elements are interrelated and influence each other in the design process, which together constitute the overall effect of tourist souvenirs. In terms of design principles, the design of tourist souvenirs should pay attention to the balance of innovation, culture, practicality, aesthetics, and marketability. Innovation means that the design should have novel and unique creativity and expression forms; Culture means that the design should reflect the regional culture and historical connotation of the tourist destination; Practicality means that the design should meet the actual use needs of tourists; Aesthetics means that the design should have a good visual effect and aesthetic value; Marketability means that the design should meet the market demand and consumer psychology. According to different classification standards, tourist souvenirs can be divided into multiple types, as shown in Table 1.

Standard of classification	*Type*	*Example*
Texture of wood	Metals	Copper ornaments, metal key chains
	Ceramics	Porcelain tea set, ceramic ornaments
	Textile category	Embroidered handkerchiefs, printed scarves

Function	Ornaments	Ornaments, pendants and paintings
	Practical category	Tableware, stationery, key chain
Regional characteristics	Ethnic customs	National costumes, national handicrafts
	Historical and cultural category	Antique jade, historical theme ornaments

Table 1: Classification table of tourist souvenirs.

At present, the tourist souvenir market is developing vigorously, the market scale is constantly expanding, and the consumer demand is increasingly diversified. However, the market competition is becoming increasingly fierce, and the phenomenon of product homogenization is serious. Lack of innovation has become one of the main factors restricting market development. In terms of demand analysis, tourists' demand for tourist souvenirs presents a trend of personalization, emotion and experience. They give importance not only to the practicality and aesthetics of products but also to the cultural significance and emotional worth they embody. Therefore, it is the key to meeting the market demand to dig deep into regional cultural characteristics and innovate design concepts and expressions.

4 COLLABORATIVE DESIGN TECHNOLOGY OF CLOUD COMPUTING AND CAD

The realization of collaborative design between cloud computing and CAD mainly includes the following aspects: building a design resource-sharing platform based on cloud computing to realize centralized management and efficient utilization of design resources; Providing powerful computing power and data storage capacity through cloud computing platform to support the operation and data processing of CAD software; The dynamic allocation and parallel processing of design tasks are realized by using the elastic and extensible characteristics of cloud computing to improve design efficiency; Ensure the security and privacy of design data through the security guarantee mechanism provided by the cloud computing platform.

Collaborative design of cloud computing and CAD has obvious advantages in the field of tourist souvenir design. It can break the limitation of time and space so that designers can carry out design work anytime and anywhere; It can realize the sharing and reuse of design resources and avoid the waste and duplication of resources. It can improve the design efficiency and shorten the time to market; It can promote the communication and cooperation between designers and stimulate innovative inspiration. These advantages make it possible to optimize the design strategy of tourist souvenirs based on cloud computing and CAD collaboration, and it is expected to bring revolutionary changes to the field of tourist souvenir design.

5 OPTIMIZATION STRATEGY OF TOURIST SOUVENIR DESIGN BASED ON CLOUD COMPUTING AND CAD COLLABORATION

In devising an optimization strategy for tourist souvenir design that hinges on the collaboration of cloud computing and CAD, this paper initially outlines several pivotal principles. Primarily, it aims to enhance design efficiency and quality. Secondly, it capitalizes on the strengths of cloud computing and CAD technology to achieve optimal resource sharing and collaborative efforts. Lastly, it emphasizes the strategy's feasibility and practicality to guarantee its effective implementation in real-world design scenarios. Based on these principles, the following specific goals are set: to build an efficient and stable cloud computing platform to support the whole process of tourist souvenir design, Realize the deep integration of CAD technology and cloud computing, and enhance the synergy and innovation of design; Through the implementation of the optimization strategy, the design cycle of tourist souvenirs is significantly shortened, the cost is reduced, and the market competitiveness of products is improved. The big data storage architecture in the cloud computing environment is shown in Figure 1.

