Analysis of CAD Method for Ceramic Design and Creation Based on Mobile Digital Multimedia Big Data Analysis

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Abstract. In order to realize the balance between the designer's own hand-painted design and the large-scale batch standardized production mode of modern chemical plants in ceramic design, a CAD method for ceramic design creation based on mobile digital multimedia big data analysis is proposed. Combined with the service mode theory of ASP and the characteristics of product customization, the corresponding design module is developed and used for ceramic pattern design. Software, algorithms, a variety of mathematical functions, and simple graphic elements can be used by designers to create complex, changing ceramic design styles as long as they run the software. The technology for developing and implementing ceramic product style systems based on the ASP platform is being seriously studied, which ensures the universality and flexibility of the system, reduces unnecessary repeated development, reduces the cost of development, and improves the possibility of development efficiency. Based on the ceramic CAD platform, the feasibility and necessity of product pattern design are analyzed and studied through big data. Based on the designer's hand-painted ceramic pattern design, this paper has successfully produced exquisite new patterns through the design system of APS platform. Compared with the traditional manual drawing method, the pattern design with the design system in this paper can greatly save the design time, time and labor cost. In terms of the firing success rate, the two methods are roughly equal, both of which are about 70%. In terms of the designed pattern repetition rate, the design system is 87.74%, which is much higher than 64.13% of the traditional manual drawing. The product has high uniformity. The pattern design system not only reduces the workload of designers. At the same time, it gives a new design idea of ceramic style design.

Keywords: Big data analysis; Ceramic design; CAD; APS.
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1 INTRODUCTION

Under the background of the Internet changing life, a series of transformation and innovation are taking place in traditional industries. The upsurge of e-commerce in recent years has also spread to the art market [1]. Moreover, despite the weakening economy, COVID-19 has led in increased e-commerce and rapid digital transformation. As lockdowns has become the new normal, businesses and customers steadily "went digital," delivering and purchasing more goods and services over the internet, increasing e-share commerce's of global retail trade from 14 percent in 2019 to over 17 percent in 2020 [2, 3]. Ecommerce has always been the technology of the future, and it is now more than ever. The outer world has become one of ambiguity, caution, and social distance, highlighting the multiple benefits of e-commerce for both firms and customers [4, 5].

China's advantages in globalization and complex production transfer are decreasing, notably its low-cost labor pool. Despite China's apparent impact on global tile volumes, Italy remains a world leader in value-added ceramic tiles made by flexible and imaginative small and medium-sized firms (SMEs). A country's competitiveness is determined by an industry's capacity to innovate and upgrade. Under the new trend of "Internet plus art", China's art business has been growing rapidly and has attracted more and more attention. The development process, current situation and future development trend of Chinese art e-commerce platform have also attracted wide attention. The era of art e-commerce has quietly come [6, 7]. Doing business online offers both apparent and not-so-obvious benefits. You can take advantage of them if you know what they are.

With the advent of ecommerce platform technology, setting up and managing a low-cost ecommerce business is now exceedingly simple and affordable [8, 9]. Merchants no longer need to spend large sums of money on television advertising or billboards, nor do they need to worry about staff or real estate expenditures [10, 11]. Using ecommerce systems, merchants may deliver personalized information and product recommendations to registered customers [12, 13]. In Jingdezhen, the porcelain capital of China, there is tens of thousands of excellent artistic ceramic works every year, and the artistic ceramic platform has been launched in recent years. At the same time, the high-end market of Chinese contemporary art ceramics is transforming into a mass consumer market. The performance of high-end art market is sluggish, while the middle and low-end art market has rebounded significantly, which is a sign of popularity.

Nowadays, the post-80s and post-90s have gradually become the main consumers, and their purchasing power, consumption habits and preferences are affecting and guiding the mainstream marketing strategy. This group pays attention to the embodiment of personal value and pursues personalization, differentiation and emotion. They have a strong ability to accept new things, are used to and prefer electronic transactions such as online shopping and mobile payment. They advocate creativity, fashion and uniqueness. Although they are discouraged from investing in the collection of expensive original works of art ceramics, they have a strong purchase intention for mass consumer goods of art ceramics. Ceramic art is a merger of science, materials, and art, and many of its characteristics are vital for current product design, notably the integration of ceramic material qualities, decorative patterns, and modern product design, which may boost its quality and cultural significance. Because ceramic art has its own attraction, worth, aesthetic quality, and cultural significance, present designers must inherit and evolve rather than just imitate its components and traits. Ceramics' demand in the worldwide market might be boosted as a result of this. They tend to use art ceramics for space decoration and beautification or personal taste demonstration, which is an important basis for the transformation from the high-end market of contemporary art ceramics to the mass consumer market [14].

