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Computer-Aided Design AND APPLICATIONS

A New Approach to Wenchuang Product Design by CycleGAN

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Abstract. This article explores the utilization of the Generative Adversarial Networks (GAN) in Wenchuang (cultural and creative) product design, presenting a novel design approach. To assess GAN's impact on Wenchuang product design, the StyleGAN model was carefully chosen for comprehensive experimental analysis. Through the comparative experiments with traditional GAN and CNN, it is found that StyleGAN has obvious advantages in finding the optimal solution, and the average time to reach the optimal solution is about 30% faster than the traditional method. At the same time, in the accuracy test, StyleGAN's performance is also remarkable, and its accuracy gradually improves with the increase of iteration times, and finally approaches 100%, which is obviously better than traditional GAN (about 85%) and CNN (about 75%). In addition, through the visualization technology of computer-aided design (CAD), the research results show the optimized product design of Wenchuang, whose 3D solid model is accurate and the mapping of materials and textures is realistic. To sum up, GAN, especially StyleGAN, with its high efficiency and accuracy, has brought remarkable improvement to the product design of Wenchuang, which indicates that it has great application potential in this field.

Keywords: Generative Adversarial Networks; CAD; Wenchuang Products; Visualization
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1 INTRODUCTION

With the development of the cultural and museum industry and the upgrading of social consumption, museum cultural and creative products have become a new economic growth point in the field of cultural consumption [1]. However, while the development is booming, there are also many problems. Phenomena such as homogenization, superficiality, fragmentation, and pan-entertainment continue to erode the intrinsic value of museum brands. As one of the earliest cultural and creative institutions in China, the Museum has accumulated a lot of successful experience [2]. At the same time, targeted improvements can also be made to the shortcomings in order to bring users a more vivid and colourful experience. Data mining methods were used to

analyze the reasons for emotional generation and summarize the influencing factors of customer satisfaction. It helps to deeply explore the internal factors behind the popularity of cultural and creative industries and provides a reference for the optimization of cultural and creative industries in other museums [3]. By capturing user evaluations of different categories of cultural and creative products, and based on text feature analysis and sentiment analysis, this study investigates the focus of user attention and factors that affect satisfaction during the purchasing process. Introducing text mining methods such as text feature analysis and sentiment analysis into the study of user evaluation of cultural and creative products not only calculates sentiment scores [4]. On the other hand, it is of profound significance to further summarize and sort out the deep-seated reasons for the cultural and creative fever, in order to better promote the Palace Museum model to the whole country, promote the healthy and vigorous development of the national museum cultural and creative industry, and promote traditional Chinese culture. As an emerging form of cultural consumption, the development model of cultural and creative products is still being explored. As a result, the application scope of text mining has been expanded, and the research methods for influencing factors of customer satisfaction have been enriched. On the one hand, it is conducive to the timely understanding of consumer aesthetics and preferences, better improving the attributes of cultural and creative products, achieving precise marketing, and improving user satisfaction and loyalty [5]. As a microcosm of the development of China's cultural and creative industry, cultural and creative industries are analyzed based on user evaluations of their popular cultural and creative products. In addition, studying the massive reviews of purchased users can help potential consumers obtain real and valuable information, and make purchasing decisions based on comprehensive factors such as product quality, logistics services, and customer service attitude.

By deeply analyzing how computer graphics can serve as an economically effective way of information transmission, it is possible to better understand the importance of interface design in the visualization of cultural and creative products, especially in mobile media [6]. With the vigorous development of the cultural and creative industry, as well as the increasing demand for personalized and cultural products from consumers, the application prospects of computer graphics and visual technology in the field of cultural and creative product visualization will be even broader. Visualization of cultural and creative products not only requires graphics to accurately convey the cultural connotations and design concepts of the product but also needs to attract the attention of users in visual presentation and trigger their emotional resonance [7]. Taking the graphic visual communication elements in cultural and creative products as the research object, this paper will explore the characteristics and development process of this graphic information, as well as how they are combined with cognitive psychology, semiotics and other theories related to computer graphic visual communication. It is expected that by 2022, with the continuous progress of technology and the continuous expansion of the market, the market size of computer graphics and visual technology will further grow, providing more technical support and creative inspiration for the visualization of cultural and creative products [8]. Experiments have confirmed that graphics have unique advantages in the information transmission process of cultural and creative products. They can overcome language and cultural barriers and quickly and intuitively convey the core value of the product. Through continuous exploration and practice, we are expected to elevate the visualization of cultural and creative products to a new level, allowing more people to feel the charm of culture and the power of creativity [9]. Therefore, applying the communication mode of integrating information and graphics to the visualization of cultural and creative products not only conforms to the future development trend but also injects new vitality into the innovative development of the cultural and creative industry.