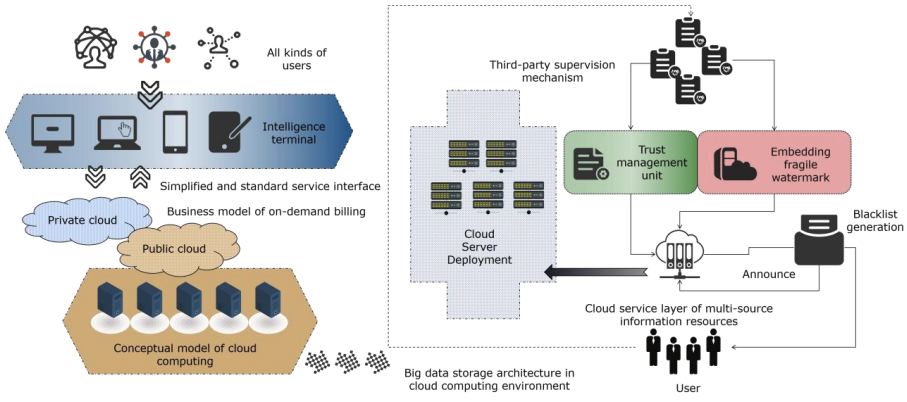

Figure 1: Big data storage architecture in a cloud computing environment.

To realize the sharing of design resources, this paper first constructs a centralized design resource library through the cloud computing platform and integrates the scattered design resources together. This resource library not only contains all kinds of design materials, model libraries, and case libraries but also provides powerful search and screening functions, which makes it convenient for designers to find the needed resources quickly. At the same time, distributed storage and backup technology are adopted to ensure the security and reliability of resources. On the basis of resource sharing, the dynamic allocation of resources is further realized. The formula of the resource demand forecasting algorithm is as follows:

$$\text{Resource Demand } t = f\ \text{Task Queue, Historical Data} \tag{1}$$

This formula predicts the resource demand at a time t, where f is a function that takes into account the current task queue and past historical data. The calculation formula for the resource utilization rate is as follows:

$$\text{Resource Utilization} = \frac{\text{Activated Resources}}{\text{Total Resources}} \tag{2}$$

This formula is used to calculate the current resource utilization rate, which $\text{Activated Resources}$ refers to the number of resources being used and Total Resources the total number of resources. Using weighted shortest job priority algorithm to prioritize design tasks;

$$\text{W}SJF = \frac{\text{Cost of Delay}}{\text{Duration}} \tag{3}$$

Where Cost of Delay is the cost of task delay and Duration is the estimated task duration? Tasks with high WSJF scores will be given priority. Resource allocation using maximization and minimum fairness algorithm;

$$Maximize \min_{i \in N} \frac{\text{x}_\text{i}}{\text{d}_\text{i}} \tag{4}$$

Where x_i is the amount of resources allocated to user i and d_i is the demand of user i. The algorithm aims to ensure that all users get their fair share of resources. Load balancing using the minimum number of connections algorithm;

$$\text{Server with minimum connections} = \arg\min_{j \in S} conn_j \tag{5}$$

Where S is the server set and $conn_j$ is the current number of connections on the server j. New requests will be sent to the server with the least number of connections. Through the intelligent scheduling algorithm of the cloud computing platform, the most suitable computing resources and design tools can be automatically allocated to the corresponding designers according to the needs and priorities of design tasks. Use the resource utilization threshold to control the dynamic allocation of resources:

$$If\ U > U_{\text{threshold}} then\ scale\ up, else\ if\ U < U_{\text{threshold}} then\ scale\ down \tag{6}$$

Where U is the current resource utilization rate and $U_{\text{threshold}}$ is the preset utilization threshold? When the utilization rate exceeds the threshold, resources are increased; when the utilization rate is below the threshold, resources are reduced. Use cost-benefit analysis to optimize the cost of resource allocation;

$$\text{Benefit-Cost Ratio}\ \ BCR = \frac{\text{Total Benefits}}{\text{Total Costs}} \tag{7}$$

Among them, Total Benefits is the total revenue brought by resource allocation and Total Costs is the total cost of resource allocation. By comparing BCR different resource allocation schemes, the most cost-effective scheme can be selected. This can not only improve the utilization rate of resources but also avoid the waste and idleness of resources.

