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Research Article

Structural Design of Handicrafts Based on Dynamic Simulation Technology

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In order to improve the effect of handicraft structure design, this study combines the dynamic simulation technology to build a handicraft structure design system and transmits data through dynamic simulation signals to improve the effectiveness of the interactive design of artworks. In order to provide a simpler and faster development process for interactive media applications, this study develops an interactive media art design system with a node-based visual programming model as the core processing logic. The digital Gaussian shaping method based on the programmable logic device can not only realize real-time Gaussian shaping of the nuclear pulse signal but also meet the needs of later function expansion, maintenance, and upgrade of the system. In addition, this study verifies the effectiveness of the handicraft structure design system based on dynamic simulation technology through the analysis of multiple sets of simulation data.

1. Introduction

Art designers put more energy on the design and perceptual needs of product appearance. Moreover, the old practice of planning and forecasting before product launch will become obsolete, replaced by a market model that is constantly revised in dialogue with consumers. Therefore, how to accept orders in a short period of time and deliver products to consumers as required will become the focus of competition [1].

With the development of the handicraft industry, the cultural colors, individual characteristics, and artistic characteristics of the handicrafts are becoming stronger and stronger, and people are becoming more interested in handicrafts with high cultural content and distinctive individual characteristics and sentiment [2]. In the process of developing and designing handicrafts, each handicraft enterprise also attaches great importance to the excavation of cultural factors of handicrafts, the development of regional characteristics, the expression of individual characteristics, and the embodiment of artistic value. The competition in the handicraft industry will ultimately be the competition of culture, personality, and art, which has been generally recognized by the industry [3].

Aesthetic features are the most basic features of a handicraft. Only delicate and beautiful products can attract people's attention and move people's hearts. The exquisite beauty of handicrafts is mainly reflected in the beauty of materials, shapes, colors, craftsmanship, and decoration of the handicrafts themselves [4].

Due to the continuous progress of human science and technology, culture, and art, new materials appear one after another. It is also due to the continuous development of modern industrial technology, which puts forward more new requirements for materials. As a handicraft that leads to people's visual aesthetic needs, in addition to traditional jade, bronze, pottery, lacquer, and other products, there are also some new materials, such as resin handicrafts, and rubber handicrafts. The material beauty of handicrafts refers to the handicrafts that are designed and processed through the analysis and design of the texture, color, and other factors of the raw materials, and through the smart use of the

material characteristics of the raw materials. Therefore, a good artwork should be the perfect combination of material beauty and craftsmanship [5].

The pursuit of beauty is an instinct of human nature. No matter what era, modeling beauty is the most basic criterion for selecting a handicraft. A product can be called a handicraft because it has a perfect shape. The perfect shape of handicrafts usually expresses its appearance beauty through its modeling structure, and the appearance of these handicrafts usually contains many aesthetic concepts [6]. Modern handicrafts and plastic arts belong to the category of arts and crafts. It is the perfect combination of modern craftsmanship and people's aesthetic taste. Comprehensive consideration is required to create a perfect image for improving the product's appearance quality [7].

The color beauty of handicrafts includes the color beauty of the material itself and the colorful beauty of the processing. Some materials have a certain beauty in their own colors without adding artificial colors; for example, gold, silver, copper, crystal, jade, and other products are very beautiful in their own colors. And some materials need to be artificially added with some colors to increase the beauty of handicrafts, for example, blue calico handicrafts, lacquerware, etc. The color design of handicrafts is a very important and meticulous work, which involves many aspects [8]. To scientifically understand color, it is necessary to straddle the three academic fields of physics, physiology, and psychology. "Color is like a bond, amazingly connecting these different fields, physical, physiological, psychological, spiritual phenomena into one, forming the crystallization of color science life, which is science and art Highly fused crystals" [9].

Craft beauty refers to a kind of beauty formed by exquisite craftsmanship or unique style. Good handicrafts are well-made, cleverly conceived, and unique, which are pleasing to the eye, reflect the ingenuity of the craftsmen, and make buyers feel as if they have obtained a treasure [10].

Decorative beauty is the aesthetic characteristics of products through decorative design through some artistic techniques and means. The decorative beauty of handicrafts is expressed through its own modeling, and through decoration of the patterns. Products with their own unique shapes have decorative characteristics, and patterns are the most effective ways to express decorativeness [11]. There have always been many decorative patterns, especially auspicious patterns. These are patterns with decorative meanings. Using patterns to reflect the beauty of decoration is the most effective method [12].

Many handicrafts have certain practicality in addition to having certain aesthetic qualities for viewing, such as porcelain, pottery, lacquer ware, bamboo weaving, straw weaving, plastic products, and other practical handicrafts, all of which have practical value and certain ornamental [13].