Therefore, the ceramic product design system is a high-tech computer application system for ceramic production to meet the needs of young customers. It is an intelligent system for porcelain pattern design and tile making. It is possible to print spot color patterns and moiré patterns with functions such as porcelain pattern deformation. The system is powerful, simple to operate, and stable [15]. Ceramic objects have a complex production process and a diverse product line. The raw materials are flammable, explosive, and toxic, but the completed goods and semi-finished

products are mostly solids and solid-liquid combinations [16, 17]. It is seen that product and raw material storage regulations are becoming increasingly demanding. As a result, top individuals from the ceramic and logistics sectors are undertaking research into technology applications [18, 19].

Ceramic factories have played a huge role in developing new products, increasing production efficiency, improving product quality and promoting. Based on the existing digital multimedia big data analysis, the ASP platform-based ceramic product design system was created to provide effective product design solutions. Ceramic pattern plays a role in decoration and beautification of ceramics. Especially in modern society, people continue to pursue personalized beauty and pay attention to personalized development, which provides a broad development prospect for the development of ceramic pattern design. This puts forward a new requirement for the ceramic market, which makes it develop towards the direction of small batch, multi variety, high quality and most convenient, so as to meet people's requirements of personalization, fashion and beauty [20]. Figure 1 shows the big data analysis architecture of mobile digital multimedia.

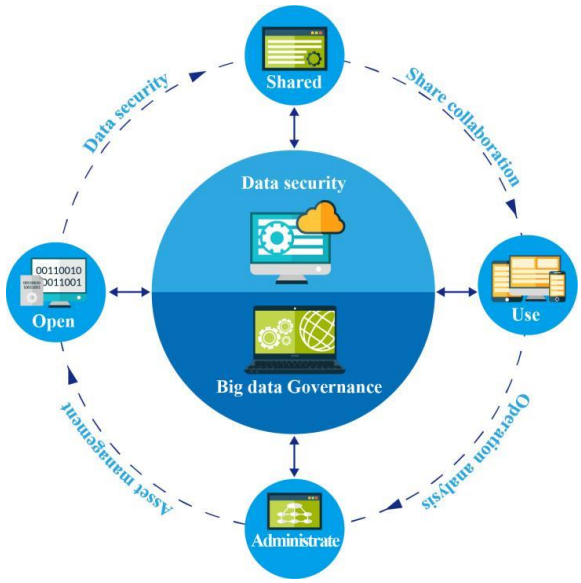

Figure 1: Big data analysis architecture of mobile digital multimedia.

This network shown in Figure 1 will help to meet the market requirement as per the changing trends. It is governed through big data and product design system is created for the development in the field. Moreover, it will provide a new design idea of ceramic style design.

2 LITERATURE REVIEW

Ceramics is a unique product. Its uniqueness and unevenness make it difficult to apply the pattern to ceramics. When applying patterns to ceramics, it will be limited to a certain extent in the form of ceramics. Features need to be perfectly combined. The use of decorative patterns on ceramics represents the perfect combination of artistic and practical. It is natural and has a unique structure, rich colors, strong visual effects and artistic charm [21]. With the help of porcelain media, its design can decorate ceramics and satisfy people's aesthetic taste, and the pattern sensitivity not only reflects the image, but also the accompanying porcelain design. reflects different personalities and different local characteristics. In addition to expressing the culture of the nation, the pattern also reflects the various senses and aesthetic concepts of life [22, 23].

When people start creating patterns, sketch design software is a must because they are not sure about the end result. Through such software, even if the original idea is vague, it is possible to determine the appropriate location according to such a vague idea. Based on this idea and organization, select the appropriate elements. Finally, the art style is created intelligently. Through such software, it is easy to express what people are thinking [24, 25]. With the help of computer-generated patterns, people's ideas for creating patterns have become clearer. Therefore, it is necessary to develop such sketch design software to provide a functional plugin to strengthen the design function of the CAD system of ceramic products. Creating a ceramic product design system based on the ASP platform can provide an effective product design solution. This will provide ample opportunities for the development of ceramic pattern design and support the healthy and active development of the ceramic market [26, 27].

Moreover, Computer Aided Decoration of Ceramic Tableware (CADOCT) is a CAD/CAM system designed for the production and manufacture of designs for ceramic tableware. Several industrial case studies involving ceramic dinnerware prototypes are carried out and presented in order to highlight the multiple advantages of using the prototype CADOCT system [28, 29].