In the aspect of design collaboration, this paper realizes the function of online editing and modifying design models by many people at the same time through CAD software, which enables designers from different regions and different professional backgrounds to communicate and cooperate in real-time. In order to further improve collaborative efficiency, we also introduced version control and timeline management functions to ensure that each designer's modifications can be effectively recorded and tracked. The timeline management function can record the modification history of each designer and provide rollback and comparison functions. This can be achieved by OT (Operational Transformation). OT algorithm ensures that multiple concurrent operations can be correctly applied to shared data by defining and operating a set of transformation functions. A simple operation conversion algorithm is as follows:

$$\text{Apply}\ \ S, O = \text{S}' \tag{8}$$

$$Transform\ \ O_1, O_2 = O_1^{'} \tag{9}$$

Where S is the state of shared data, O is an operation and S' is the new state after the operation is applied? O_1 and O_2 are two concurrent operations, and $O_1^{'}$ is to convert O_1 into a form concurrent with O_2. In this way, it can be ensured that each designer's modification can be effectively recorded and tracked and can be rolled back to any historical state when necessary.

Finally, through the combination of CAD technology and virtual reality technology, this paper realizes the three-dimensional visualization and interactive experience of tourist souvenir design. Designers can view and adjust the model in all directions in the virtual environment, and customers can also feel the actual effect and experience of the product in advance. This way can not only reduce the misunderstanding and rework rate in the design process but also enhance the customer's sense of identity and willingness to buy products.

6 SIMULATION EXPERIMENT AND ANALYSIS

To validate the efficacy of the optimization strategy for tourist souvenir design that leverages cloud computing and CAD collaboration, comprehensive simulation experiments were conducted. These experiments encompassed the creation of a simulated cloud computing environment, the deployment of CAD collaborative design tools, and the replication of authentic design tasks and workflows. Representative design cases were chosen as focal points, and professional designers were engaged in

the experimental process. Advanced cloud computing simulation software and CAD collaborative design systems facilitated the replication of real-world design conditions and workflows, capturing a range of data and metrics. Emphasis was placed on repeatability and comparability to uphold the objectivity and precision of the findings. The experimental phase yielded extensive data on design efficiency, quality, and cost. Analysis of this data revealed that the optimization strategy, grounded in cloud computing and CAD collaboration, delivered notable improvements across multiple dimensions in tourist souvenir design.

Illustrated in Figure 2 is a comparison of design efficiency pre-and post-implementation of the optimization strategy.

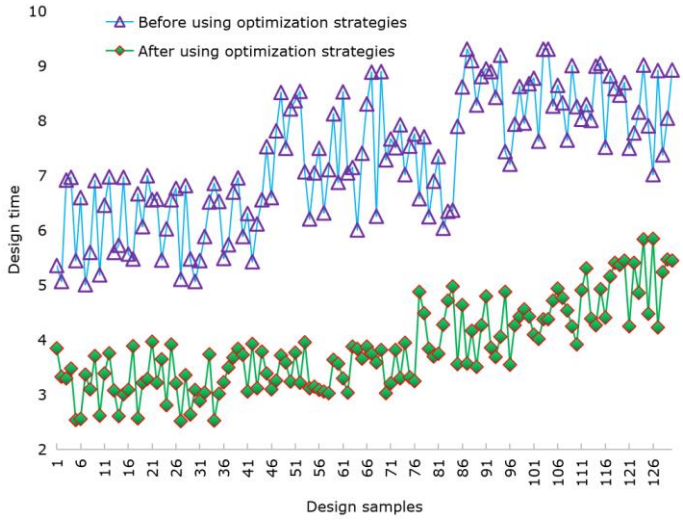

Figure 2: Comparison of design efficiency before and after using optimization strategy.

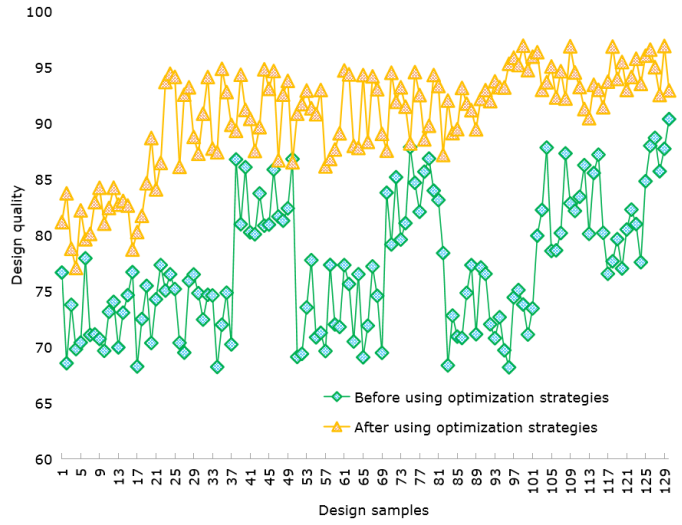

Figure 3: Comparison of design quality before and after using the optimization strategy.