In various contemporary new art trends, including the postmodern art design trend, the absorption and integration of craftsmanship by postmodernism is not a borrowing of forms of expression or a transfer of craftsmanship techniques, but profound immanence and essential meaning. Postmodernism emphasizes the metaphor of form, symbolization, and the historicity of culture, the semantic character of form, the social, psychological, and cultural context, and the continuity of modernity and history. Integration, emphasis on sensibility and experience [14]. Traditional craftsmanship provides an intentional reference for this, and it is precise because of this effort of postmodernism that some qualities of traditional craftsmanship are extracted from the deepest depths, or expressed in the language of modern art so that people's understanding of craftsmanship is enhanced. Knowledge is not only at the level of handicrafts, but mainly the essence of craftsmanship and the way of existence. The value is affirmed. In Italy and the Nordic countries, traditional handicrafts are paid attention to the design and production of large-scale industrial products. By adjusting measures to local conditions and pursuing the balance between the functionality and aesthetics of design, practitioners find value and inspiration from them, so that the handicraft industry and the mechanical industry can be organically integrated and gradually form a design method with its own traditional characteristics [15].

From the perspective of commodities, emotional products refer to products with the characteristics of expressing an emotional state. Through the shape, material, usage, and related background stories, they attract consumers and create happy emotional characteristics, making them full of moving and happy life. Designers can start from the shape, function, and texture of traditional handicrafts, as well as the background and related stories of handicrafts, to find elements that can attract tourists and make tourists have a certain resonance, so as to create products with an aesthetic experience [16].

In order to improve the structural design effect of handicrafts, this study combines dynamic simulation technology to construct the structural design system of handicrafts, to improve the structural design effect of modern handicrafts.

2. Dynamic Analog Signal Simulation Technology

When designing the artwork structure, this study mainly transmits data through dynamic analog signals to improve the effect of artwork interaction design.

2.1. Circuit Simulation of Nuclear Pulse Signal and Its Gaussian Shaping. Before establishing the digital Gaussian shaping model, it is necessary to simulate the hardware circuit signal to verify the correctness of the S–K filter Gaussian shaping circuit.

Before Gaussian shaping, a differential circuit needs to be used to generate a negative exponential signal. Figure 1 negative exponential signal generation circuit.

In the above figure, a pulse signal is an input at the input signal end, and through the combination of the differential circuit of C_1 and R_1, a negative index signal is an output at the output signal end, and the negative part of the output amplitude is then deducted by the $Q1$ transistor. In the above differential circuit, modifying the combination of C_1 and R_1

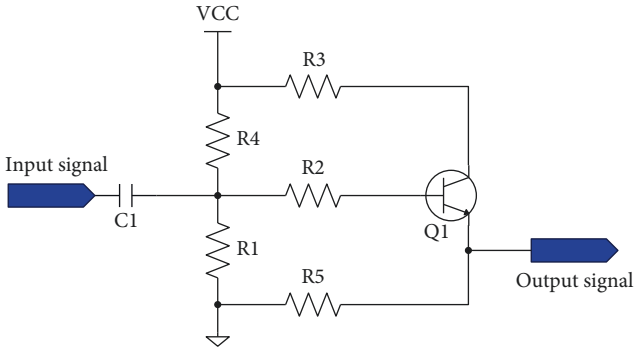


Figure 1: Negative exponential signal generation circuit.

can produce different types of negative exponential signal outputs.

Circuit simulation is carried out in the EWB (Electronics Work Bench) simulation environment. EWB software can realize the mixed simulation of analog and digital circuits. Using it, the real-time status information of various circuits, such as voltage, current, and output waveform, can be seen directly from the simulation interface.

Figures 2 and 3 are circuit simulation results of negative exponential signals with different combinations of C_1 and R_1.

The S–K filter is a commonly used Gaussian shaping circuit, which realizes the transformation from the input negative exponential signal to the output Gaussian signal. In addition, according to the requirements of filter shaping in practical applications. S–K filters can be used in multiple stages in series. In the EWB simulation environment, the output signal is used as the output signal of the S–K filter, and the circuit simulation of Gaussian shaping is carried out. Figure 4 is a simulation result of Gaussian shaping of a single-stage S–K filter.

2.2. The Establishment of Gaussian Forming Model. Kirchhoff's current law describes the constraint relationship between the currents in each branch connected to any node in a lumped circuit, and its physical essence is charge conservation, namely:

For any node in a lumped circuit, at any time, the algebraic sum of currents flowing out (or flowing into) that node is equal to zero. Its mathematical expression is:

$$\sum_{k=1}^{n} i_k = 0. \tag{1}$$

In formula (1), i_k is the current of the kth branch of the node, and n is the number of branches at the node. When formulating equations using this law, the reference direction of each branch current should be marked first. It is generally specified that when the reference direction of the branch current leaves the node. In the KCL equation, the "+" sign is taken in front of the branch current; otherwise, the "−" sign is taken.