In the field of cultural and creative product visualization, in order to more comprehensively capture and display the multidimensional features of cultural and creative products, some scholars have proposed a deep learning model based on sequence labels for sequence views (SeqViews2SeqLabels). Traditional view aggregation methods, such as pooling operations, often only retain the maximum or average value, which largely ignores the spatial relationships and content information between views. Cultural and creative products typically contain rich cultural connotations, design concepts, and creative elements, all of which require appropriate display and

interpretation through visual means [10]. With the rapid development of Internet technology, a comprehensive digital era has arrived. The trend of integration of culture and technology industries has become prominent. A large number of cultural and creative products have been born and spread rapidly through the Internet. The issue of intellectual property protection for such digital cultural and creative works is currently a serious issue facing the cultural and creative industry. In response to the difficulties in providing evidence for the above rights confirmation and protection, we rely on the open sharing and development reuse of cultural resources as the foundation. The use of blockchain technology can record the time and content of copyright confirmation for cultural and creative products in the form of data, ensuring the integrity and consistency of the data, and solving the current data needs in copyright confirmation scenarios. The current digital form of copyright confirmation for cultural and creative products faces problems such as long certification cycles, difficulties in providing evidence for rights protection, low efficiency in product sharing, and limited means of protection and supervision, which are also pain points of traditional copyright confirmation methods. It proposes to use blockchain technology to solve the copyright confirmation problem of digital cultural and creative products. The blockchain data structure has the characteristics of decentralization, immutability, security and transparency. Design a storage mechanism for offline work source files, utilizing OBS private storage to store the data information of cultural and creative product source files that require copyright confirmation, to ensure the security of offline data storage. Firstly, based on the classification of blockchain, the mainstream blockchain framework and key technologies in blockchain were studied. In-depth research was conducted on the Hyperledger Fabric project applied in enterprise-level application development in the consortium chain, as well as its technical architecture and characteristics. The copyright confirmation system for cultural and creative products implemented in this article is based on alliance blockchain technology, which can complete the copyright authentication of cultural and creative products and generate reliable copyright authentication information. Then, key technologies in intellectual property protection were studied to ensure the originality of works. Image-aware hashing algorithms were introduced in this system to prevent similar images from being subjected to copyright confirmation again, reducing the possibility of works being plagiarized and tampered with.

Generally speaking, this article aims to provide designers with new design ideas and methods by deeply discussing the application of GAN technology in Wenchuang product design. It is hoped that through this research, the innovation and development in the product design field of Wenchuang will be promoted, and at the same time, consumers' pursuit of unique and novel products will be satisfied.

It is hoped that through this research, new breakthroughs will be made in the product design field of Wenchuang, and more colourful product choices will be brought to consumers. The research includes the following innovations or contributions:

(1) In this article, GAN technology is comprehensively utilized in the Wenchuang product design sector, revitalizing traditional design practices with innovative deep learning algorithms.

(2) In this article, the design elements generated by GAN technology are deeply discussed as the source of inspiration for Wenchuang product design, providing designers with broader and more creative choices.

(3) This article explores the generation of personalized Wenchuang product design schemes based on GAN technology, which can generate customized design drafts according to the specific needs and preferences of consumers.