After implementing the optimization strategy, designers were able to accomplish design tasks at a much faster rate, indicating a substantial enhancement in the efficiency of the design process. Figure 3 illustrates the comparison of design quality between before and after the application of the optimization strategy.

Quality improvement: the optimization strategy significantly reduces the design errors and rework rate, which shows that the design quality has been significantly improved. The optimization strategies in this paper include stricter design review, using high-quality design resources, and more accurate design methods, which are all helpful in improving design quality. Figure 4 shows the cost comparison before and after using the optimization strategy.

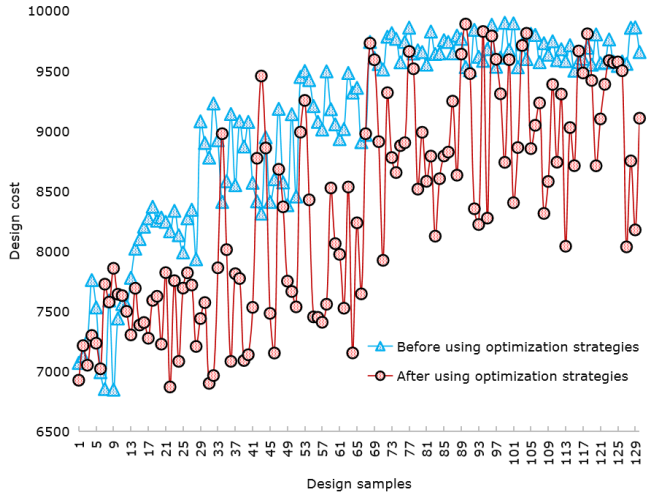

Figure 4: Cost comparison before and after using the optimization strategy.

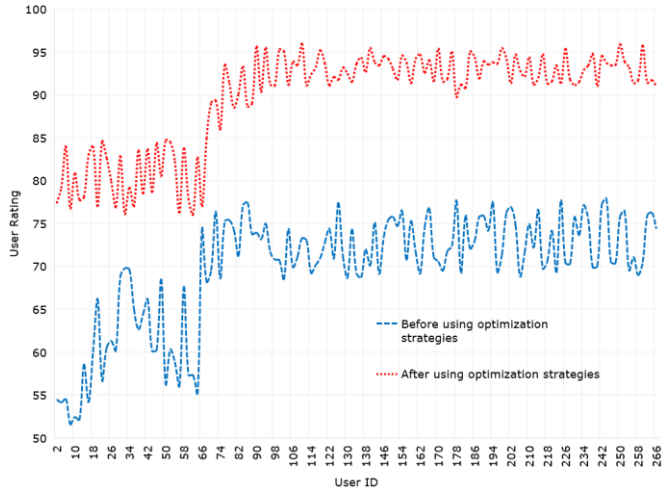

Figure 5: User's satisfaction score.

Cost reduction: After using the optimization strategy, the cost in the design process is reduced. Cost reduction comes from many aspects, such as reducing repetitive work, improving resource

utilization, reducing error rate and thus reducing correction costs. Figure 5 shows the user's satisfaction score.

High degree of satisfaction: The user satisfaction score is high, indicating that the optimization strategy has achieved success in improving the user experience. The improvement in user satisfaction is the result of many factors such as the improvement of design efficiency, the improvement of design quality and the reduction of cost. In addition, good customer service and effective communication may also have a positive impact on user satisfaction.

The above experimental results show that: In terms of design efficiency, designers who use optimization strategies can complete design tasks faster; In terms of design quality, optimization strategy can significantly reduce design errors and rework rate; In terms of cost, the optimization strategy can reduce the cost in the design process; In terms of user satisfaction, user satisfaction is generally high. According to the experimental results and data analysis, we draw the following conclusions: The optimization strategy of tourist souvenir design based on cloud computing and CAD collaboration is effective, which can significantly improve the design quality; The optimization strategy has high maneuverability and practicability in the actual design work; The application prospect of optimization strategy is broad, which can bring revolutionary changes to the field of tourist souvenir design.