Figure 5 is a circuit model of the S–K filter. According to the KCL law, we get [17]

$$\frac{V_i - V_f}{R_1} = \frac{V_f - V_p}{R_1} + C_2 * \frac{d\left(V_f - V_o\right)}{dt}, \tag{2}$$

$$\frac{V_f - V_p}{R_1} = C_1 * \frac{dV_p}{dt}, \tag{3}$$

$$V_o = V_o * \frac{R_3}{R_3 + R_4}. \tag{4}$$

In formulas (2)~(4), we take $R_1 = R_2 = R_3 = R_4 = R$ and $C_1 = C_2 = C$. Then, through joint derivation, we get

$$\frac{V_i - V_f}{R} = \frac{V_f - V_p}{R} + C * \frac{d\left(V_f - V_o\right)}{dt}, \tag{5}$$

$$\frac{V_f - V_p}{R_1} = C * \frac{dV_p}{dt}, \tag{6}$$

$$V_p = \frac{V_o}{2}. \tag{7}$$

By substituting formulas (7) into (6), we get:

$$\frac{V_f - V_o/2}{R} = C * \frac{dV_o/2}{dt} \tag{8}$$

By simplifying formula (7), we get:

$$V_f = \frac{V_o}{2} + \frac{RC}{2} * \frac{dV_o}{dt} \tag{9}$$

By simplifying formula (4), we get:

$$V_i - V_f = V_f - V_p + Rc * \frac{dV_f}{dt} - RC * \frac{dV_o}{dt} \tag{10}$$

By substituting formulas (7) and (9) into formula (10) respectively, we get:

$$V_i - \left(\frac{V_o}{2} + \frac{RC}{2} * \frac{dV_o}{dt}\right) = \left(\frac{V_o}{2} + \frac{RC}{2} * \frac{dV_o}{dt}\right) - \frac{V_o}{2} + Rc * \frac{d\left(V_o/2 + RC/2 * dV_o/dt\right)}{dt} - RC * \frac{dV_o}{dt} \tag{11}$$

By simplifying formula (11), we get:

$$2 * V_i = (RC)^2 * \frac{dV_o/dt}{dt} + RC * \frac{dV_o}{dt} + V_o \tag{12}$$

Finally, RC = k in formula (12). Formula (12) is transformed into [18]:

$$k^2 * y'' + k * y' + y = 2x \tag{13}$$

To sum up, the Gaussian shaping model based on the S–K filter can be summarized as a mathematical function

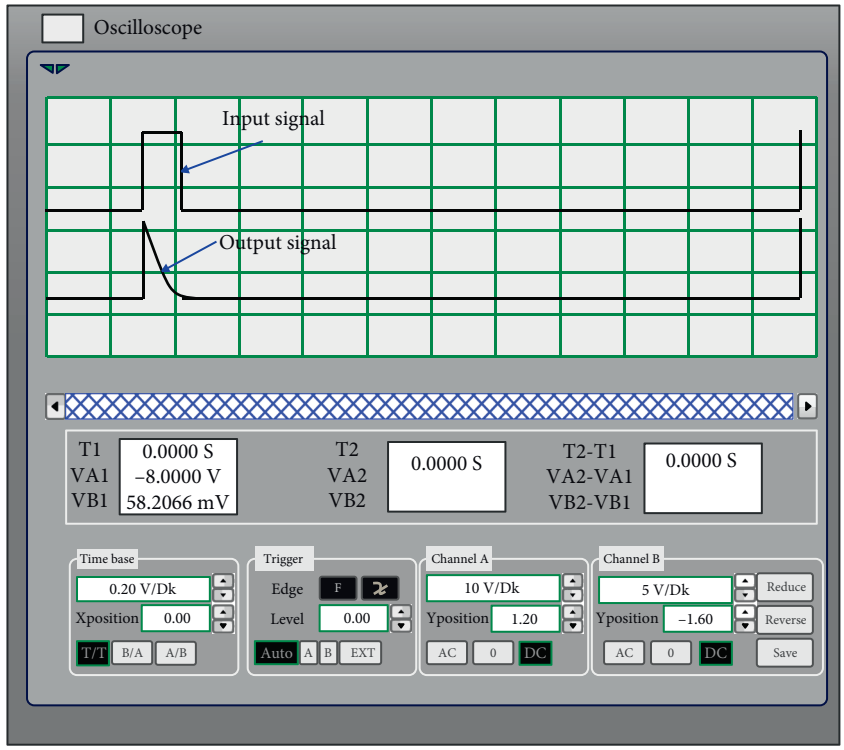


Figure 2: Simulation results of negative exponential signals at $C_1 = 15\,\text{pF}$ and $R_1 = 20\,\text{k}\Omega$.