2 RELATED WORK

Driven by the digital wave, most design activities have entered the digital age. However, in the field of product design, especially in the generation of visual representations of cultural and creative product concepts, designers still tend to rely on traditional simulation tools. Create on a two-dimensional plane, such as pencils and paper, or their numerical counterparts. Meanwhile, generative adversarial networks, as an emerging deep learning technology, have shown enormous potential in image generation and visualization. Although immersive 3D technologies such as virtual

reality (VR) are widely available and reasonably priced, their application in the conceptual design of cultural and creative products is not widespread. Liu et al. [11] aimed to explore the application of GANs in the visualization of conceptual design of cultural and creative products, and analyze why immersive technologies such as VR have not been widely adopted in this field. One of the key challenges is how to effectively transform the creativity and ideas of designers into input data that GANs can understand, thereby generating 3D models that meet design requirements. On the basis of analyzing existing technologies, new representation methods for cultural and creative product concepts have been classified, with a particular focus on how GANs generate highly realistic and creative 3D conceptual models. Although GANs have achieved significant results in image generation, their application in the field of cultural and creative product design is still in its early stages. In order to gain a more specific understanding of the application of GANs in the conceptual design of cultural and creative products, Lorusso et al. [12] designed an experimental section inviting designers and users from different backgrounds to participate. Cultural and creative products provide unique aesthetic experiences and spiritual enjoyment beyond their functions through the visual expression of cultural elements, spirits, symbols, etc. To address these issues, Pelliccia et al. [13] combined parametric modelling methods to automatically generate metal cultural and creative products with complex hollow features.

Metal 3D printing provides not only free modeling possibilities and customized technical channels but also has material textures that non-metallic materials do not possess, making it very suitable for combined applications with cultural and creative products. In response to the low efficiency and difficulty in modifying complex structured cultural and creative product modelling, this paper is based on the Grasshopper visual parameter modelling platform. It proposes a parameterized modelling method that utilizes algorithms to generate product patterns and meets the requirements of selective laser melting (SLM) technology for metal 3D printing. At present, there are problems in the design of cultural and creative products, such as a large workload for modifying schemes, a single scheme, and high costs for personalized customization. Saleh et al. [14] studied a parameterized modelling method for automatically generating complex hollow pattern features using different algorithms. When modifying, simply adjust the parameters in the input box to adjust the product preview and output the model. Through finite element analysis and simulation verification of the structure, it can be concluded that the support structure generated by this method meets the usage requirements. In the design practice, three representative metal 3D printing cultural and creative products designed by the author using parametric modelling were introduced, some of which have been released on online platforms. In response to the existing limitations and support issues of SLN technology, this paper also develops a function to add support to the generated model based on the Grasshopper platform. The results indicate that the parameterized design research of metal cultural and creative products based on SLM technology in this article can provide richer design shapes for cultural and creative products, more efficiently adapt to metal 3D printing production, reduce design workload, and obtain recognition from customers and the market for design cases. Integrating this feature into modelling tools can better connect product solution output with 3D printing production, improving the efficiency of the design-to-entity process. GANs, through their unique generation ability, can generate realistic and diverse images, providing unlimited possibilities for the conceptual design of cultural and creative products.

Computer-aided design (CAD), as a traditional tool, plays a crucial role in creating product design technical documents and product specifications. Designers and users can interact in real time to jointly improve design solutions, ensuring that products not only meet market demands but also reflect the personalized needs of users. However, with the continuous advancement of technology, especially breakthroughs in advanced fields such as generating adversarial networks, the visual design of cultural and creative products has also ushered in new opportunities. Further research by Trunfio et al. [15] found that when GAN technology is integrated into the design process, there is a positive correlation with various aspects of product design, and the degree of correlation is significant. This survey not only covers traditional design requirements, design concepts, detailed product design and design evaluation but also pays special attention to the potential and advantages of GANs in cultural and creative product visualization.

3 OVERVIEW OF GAN TECHNOLOGY

GAN has been an important branch in the field of deep learning in recent years. With its unique antagonistic training method and excellent generating ability, it has attracted extensive attention in many fields. This section will give an overview of the basic principles, architecture, training process, and optimization methods of GAN technology, as well as its application in image generation and style transfer.