3 RESEARCH METHODS

3.1 Introduction to ASP Platform

ASP (application service provider), that is, application service providers, refers to companies that sell or rent application systems running on their own servers to enterprises that need to use these application systems through Internet public network or VPN (which should be proposed to be a private network). It gives internet access to applications and related services for both consumers and enterprises. Although software as a service (SaaS) companies have almost all replaced the term, organizations in some parts of the world continue to use the two terms interchangeably. In fact, ASP is a business leasing mode. Through ASP, enterprise users can directly rent SP computers and their systems for their own business processing, so as to save the funds for the purchase and operation of IT products and technologies. With the development of Internet technology, the emergence of ASP is not only an inevitable product, but also the need of the development of small and medium-sized enterprises. The ASP market will deliver standardized application software through a network, but not primarily or mainly the Internet, via an outsourced contract based on usage-based transaction pricing. The ASP industry is made up of service providers (Web hosting and IT outsourcing), independent software producers, and network/telecommunications providers. Enterprises rent various application software services needed through the Internet, which can greatly reduce the burden of implementing information system for small and medium-sized enterprises, provide conditions for small and medium-sized enterprises to realize information needs, and provide space for enterprise information development. In order to better use ASP system, we must have a clear understanding of its applicable conditions. The characteristics of the system are as follows:

1) Take application as the core. The core of ASP is the application system. Various activities in the implementation, promotion and application are carried out on the basis of the application system, not through other services or other hardware platforms.
2) Internet applications. If the application software developed by Internet is based on the requirements of ASP server, all the application software developed by Internet should be installed on the server. When using, each application customer needs to use the browser to access the ASP running platform through the Internet public network.
3) Centralized management. All ASP application software is installed on the application server of the ASP central computer room (IDC), which is uniformly managed by ASP. Relevant data is also placed on the database server of the ASP central computer room, and ASP is also responsible for daily system maintenance and data backup.
4) Systematization. Because the ASP application system serves multiple application customers at the same time, and the data between customers is completely separated logically, the

ASP application system is packaged and runs the data of multiple application customers on a set of system.

5) Rental charges. The biggest difference between ASP mode and software sales is that the charge of ASP mode is rental charge, that is, the charge mode such as annual package, monthly package and membership system is adopted, rather than one-time buyout under the software sales mode. In ASP mode, the copyright and use right of the software are ASP's rather than the customer's. Under the software sales mode, the customer pays the software purchase fee at one time and has the right to use and even transfer the software under the conditions specified in the contract [30].

The emergence of ASP is the inevitable result of market competition. With the increasing progress of ASP technology, it is easier and easier for enterprises to carry out the mode of information and audio industry, which promotes the faster and better development of enterprises.

3.2 ASP Platform Construction

ASP platform is a supporting platform for enterprise informatization operation mode, mainly including application platform, security certification subsystem, platform support subsystem, operation support subsystem and business operation subsystem. The ASP manages the infrastructure and executes these applications, as well as supporting you in setting up and managing your own servers. An ASP provides a dependable application that can be accessed from anywhere. When a firm needs a software product that it cannot buy or build, such as social media marketing automation tools, it typically works with an ASP.

The application platform provides a variety of applications for enterprises; The security authentication subsystem has the functions of user identity management, resource authorization, user identity authentication and so on; The operation support subsystem manages the user account, including the management platform of car purchase service, rental and payment. The support subsystem manages the software, hardware and database of the whole platform, including database maintenance, data backup, software and hardware upgrade and maintenance, so as to ensure the normal operation of the system; Specific operation of business operation subsystem management platform [31]. The security authentication subsystem consists of three modules: user identity authentication, identity management and resource authorization. User identity management records the user's basic information, user's place of belonging, etc. Because ASP platform concentrates a large number of applications, resource authorization is particularly important.

As a platform for providing public services, in order to prevent illegal intrusion and ensure the security of the platform, the requirements of identity verification are often very strict. As a commercial platform for the majority of small and medium-sized enterprises, it should not only have user management, authentication and authorization, but also have a fairly complete business operation mode. The operation support subsystem usually has three modules: business, accounting and billing. The business module manages user account information and records the time, purchase and specific content of user changing services. The billing module includes a complete pricing system, which can be charged according to the usage of users. The accounting module carries out charge management, and carries out credit registration according to the user's payment.