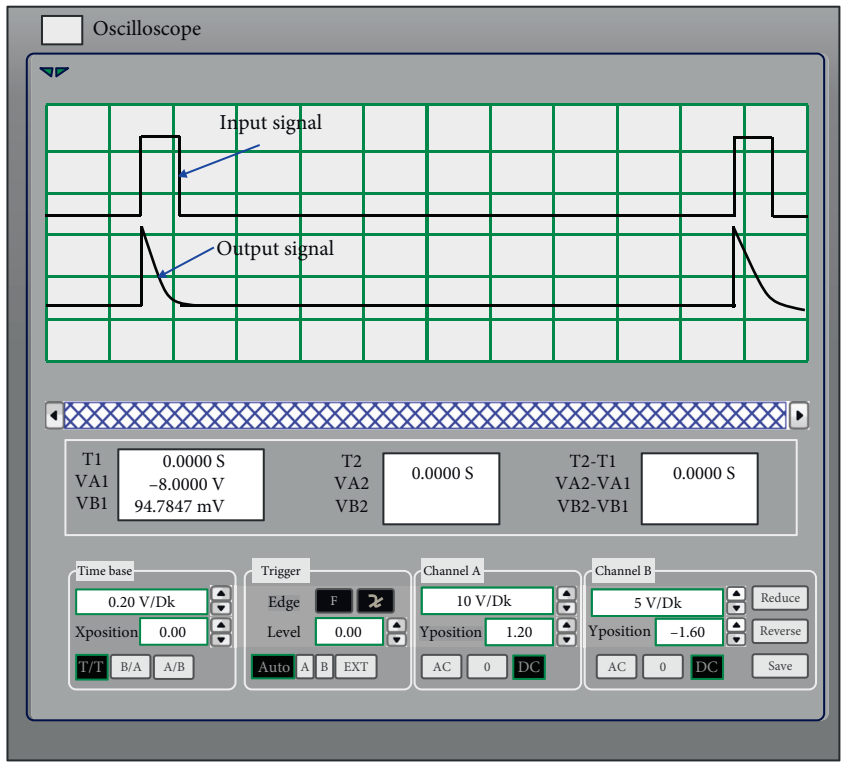


Figure 3: Simulation results of negative exponential signals at $C_1 = 30\,\text{pF}$ and $R_1 = 20\,\text{k}\Omega$.

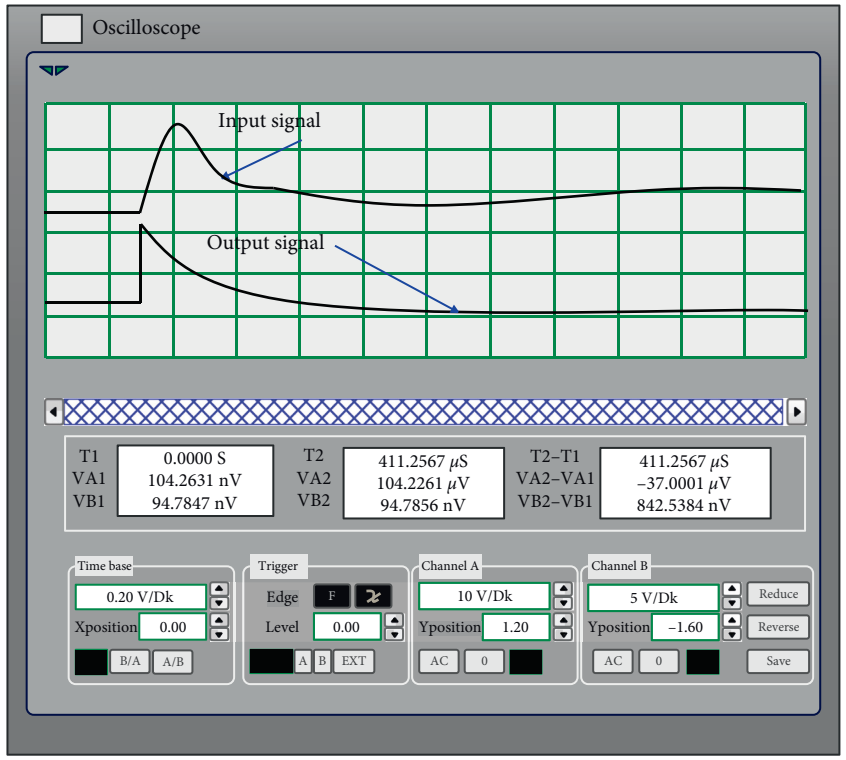


Figure 4: Simulation results of Gaussian forming of the single-stage S–K device.