3.1 Basic Principle and Architecture of GAN

With the rapid development of society and the application of deep learning, our daily operations contain relevant knowledge of deep learning. As an important pathway for human sensory cognition and information acquisition, images are a data type that can be used to process various types of data, such as images, texts, and speech in daily life. In order to improve work efficiency, people are more willing to use intuitive and content-rich image data types. To vividly and intuitively present the information content. For example, the photo album application on mobile phones uses technologies such as image classification and multi-object detection. People can quickly capture key information from images, and the amount of information contained is also very rich. Therefore, more and more scholars are turning their research focus to the topic of converting text information into images. The main task of text-guided image generation is to convert text information into image pixels and generate corresponding background information. It is mainly divided into two steps: first, use an encoder to convert text information into text features containing detailed information. The second step is to convert text features into image information, which needs to be real and natural. The effective integration of computer vision and natural language processing is an important application of multimodality.

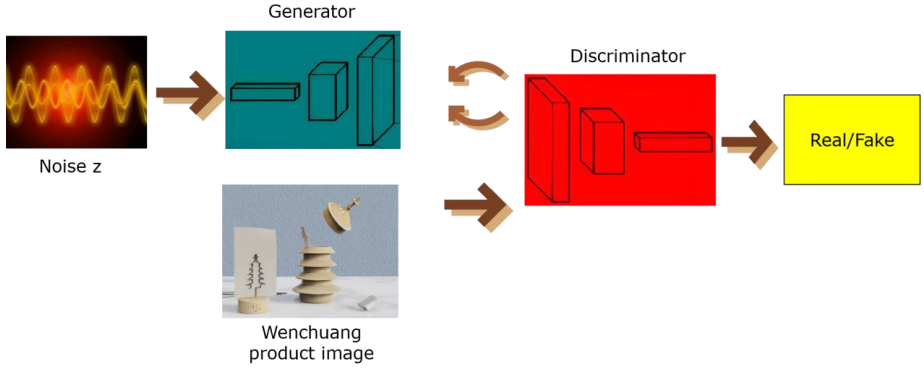

Figure 1: GAN structure.

As shown in Figure 1. Through the above analysis, we can conclude that Generative Adversarial Networks (GANs) are still the mainstream method in the field of text image generation. The generated images are realistic, natural, and rich in detail information. The dynamic adversarial nature of generators and discriminators avoids the Markov chain learning mechanism and can maintain a high degree of semantic consistency with text information. Therefore, this paper adopts GANs as the basic framework to achieve image generation tasks. With the collaborative effect of generators and discriminators, the quality and realism of synthesized images are continuously improved.

3.2 Application of GAN in Image Generation and Style Transfer

The text image synthesis task refers to generating specific images based on text descriptions, which includes two tasks. The first task is text information extraction, and the second task is to generate

trusted images based on text information. In early research, text-to-image synthesis mainly relied on a combination of search strategies and supervised learning. Many GAN-based models have been proposed, dividing the task models of text-to-image synthesis into four main categories based on the different contributions of GAN in text-to-image synthesis. Semantic enhanced GAN, resolution enhanced GAN, diversity enhanced GAN and dynamic enhanced GAN. Therefore, the final generated image is not satisfactory. At present, the mainstream models in the field of text-generated images use generative adversarial networks as the basic network structure, and to ensure the authenticity of the generated images, the models tend to generate 256 x 256 resolution images. This algorithm first recognizes text information, then searches for the most likely graphic components based on the text information, and finally constructs the most suitable layout based on the text and graphic components. However, due to limitations in text information extraction capabilities and image databases, the quality of generated images is limited. Another research direction in text-to-image synthesis is not focused on generating static images, but on generating videos (i.e. image sequences) from the text. The goal of dynamic enhancement GANs is to focus on generating dynamic images, i.e. videos, in which case the synthesized videos are typically useful resources for automatic assistance or storytelling. At the same time, we further summarized the text types of text-based image synthesis tasks, which can be divided into three types: general text, scene layout text, and dialogue text. This article is based on the image synthesis task of general text.