3.3 Sketch Design Module

The process of creating a traditional pattern is mainly based on an idea and creates an appropriate organization. Depending on the concept and organization, select the appropriate elements. Finally, the art style is created intelligently. The sketch design plugin can easily mimic the traditional style creative process. This article provides solutions for key sketch plug-in technologies, such as image element library management, grammar library management, and clever pattern creation. The primary library is mainly used to store the original material, which is the basic material for sketching, and makes the sketch design meaningful. The management of element library is to first

give each element a unique ID into the element library, and then have a unique storage address (URL) in the library [32]. Figures 2 and 3 are the main flow charts of element operation:

1) Flow chart of element loading

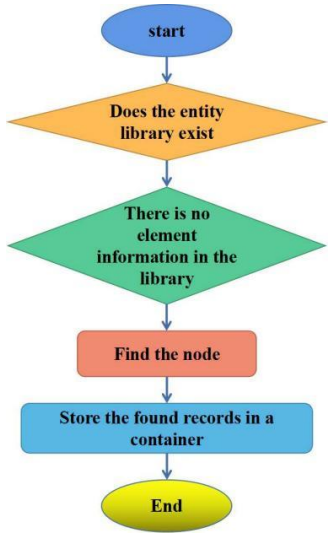

Figure 2: Flow chart of element loading.

2) Flow chart of element display

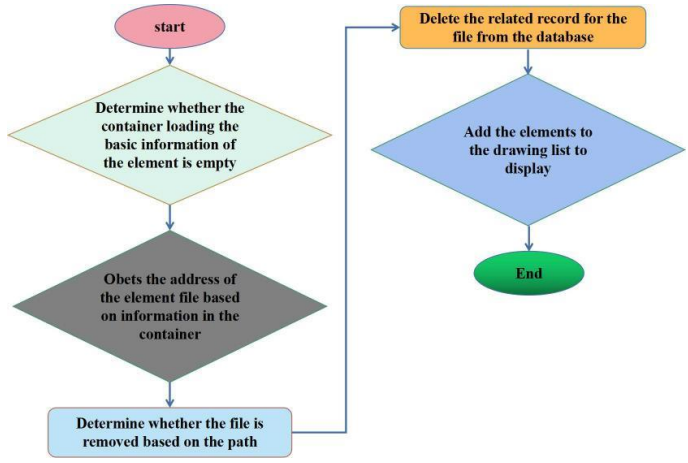

Figure 3: Flow chart of graphic element display.

One in the rule base represents the basic information of an element, such as the size of the element, the rotation angle of the element, and the specific position of the element display. A sketch template drawing can be formed through a series of such sketch rule information. Such a sketch template can be saved or displayed directly. The system intelligently displays a pattern by reading its saved parameters.

3.4 Iterative Function System

In 1981, the idea that fractal can be generated by compression mapping method came into being, and then the iterative function system was invented. Affine transformation is introduced below, and its corresponding mathematical expression is shown in formulas (3.1) and (3.2):

$$X' = ax + by + e \tag{3.1}$$

$$Y' = cx + dy + e \tag{3.2}$$

a, b, c, d, e and f are the coefficients of affine transformation. For more complex graphics, multiple different affine transformations may be needed to realize, and the probability of each affine transformation being called is not necessarily the same, so a parameter probability p is introduced. a, b, c, d, e, f and p constitute an IFS code. IFS are the theoretical basis of fractal compression. How to make the computer automatically generate IFS code is a research focus. In the practical research of fractal compression coding, the iterative function system coding algorithm is modified, and fractal block coding is proposed, which is a computer automatic algorithm of fractal compression coding based on block division. This is the first step in the practical application of fractal image coding and points out a development path for fractal coding. At present, most fractal coding is based on fractal block coding. Ifs can simulate various natural landscapes and can be used to generate various forms of plants, jungles, mountains and rivers, clouds and smoke, etc. The theory and method of IFS is the theoretical basis of fractal image compression and has a broad application prospect.

4 RESULT ANALYSIS

4.1 Ceramic Pattern Design Platform

Ceramic product design is a high-tech computer application system for ceramic production. It is an intelligent system for ceramic pattern design and tile making. It supports online collaborative design, has the ability to print spot color patterns and cloud pattern, and more ceramic pattern deformation. The system has powerful functions, simple operation and good stability. Ceramic factories can play a better role in developing new products, increasing production efficiency, improving product quality.

4.2 Functions of Ceramic Pattern Design System

Through the introduction of the whole system, the structural arrangement of the sketch plug-in part in the system is shown in Figure 4:

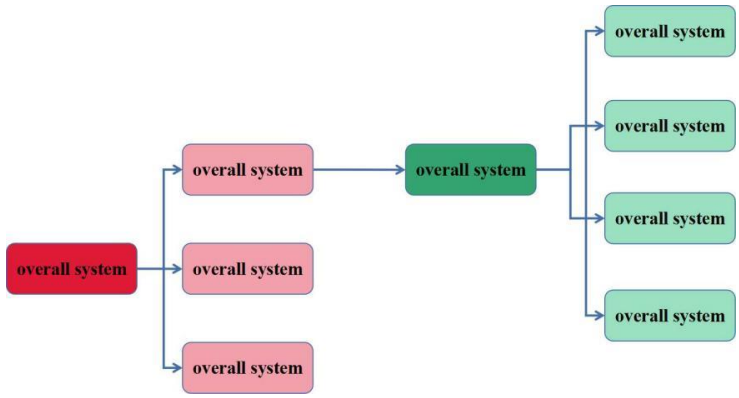

Figure 4: Overall design.