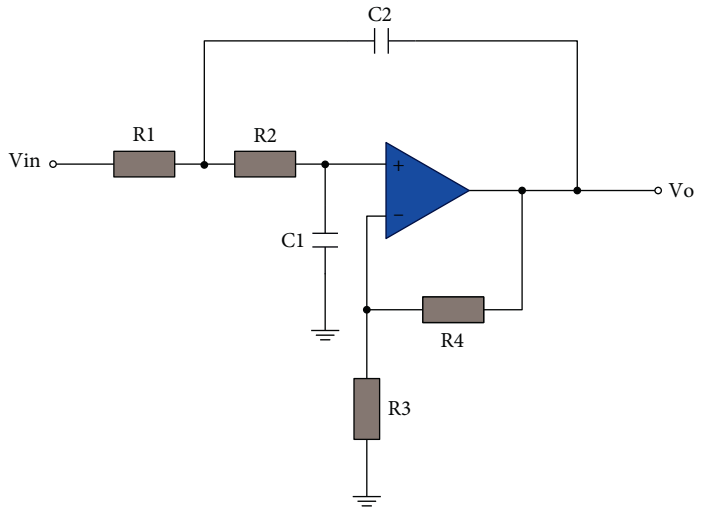


Figure 5: Circuit model of S–K filter.

$y = f(x)$. According to equation (13), it can be known that the function is an inhomogeneous quadratic differential equation. Therefore, by solving this equation, the mathematical relationship model of the pulse signal output after Gaussian shaping can be obtained.

Considering the characteristics of the statistical fluctuation of the nuclear pulse signal itself, the solution process of equation (13) cannot be carried out in the way of "general solution-specific solution." The reason is that this method is only suitable for solving quadratic differential equations of continuous signals. Therefore, the solution of formula (13) can only be completed by the differential numerical method, that is, the solution method of the quadratic differential equation of discrete signals.

By using the differential numerical method, formula (13) is transformed into:

$$(RC)^2 * \frac{(y_{n+1} - y_n/\Delta t - y_n - y_{n-1}/\Delta t)}{\Delta t} + RC * \frac{y_{n+1} - y_n}{\Delta t} + y_{n+1} = 2x \tag{14}$$

After merging and sorting formula (14), we get:

$$\left(1+\frac{RC}{\Delta t}+\left(\frac{RC}{\Delta t}\right)^2\right)\times y_{n+1}=\left(\frac{RC}{\Delta t}+2\left(\frac{RC}{\Delta t}\right)^2\right)\times y_n-\left(\frac{RC}{\Delta t}\right)^2 \times y_{n-1}+2x \tag{15}$$

Among them, $RC/\Delta t = k$. Formula (15) is transformed into:

$$\left(1+k+k^2\right)\times y_{n+1}=\left(k+2k^2\right)\times y_n-k^2\times y_{n-1}+2x \tag{16}$$

According to formula (16), we can get:

$$y_0=\frac{2x_0}{1+k+k^2}, \tag{17}$$

$$y_1=\frac{\left(k+2k^2\right)\times y_0+2x_1}{1+k+k^2}, \tag{18}$$

$$y_2=\frac{\left(k+2k^2\right)\times y_1+k^2\times y_0+2x_1}{1+k+k^2}, \tag{19}$$

$$y_n=\frac{\left(k+2k^2\right)\times y_{n-1}+k^2\times y_{n-2}+2x_n}{1+k+k^2}. \tag{20}$$

To sum up, the digital Gaussian-shaped output signal of the nuclear pulse signal can be realized by the recursive calling of the formula (20). Among them, k represents the adjustment parameter of the Gaussian-shaped output signal. The pulse width and pulse amplitude of the output Gaussian waveform can be set by adjusting k.

3. Structural Design of Handicrafts Based on Dynamic Simulation Technology

Due to the limited amount of artwork graphic data referenced in the actual design process, various museum websites, industry platform websites, and e-commerce platforms have massive artwork graphic data. In addition, the e-commerce platform also has a large number of artwork images and corresponding market price information. This Internet information can greatly supplement the existing graphic data and form a data set with a wide coverage and a large amount of information. This information is suitable for fast crawling by crawlers. By analyzing the characteristics of each website page that needs to be crawled in this study, the information crawling process adopted in this study combines two methods of direct information crawling and nested information crawling. The specific crawling process and some crawling results are shown in Figure 6.