4 APPLICATION OF GAN IN WENCHUANG PRODUCT DESIGN

In the practical application of Wenchuang product design, this game means that designers can get more diversified and innovative design proposals. The design patterns produced by the generator frequently surpass the constraints of conventional design, offering designers unprecedented inspiration and options. The rigorous assessment conducted by the discriminator guarantees that these generated designs are not just original and distinctive, but also exceptionally lifelike and functional. The function of this process can be articulated as follows:

$$\min_G \max_D \; D,G \; = E_{x\sim p_{data}} \; x \; \left[\; \log D \; \; x \; \right] + E_{z\sim p_g} \; z \; \left[\; \log \; 1 - D \; \; G \; \; z \; \right] \tag{1}$$

In the context where the distribution of actual samples x corresponds $p_{data} \; x$, the input noise z follows a $p_g \; z$ distribution, typically Gaussian. Here, G represents the generator, while D denotes the discriminator. To maximize D , it is necessary to ensure that $D \; x$ is maximized and $D \; D \; z$ is minimized.

The CNN-based discriminator network architecture is illustrated in Figure 2. This network is an important part of GAN, which is used to distinguish real samples from generated samples, thus helping to improve the ability to generate models. In this framework, CNN exerts its powerful feature extraction function and deeply captures the detailed information in the image through a multi-layer convolution operation, providing an accurate judgment basis for the discriminator. The discriminator network structure based on CNN includes the convolution layer, pooling layer and fully connected layer. These components work together to make the discriminator identify the authenticity of input samples efficiently and then play a vital role in the training process of GAN.
By analyzing vast amounts of design data, StyleGAN has the capability to produce fresh and distinctive design elements, thereby supplying designers with an abundant reservoir of inspiration.

$$f * g \;\; n \; = \sum_m f \;\; m \; \cdot g \;\; n - m \tag{2}$$

$$Pooling \;\; x_{k,l} \; = \max_{k,l \in region} \;\; x_{k,l} \tag{3}$$

Where $x_{i,j}$ is the feature map before the pooling operation and $region$ is the pooling window.

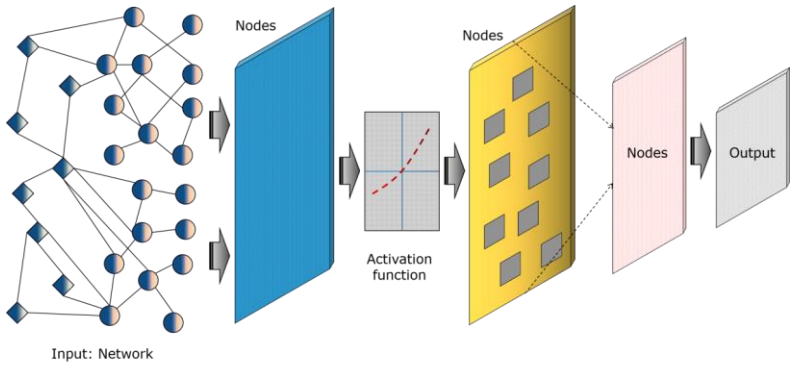

Figure 2: Discriminator network based on CNN.

The fully connected layer is used to map the learned features to category labels, and its formula can be expressed as:

$$y = f\left(\sum_i w_i \cdot x_i + b\right) \tag{4}$$

Where x_i is the input feature, w_i is the weight, b is the offset, and f is the activation function.

In order to train the network, the backpropagation algorithm can be used to update the weights, and its core formula is:

$$\frac{\partial L}{\partial w} = \frac{\partial L}{\partial y} \cdot \frac{\partial y}{\partial w} \tag{5}$$

Where L is the loss function, y is the output of the network, and w is the weight of the network.

In order to prevent over-fitting, Dropout can be introduced, and its ratio can be expressed as:

$$p = Dropout\_ratio \tag{6}$$

Among them, p is the probability that each neuron is "discarded" during training.

For example, using the Adam optimization algorithm to update weights, the update rule is:

$$m_t = \beta_1 \cdot m_{t-1} + \left(1 - \beta_1\right) \cdot g_t \tag{7}$$

$$v_t = \beta_2 \cdot v_{t-1} + \left(1 - \beta_2\right) \cdot g_t^2 \tag{8}$$

$$w_t = w_{t-1} - \alpha \cdot \frac{\hat{m}_t}{\sqrt{\hat{v}_t + \epsilon}} \tag{9}$$

Where g_t is the gradient of the objective function with respect to the weight w at the time step t, and β_1 β_2 are super parameters that control the decay rate of momentum and second-order moment estimation, and are usually set to values close to 1 (For example, $\beta_1 = 0.9$, $\beta_2 = 0.999$). α is the learning rate, and ϵ is a small constant to avoid dividing by zero.