Finally, different ceramic patterns are obtained by inputting different parameters. Then, the two pattern design methods are compared from three aspects: the design time, the firing success rate of the pattern on the ceramic products and the repeatability of the drawn dough, as shown in Table 1:

	Time (h)	*Firing success rate (%)*	*Firing pattern repetition rate (%)*
Traditional hand drawing	8	70.05	64.13
Design system drawing	0.2	67.44	87.74

Table 1: Comparison of two pattern design methods.

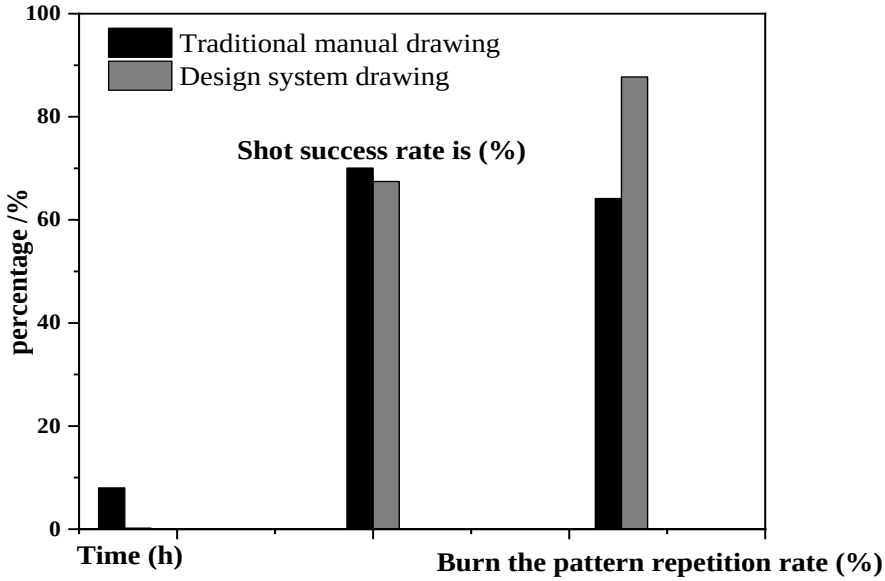

Figure 5: Comparison of two pattern design methods.

As can be seen from Figure 5, compared with the traditional manual drawing method, the design system in this paper can greatly save the design time, time and labor cost. The proposed method has proved out to be efficient as compared to traditional one. The figure 5 clearly shows that through this method, designers can present their preliminary impression through sketch design. It is observed that, the method will reduce the workload of designers. In terms of the firing success rate, the two methods are roughly equal, both of which are about 70%. In terms of the designed pattern repetition rate, the design system is 87.74%, which is much higher than 64.13% of the traditional manual drawing. The product has high uniformity.

5 CONCLUSION

Product design has played an increasingly important role in the concept of modern product design for people. Restrictions on the design of traditional products no longer meet consumer demand. With a specific style that will appeal to consumers, designers can only finish without production based on their experience and intuition. How product design provides a scientific, realistic, and effective design method and procedure, and how to provide an effective product style application system to help designers design, are issues that need to be addressed urgently.

Through the research on the theory, method, program and application system of product pattern design, this paper obtains the following main conclusions:

1) Through the application trend of ASP platform, under the situation of enterprise information development, it is feasible and effective to apply ASP platform mode in ceramics;
2) Sketch is a special form of symbol system, which has the characteristics of semantics, grammar and fuzziness, and can meet the vertical and horizontal thinking activities of designers. By hand sketching, the designer can define the general outline shape of the drawing (the topology expressed in the form of sketch), convert the information of the hand-painted drawing into geometric features, and convert the line type, line width and other information of the drawing into attribute features, so as to define a specific graphic object. Through the understanding of the particularity of ceramic product pattern, this paper focuses on the research and design of sketch design module, so that designers can present their preliminary impression through sketch design.
3) Preliminarily develop the product pattern aided design system for ceramics, support the product pattern design methods and procedures, and provide a two-way communication platform for enterprise designers and consumers.

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