7 CASE STUDY

7.1 Case Selection and Background Introduction

In order to show more specifically the practical application effect of the optimization strategy of tourist souvenir design based on cloud computing and CAD collaboration, this section selects several representative cases for research. These cases cover different types of tourist souvenirs, such as handicrafts, costumes, jewelry, etc., and involve different design teams and workflows. Through the in-depth study of these cases, we can more comprehensively understand the applicability and effect of the optimization strategy in different scenarios (Figure 6).

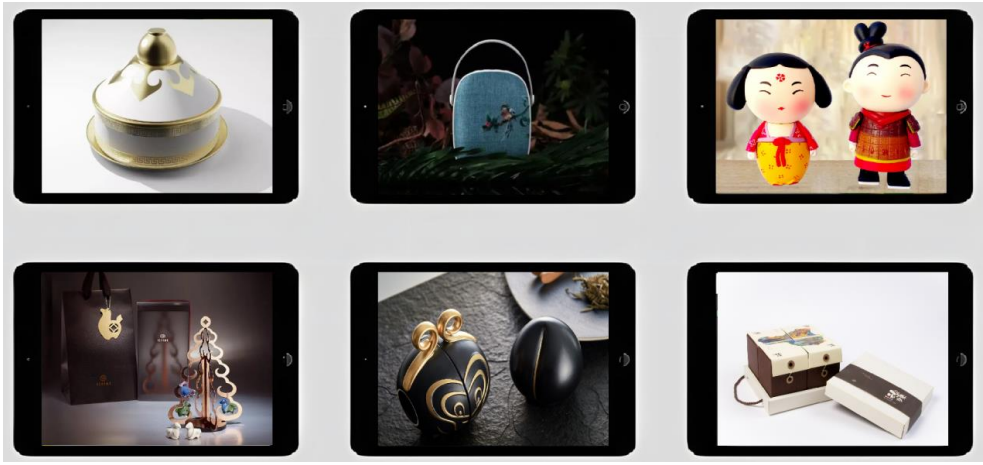

Figure 6: Case details.

In the case of selection, this paper pays special attention to the typicality and representativeness of cases. In the experiment, we selected the cases that encountered obvious bottlenecks and challenges in the design process, as well as the cases that successfully applied the optimization strategy and achieved remarkable results. In this way, we can show the actual value and application prospects of the optimization strategy more intuitively.

7.2 Design Practice of Tourist Souvenirs Based on Cloud Computing and CAD Collaboration

In the process of case study, this paper focuses on how the design team uses cloud computing and CAD collaborative technology to share and work together on design resources, and how to improve design efficiency and quality through optimization strategies. Figure 7 shows the rating of sample cases by professional designers.

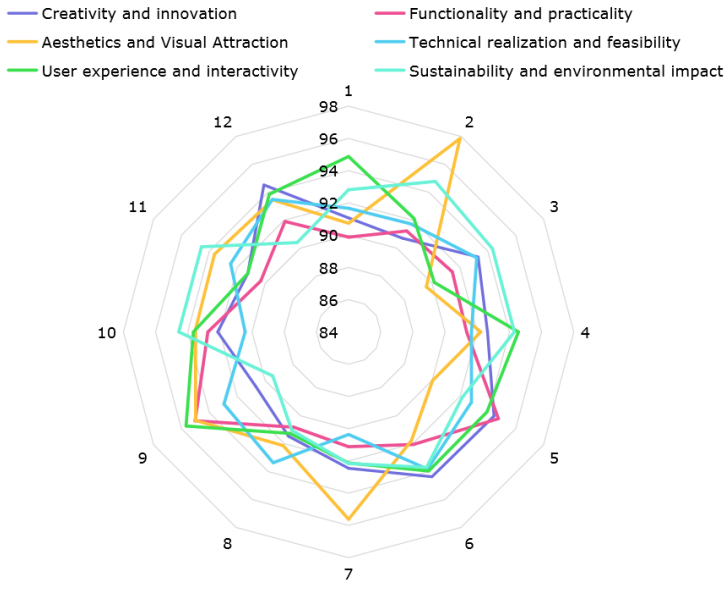

Figure 7: Rating of sample cases by professional designers.