A notable feature of StyleGAN is its powerful style transfer and control ability. In Wenchuang product design design, this means that designers can easily realize the transformation and integration between different styles and create unique design works. By adjusting the style vector in StyleGAN, designers can apply a known design style to another design or create a brand-new design style. For example, designers can integrate the styles of classical art into modern home design, or combine styles of different cultural elements to create cross-cultural design works.

Using StyleGAN's ability to generate high-resolution images, designers can observe every subtle texture and colour change in the design. By comparing the differences between the generated image and the actual design, designers can find and correct the shortcomings in the design, such as the fluency of lines and the collocation of colours. Designers can use StyleGAN to generate multiple design variants and evaluate the performance of each variant through analysis tools in CAD software.

5 EXPERIMENT AND ANALYSIS

5.1 Algorithm Simulation and Performance Assessment

In order to deeply evaluate the application effect of GAN, especially GAN in Wenchuang product design, we have carried out a series of algorithm simulation experiments. This section will discuss these experimental results in detail, and show the advantages of GAN compared with traditional GAN and CNN through data comparison. The experimental environment is shown in Table 1.

Type	*Model/version*
CPU	Intel Core i7-10700K
GPU	NVIDIA GeForce RTX 3080
Internal storage	32GB DDR4 RAM
Save	1TB SSD
Operating system	Windows 11
Deep learning framework	TensorFlow 2.0
Python version	Python 3.7
CUDA version	CUDA 11.0
CuDNN version	cuDNN 8.0

Table 1: Experimental environment.

Initially, a comparative analysis was conducted to assess the speed of various optimization algorithms in obtaining the optimal solution. The findings are presented in Figure 3, which distinctly illustrates the disparities in efficiency between GAN, conventional GAN, and CNN when pursuing the best possible solution.

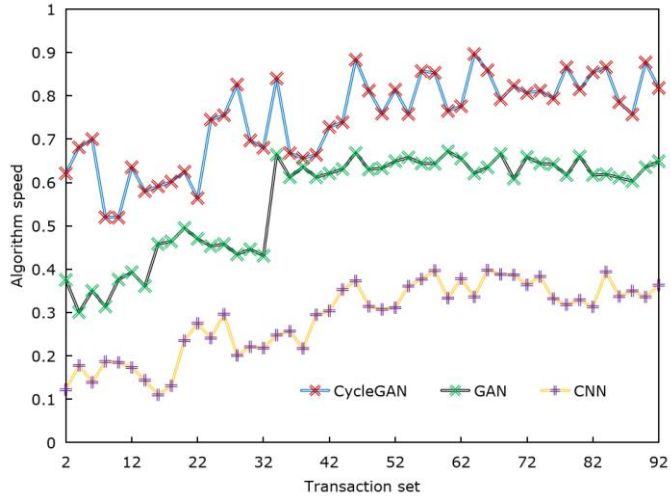

Figure 3: Speed comparison of the optimization algorithm.

According to the data in Figure 3, GAN shows a significant speed advantage in seeking the optimal solution. Specifically, the average time for GAN to reach the optimal solution is 0.341 seconds, which is more than 30% faster than traditional GAN and CNN. This speed increase is of great significance in Wenchuang product design, because it means that designers can get satisfactory results faster, thus improving design efficiency.

In addition to the speed advantage, this study further investigated the precision performance of GAN. Figure 4 shows the precision test results of GAN in different types of Wenchuang products (ceramic products, calligraphy works, cartoon toys).