The forms of intelligent art design are diverse, and intelligent interactive art design can be said to be an important point of expression in intelligent art design. Moreover, many works of art created by intelligent interactive art design have become part of people's daily life. In addition, there are some intelligent performing arts based on intelligent technology, which have also appeared in people's field of vision through music, dance, video, and other forms. However, from the technical point of view, most of the current intelligent

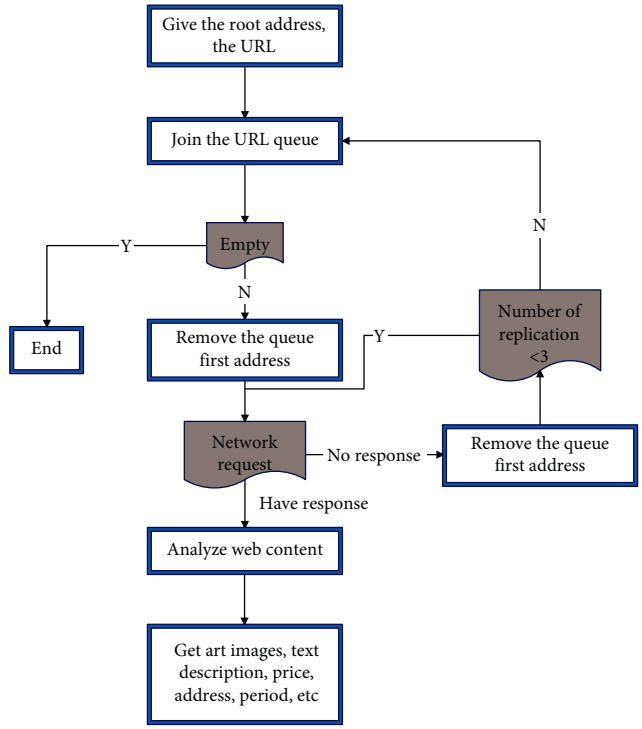


Figure 6: Flowchart of the crawler program.

interactive art design is the feedback of various inductions of weak intelligence and also belongs to weak intelligence art. Its research and development are mainly to gradually understand the essence of human art intelligence and to be able to study strong intelligence art, which is a kind of intelligent creation and design method similar to human beings.

The first stage is the interactive art design oriented by the intelligent platform. It is to apply artificial intelligence technology on some software platforms, or integrate artificial intelligence technology into some mature design software products to form art designs that can create human-computer interaction in intelligent platforms. Through deep learning, artificial intelligence has been significantly improved in natural language, machine vision, etc., and design and creation are carried out through intelligent interactive platforms. Just like Alibaba's Luban, it only analyzes, models, and organizes massive data to obtain the internal database of the machine by simulating the works designed by human intelligence. Furthermore, when human beings need it, it analyzes, organizes, and deconstructs works from the database, and generates relevant poster works with one click. This is a high degree of fusion of artists and engineers, which creates a new interactive platform. With the continuous development of technology, artificial intelligence technology has been applied to different design platforms, which is what we now call intelligent design platforms. In addition to Luban, there are also a series of design-related intelligent platforms such as naughty rabbit cutouts, smart copy-writing, and micro-posters. This intelligent platform is designed with several matching methods, namely text matching text, text matching image, image matching text, and image matching image. In artificial

intelligence design, there are more matching schemes for design elements, such as automatic color matching, the automatic coloring of line drafts, and automatic correction of hand-drawn graphics. Through these different matches, there have been many artificial intelligence designers of different professions, including specialized poster designers, web designers, logo designers, etc. There are also some intelligent interactive platforms called "artists."

Text matching text interactive art design is mainly achieved through intelligent color matching. Intelligent color matching first obtains a large database of color matching, and uses a certain algorithm to extract the main color distribution area according to the pixels on the image to form a data set. The color is expressed in the form of text, through the transformation of a certain set of algorithms, a large amount of data on the color scheme of the picture is collected, and a certain color matching model is obtained through deep learning to complete the work.

The interactive art design of text-matching images automatically generates design proposals by providing relevant design suggestions. One of the suggestions for artificial intelligence design is the suggestion made by the designer, and the other is the suggestion made by the design demander. According to different needs and suggestions, artificial intelligence design analyzes and compares the data of the best designers by collating a large amount of data, including the most popular design trends, styles, colors, and then judges what is a good design.

Based on the current design industry, a variety of artificial intelligence interactive art design platforms, or artificial intelligence designers, have been born. The speed, optionality, time, and other factors of their design are unmatched by human design. However, although human designers take a long time to design and have limited solutions, the creativity of human designers is currently beyond the reach of intelligent designers. Moreover, there is a complementary relationship between the two. Artificial intelligence designers will promote human designers to design more innovative, creative, and creative designs. At the same time, the technology of artificial intelligence designers continues to improve, and it will also improve in terms of design creativity. In the future, the battle between the two may be on the creative and creative point of the design.