The high scores in all aspects in the figure show that the case has performed well in the above aspects, and it can create beautiful, practical, innovative and feasible design works. The reason for the high score is that the strategy in this paper shows excellent ability in creativity and innovation, and puts forward a novel, unique and user-friendly design scheme. This innovation is embodied in the overall conception, detail treatment, material selection and the use of new technologies. This comprehensive ability enables designers to meet the diverse needs of users and provide high-quality design services. Furthermore, it also reflects the designer's recognition and satisfaction with the quality of the work.

By implementing the optimization strategy, the design team gains the ability to access and use design resources more efficiently, thus minimizing redundant efforts and time losses. Additionally, the integration of CAD collaborative tools facilitates smoother communication and collaboration among team members, effectively mitigating conflicts and misunderstandings throughout the design process. These advancements not only enhance design productivity but also lead to a notable improvement in design quality, as evidenced in Table 2.

Optimization strategy/technology application	*Design resource sharing and collaborative work effect*	*Design efficiency improvement index*	*Design quality improvement index*
Cloud computing resource sharing	Team members can access the latest design resources anytime and anywhere.	Resource search time decreased by 35.36%	The consistency of the design version is improved by 21.47%
CAD collaborative	Real-time communication	The design iteration	The design error

technology	and collaboration among team members to reduce misunderstandings and conflicts.	period is shortened by 39.78%	rate is reduced by 47.82%
Formulate design specifications and standards	Improve design consistency and stability, and reduce modification cost.	The number of design revisions decreased by 45.91%	The compliance of design specifications increased by 63.11%
Design feedback loop	Find and solve problems in the early stage of design, and avoid large-scale modification in the later stage.	The response time of customer feedback was shortened by 52.67%	Design satisfaction increased by 59.79%
Elastic computing ability	Designers can flexibly adjust their computing power according to project requirements.	The utilization rate of computing resources increased by 47.98%	The processing time of complex design is shortened by 36.14%

Table 2: The effect of cloud computing and CAD collaborative technology in design resource sharing and collaborative work.

In addition, in the process of applying the optimization strategy, the design team needs to adjust and optimize flexibly according to the actual situation. For example, for different types of design tasks, the team may need to adjust the configuration of cloud computing resources and the selection of CAD collaborative tools. This flexibility and adaptability are the keys to ensuring the effective implementation of the optimization strategy.

7.3 Optimization Suggestion

In order to evaluate the actual effect of the optimization strategy in the case, this section collects and analyzes various relevant data and indicators. At the same time, the problems and shortcomings in the case are deeply analyzed, and the corresponding optimization suggestions are put forward. For example, in view of the insufficient sharing of design resources in some cases, we suggest further improving the resource management and scheduling mechanism of the cloud computing platform; In view of the communication obstacles in the process of collaborative work, we suggest strengthening the training and communication among team members to improve the efficiency of collaboration.

These optimization suggestions not only help to improve the deficiencies in existing cases but also provide useful references for other similar design projects.

8 CONCLUSIONS

Through this study, the formulation, implementation and evaluation process of the optimization strategy of tourist souvenir design based on cloud computing and CAD collaboration are deeply discussed. Through simulation experiments and case studies, the effectiveness and practicability of the optimization strategy are verified. Accordingly, this study draws the following conclusions: (1) The optimization strategy of tourist souvenir design based on cloud computing and CAD collaboration can significantly improve the design efficiency and quality; The optimization strategy has high maneuverability and practicability in the actual design work; By adjusting and optimizing the strategy flexibly, it can adapt to different types of design tasks and workflows.

The contribution of this study is to provide a new design optimization idea and method for the field of tourist souvenir design. By integrating the advantages of cloud computing and CAD collaborative technology, we can maximize the sharing and collaborative work of design resources, thus improving design efficiency and quality. This optimization strategy is not only suitable for the field of tourist souvenir design but also can provide a useful reference for other similar design projects.

Based on the conclusions and shortcomings of the above research, the following suggestions are put forward for future research: continue to explore the application potential and optimization strategy of cloud computing and CAD collaborative technology in the design field; Pay attention to the application prospect of emerging technologies such as artificial intelligence and big data in design optimization; Strengthen interdisciplinary cooperation and exchanges to promote innovation and development in the field of design jointly. At the same time, we also hope that future research can pay more attention to the combination of practical application and market demand and provide strong support for the sustainable development of the design industry.

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