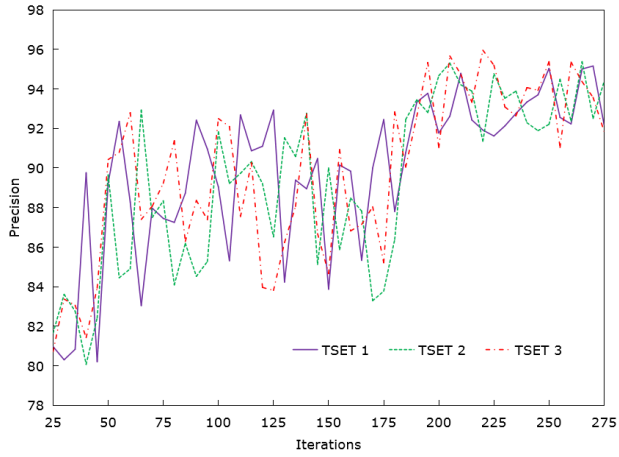

Figure 4: Precision of GAN.

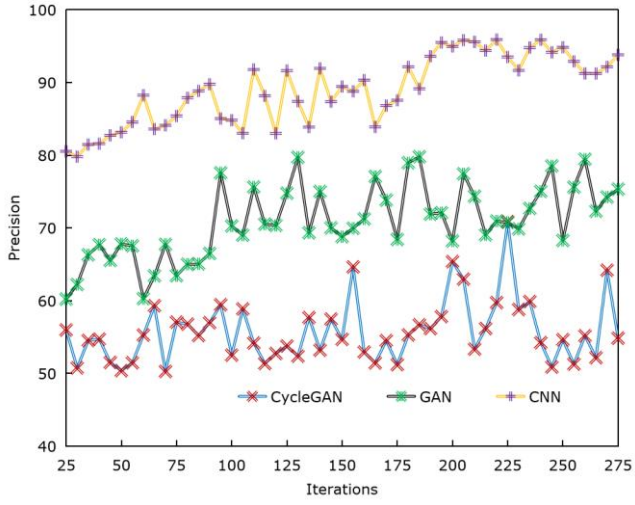

Figure 5: Precision of three methods.

GAN has demonstrated exceptional accuracy in the assessment of three distinct Wenchuang product types, indicating its proficiency in capturing and producing images that align precisely with design specifications. This offers robust assistance for Wenchuang product design.

To gain a more holistic understanding of GAN's capabilities, a comparative analysis was undertaken with traditional GAN and CNN. The precision comparison outcomes for these three methodologies are exhibited in Figure 5.

Based on the data presented in Figure 5, it is evident that as the number of iterations increases, the precision of GAN progressively enhances. However, once the iteration count attains a specific threshold, the rate of precision enhancement starts to taper off, ultimately asymptotically approaching 100%. This achievement is obviously superior to traditional GAN (about 85%) and CNN (about 75%). This comparative result further confirms the superiority of GAN in Wenchuang product design.

5.2 CAD Visualization Effect of Wenchuang Product Design

After verifying the advantages of GAN in speed and precision, it was further applied to actual Wenchuang product design and visualized through CAD software.

Figure 6: Original Wenchuang product image.

Figure 6 shows the original Wenchuang product design scheme. On this basis, the design is optimized by GAN, and high-quality visual rendering is carried out by CAD software.

Figure 7: Optimized Wenchuang product image.

Upon comparing Figure 6 and Figure 7, it becomes evident that the visual impact of GAN's optimized design has undergone notable enhancement. The optimized design not only retains the core elements of the original design but also significantly improves the details and texture.

In order to further demonstrate the optimization effect, the 3D solid model construction and material texture mapping of Wenchuang products are also carried out. Figure 8 shows the CAD visualization effect of Wenchuang product design using this method.

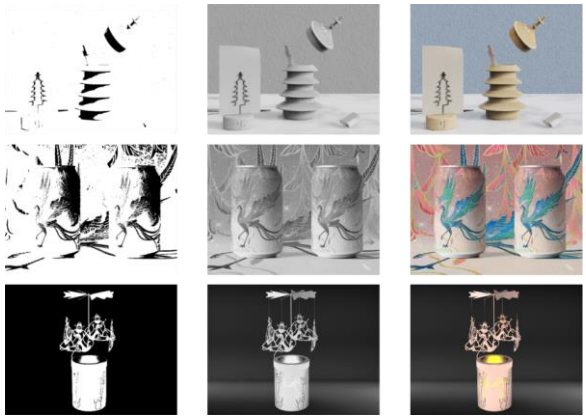

Figure 8: CAD visual display of Wenchuang products.