Whether using local features or deep convolutional features to build an image recognition model, the supervised training process requires sufficient labeled artwork image data for model learning and training. In the training phase of the model, in order to ensure that the model converges reasonably and determines the performance level achieved by the model, a validation data set and a test data set are required for verification and testing. Therefore, artwork image labeling and dataset segmentation are of great significance for model learning and training. Pre-training the model on some large-scale benchmark datasets can improve the recognition ability of the model. In addition, other types of benchmark image datasets are suitable for functional verification and performance comparison of algorithms due to their richer choices in data scale and category scale.

The products of mobile smart terminals are available to users in the form of APPs. This study studied information design combined with the development process and design method of APP product design. It includes market research, product positioning, user research, user experience, emotional factors, interaction design, and other parts for comprehensive consideration and analysis. This study summarizes the information design process of mobile terminals. The first step is the collection of information. Before developing an APP product, you should first consider the starting point of the product, the positioning of the product, the target user of the product, the core value of the product, the goal of the product, and the situation of similar products. After figuring out these issues, it can start collecting information about the product. The second step is the analysis of the information. After collecting a large amount of information, it is necessary to reconsider the relevant questions in the first step, screen the information twice, and retain useful information. Before product design, the earlier we do our homework on target users and market needs, the more we can avoid the probability of rework during product development. With the increasing competition in the mobile market, users in each field have many APP products to choose from, and users prefer products that can accurately meet their needs, are easy to use, and focus on emotional experience. The third step is the design of the message. The design of information can be divided into four stages. The first stage is to combine the extracted effective information with interaction design, user experience design, product design, and interface design to process the information and convert it into a form of expression that meets the requirements of APP products. The second stage is to quickly develop a useable product prototype, only need to implement the core functions of the product, get feedback through some user tests in a small range, and obtain the required data, so as to further improve the product. The third stage is the official release of the final product to the market. The fourth stage is the iterative design of the product. After the product is officially launched, new functions will be added or the previous version will be improved according to market conditions, hardware upgrades, user feedback, and other factors. This adjustment is an iterative update of the product, and the information design also needs to be iterated according to the changes in the product function. Based on the information design model, according to the comprehensive analysis above, this research combines our actual project experience to sort out the following information design model diagram, as shown in Figure 7.

In order to provide a simpler and faster development process for interactive media applications, this study takes the node-based visual programming model as the core processing logic, and uses *Qt* as the graphical interface library to develop an interactive media art design system. The system is named NodeComposer. The system is designed to allow both non-program developers and program developers in non-related fields to quickly and intuitively develop personalized interactive media art applications, as shown in Figure 8.

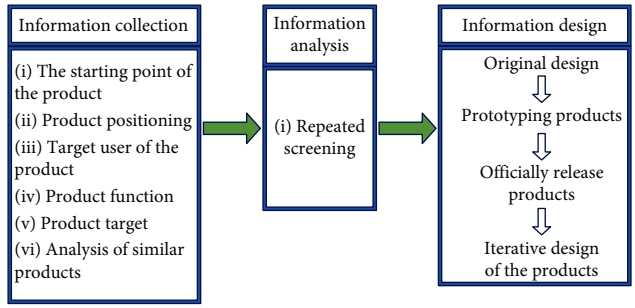


Figure 7: Artwork information design process.