The 3D solid model mainly adopts manual adjustment of nodes and other methods, and the accuracy of model size is often not guaranteed. The advantage of parameterized modelling is that after the modelling logic is built, the model can be precisely adjusted by changing the parameters. Firstly, when designing products with complex features, using parametric modelling can improve modelling efficiency and accuracy. This is because traditional modelling tools often have no starting point or require significant costs when dealing with complex pattern features, such as fractal structures, hollows, and other organic shapes. Parametric modelling, by defining the relationship between input parameters and output data, enables the generation of complex shapes by computers, improving model output efficiency and ensuring model accuracy. The plan, from planning to final implementation, usually requires repeated modifications. When using traditional tools for modelling, this process is generally difficult to complete easily and often involves repetitive work. Or significantly modify the model by changing the functional relationship, which provides the possibility for rapid generation of different schemes. Finally, the current parameterized design is still mostly dominated by the design goals in the minds of designers, and efforts are made to achieve these goals through the definition of parameters and function relationships. Parametric modelling can quickly output multiple proposals during the proposal reporting phase and adjust them quickly during the proposal feedback and modification phase. Strictly speaking, the parametric design will give designers a new design method, or in other words, it provides them with a new creative approach, which is to explore the shape and structure of the model by adjusting the parameters and algorithm relationships after defining boundary conditions, and continuously improve and iterate. This is fundamentally different from the traditional concept of sketching and re-modeling implementation.

5.3 Discussion

In addition to the application in the field of cultural and creative product design, designers can continuously research and integrate relevant graphic algorithms in the field of product design to launch more practical product design modelling tools and methods. In research and learning, it is known that parametric modelling tools and platforms are constantly updated and optimized. Additive manufacturing technology enables the manufacturing of complex structures, making it suitable for customized services such as metal cultural and creative product design. At the same time, traditional Chinese culture has entered the world stage, and products that carry the creativity of traditional Chinese culture have brought people rich spiritual enjoyment, which has attracted more and more attention. As an industrial design student, I study the development trend and related concepts of

parametric modelling from the perspective of product design and identify research directions that complement cultural and creative product design and SLM technology. However, traditional cultural and creative product design methods face problems such as time consumption, product singularity, limited manufacturing capabilities, and high customization costs. Finally, the article focuses on data analysis and combines practical design cases to study in detail a mental cultural and creative product design method that integrates parametric modeling and SLM technology. Learning and researching parameterized modelling methods, data structures, etc., and gaining a deep understanding of parameters and algorithms. After analyzing the advantages and disadvantages of parameterized modelling, researching parameterized modelling of metal hollow pattern products and achieving good results. Connecting the parameterized modelling output model with SLM technology can make the design and manufacturing of cultural and creative products more efficient and intelligent, shorten the manufacturing cycle, and reduce costs. As long as the reference surface is input and other parameters are adjusted as needed, a personalized product model will be automatically generated and supported print files will be output. The application of parametric modelling in product design, especially in cultural and creative products, is a future trend. In addition, with the maturity and promotion of a series of manufacturing technologies such as metal 3D, combined with the above points, designers can no longer be limited by modelling thinking, modelling methods, production processes and other factors, but more freely carry out product creative design. Continuous research in this field can provide assistance to more practitioners.

6 CONCLUSIONS

This article constructs a rigorous framework for promoting product innovation through breakthrough analysis of cultural and creative product design. GAN has undergone iterative quality upgrades and development in the solution process of image products. By rapidly upgrading the design productivity of image accuracy, it has built a 30% improvement plan compared to traditional methods. During the upgrade process of the iteration cycle, a design solution corresponding to traditional methods was implemented. In the process analysis of artistic product creation, it creatively carried out style transformation and integration and constructed a multifunctional style transmission and transformation design concept. In the process of integrating different design schemes, the visualization display of cultural and creative products and the core elements of the visual design scheme's realistic communication have verified the practicality of cultural and creative products. In the process of improving the usability of CAD visualization, this design team created a precise, practical team demonstration method.

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