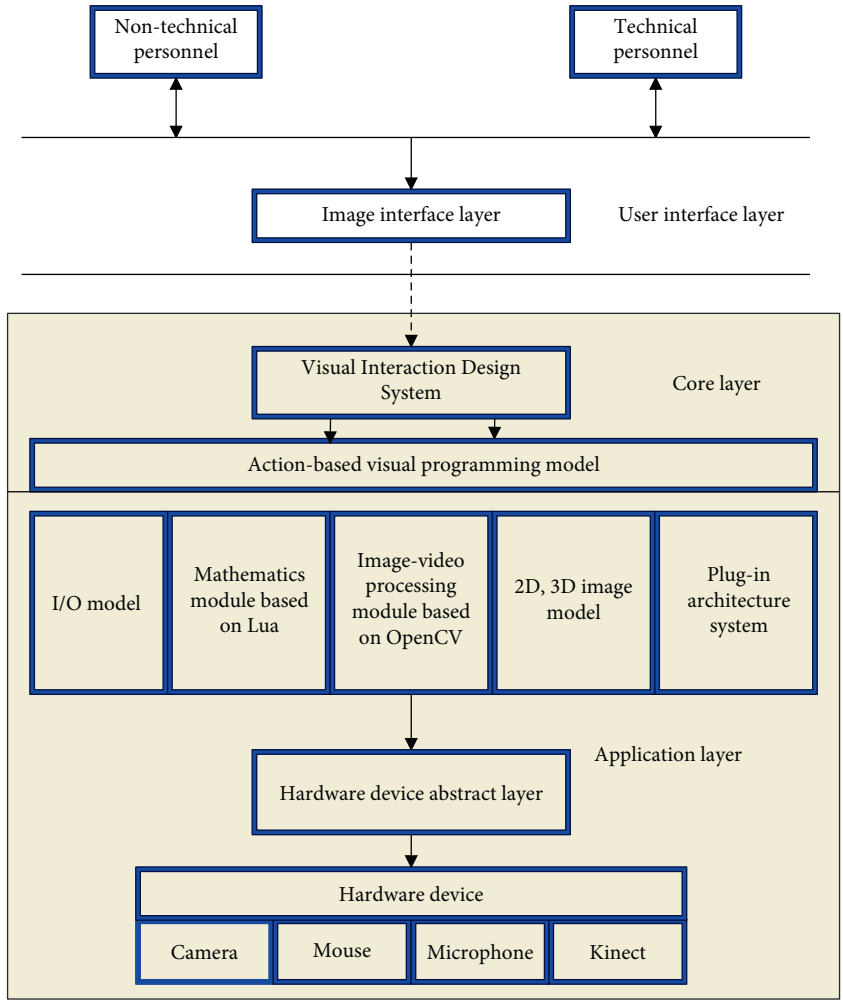
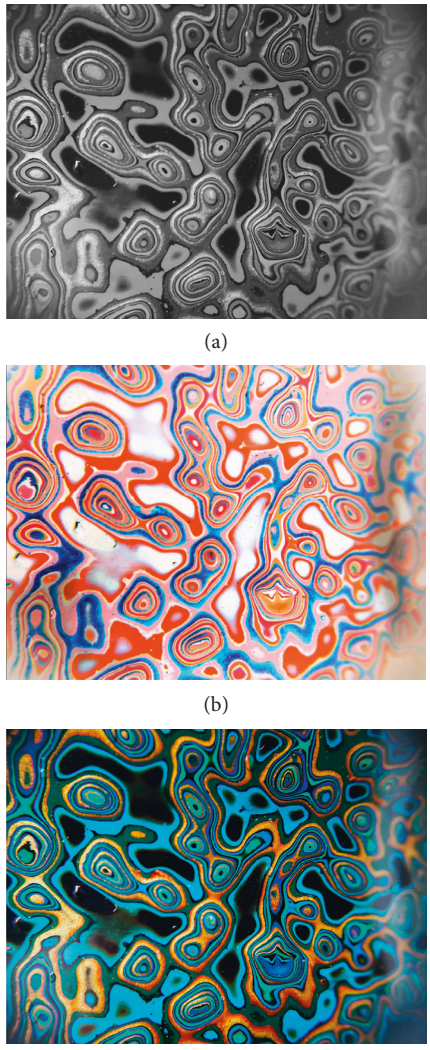


Figure 8: Crafts interactive media design platform.

Figure 9 shows an example image simulated by the system in this study on the simulation platform. It can be seen from the image that the system in this study can play a certain role in the design of artwork structure.

On the simulation platform, the effect of the handicraft structure design system based on dynamic simulation technology is verified, and the evaluation data is obtained through multiple sets of simulations, as shown in Table 1.

The effectiveness of the handicraft structure design system based on dynamic simulation technology is verified from the analysis of multiple sets of simulation data, and the system can be tested in practical design for auxiliary design.



(a) (b) (c)

Figure 9: Artwork design case. (a) Drawing of sketches. (b) Preliminary rendering. (c) Design finished product.

Table 1: Effect verification of handicraft structure design system based on dynamic simulation technology.

Number	Design evaluation	Number	Design evaluation
1	86.262	18	85.872
2	82.460	19	84.190
3	85.203	20	82.777
4	84.354	21	82.288
5	85.279	22	83.857
6	82.064	23	82.901
7	87.587	24	85.644
8	86.972	25	87.567
9	82.743	26	83.361
10	85.467	27	83.380
11	83.454	28	87.938
12	82.754	29	84.055
13	84.579	30	84.612
14	83.502	31	82.905
15	87.493	32	82.657
16	87.392	33	87.023
17	85.919	34	84.279

4. Conclusion

Handicrafts, a special personalized commodity, can better meet consumers' personalities with the help of the Internet, and make consumers part of the personalized handicraft design. The development of information technology has made it possible to master personal information and communicate with individuals, and the past practice of grasping consumers' needs according to different age groups has become outdated. Moreover, it will generate high brand value in terms of "services and products for individuals" and "personalized products" with high market value. In addition, it will become more and more difficult to seek differentiation in product functions, and more aspects will pursue differentiation in product information added value. In order to improve the effect of handicraft structure design, this study combines dynamic simulation technology to construct the handicraft structure design system. At the same time, this study verifies the effectiveness of the handicraft structure design system based on dynamic simulation technology through the analysis of multiple sets of simulation data, and the system can be tested in practical design for auxiliary design.

Data Availability

The labeled dataset used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interests.

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