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Creation of a system for designing textile patterns using an iterative function system

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Abstract

This study conducted research to tackle the issues of inadequate pattern design impacts and pattern distortion in textile pattern design systems. Using the experimental verification method, the iterative function system is tried to be used in the textile pattern design system. Through the iterative function system, the system hardware structure configuration can be improved, the system software function can be optimized, the system operation efficiency can be improved, and the pattern design and textile clarity and accuracy can be guaranteed. The textile pattern design system based on an iterated function system has high practicability in the practical application process, which can better prove the system's efficiency and improve the accuracy of pattern simulation. The fractal pattern created based on fractal theory perfectly combines science and art. These patterns can greatly enrich the pattern types of textiles and shorten the pattern design cycle. At the same time, it also breaks the habitual thinking of the human brain to a certain extent, broadens the thinking and vision for designers, helps designers develop new creative resources, and takes it as the entry point of pattern design in the textile industry, bringing new vitality to textile art design. This paper provides rich experience and guidance for textile pattern design systems based on iterated function systems and enriches the existing literature.

Keywords: Iterative function, Pattern design, Textile pattern.

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1. Introduction

Iterative function system (IFS) is a new and high-tech system that was formed with the development of modern computer technology. It is a combination of computer-aided design, computer-electronic technology, confidential machining technology, and chemical technology. It has the characteristics of fast response, high precision, no pollution, small land occupation, and simple operation [1]. It greatly meets the personalized and fashionable needs of small quantities in the modern textile printing industry, makes the printing of fine patterns flexible and simple, and makes interactive design between designers and consumers possible. With unparalleled design advantages, pattern design, as a part of the field of modern computer-aided design, plays an increasingly important role and has become an important part of product innovation design. Among them, texture pattern design, as a part of pattern design, is an art form with both decoration art and practicability. As a detailed treatment of modeling design, it is closely related to plane Color and stereo have the same modeling function [2]. Recently, the research on texture has mostly focused on material texture, which is scattered and lacks relative systematicity. Most of the relevant research is limited to the field of computer graphics design, and the research in the actual production and application of the printing and dyeing industries is relatively insufficient. This paper takes digital ink-jet printing technology as the technical support, from the characteristics of an iterative function system to the classification and composition of texture patterns. The conditions, methods, and laws of texture pattern design, color difference correction, and the application of texture pattern are studied [3].

The characteristics of an iterative function system and the definition of texture pattern are the basis of this research and discussion. The morphological characteristics, design conditions, design principles, design characteristics, design methods, and design laws of texture patterns are the focus of this paper. The Iterative function system has penetrated all fields of human life. It suffers significantly from the effects of digital technology as a traditional textile industry. However, at this stage, the scheme design cycle of many textile pattern designers is still in two relatively independent stages: the scheme conception and creation stage and the production and expression stage. How to use the computer to express the creative scheme of textile pattern design quickly and present the design creativity and production expression in a more intuitive way to meet the needs of customers has become a new research topic in the textile industry. At present, in our research on using computers to express textile pattern design works, we have been able to draw patterns directly on the computer by using some drawing tools and graphics and image processing functions provided by computer software [4]. However, the overall digital expression of creativity is still in its infancy. The plane drawing software cannot quickly simulate and present the three-dimensional effect picture of a household textile pattern directly. The pattern of household textiles still needs a long cycle from design to display in front of customers, and the efficiency is very low, which does not meet the requirements of modern textile pattern design. How can we integrate digital technology into fabric design, pattern design, and three-dimensional simulation design systems in the development of textile pattern design software? At the same time, it can be used as a three-dimensional simulation of decorative fabrics in different scenes, which has incomparable advantages in depth and breadth [5].

At present, the domestic research is still based on theoretical research; there is no complete digital performance system, and the effect on the specific implementation process is not ideal. The visual effect and texture of textile fabric patterns are not real. The digital performance of textile patterns on fabric texture is still a research area because the process is unique, and many methods are not yet perfect enough for the majority of textile pattern designers to accept [6]. The establishment of the three-dimensional simulation model library requires a lot of simulation production to carry out realistic material performance to truly restore the material properties of textiles and to truly and quickly use models and algorithms to quickly and accurately generate digital models of textiles to achieve textile pattern design ideas. The above are the main problems and technical keys of this paper.

2. Design of Textile Pattern Design System

2.1. Hardware Structure Design of the Textile Pattern Design System

A web service is a web service, also known as an XML (Extensible Markup Language) web service. It is a technology that uses extensible markup language (XML) technology to realize communication services between various systems on the Internet. The emergence of web services solves the communication problems caused by the differences in operating systems, programming languages, and object models between devices connected to the Internet and unifies the call interfaces between various web services [7]. The general architecture of web services is shown in the Figure 1.

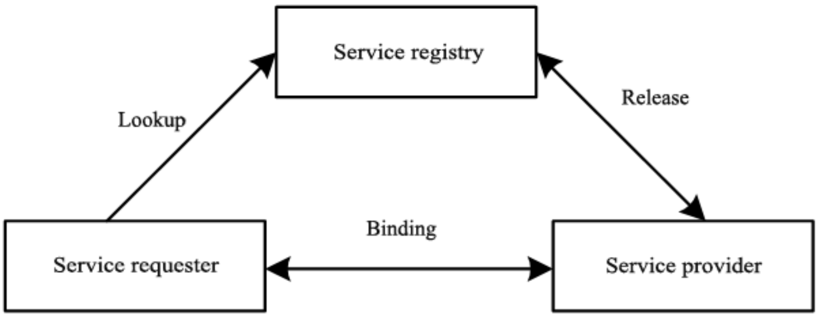

Figure 1.
Web service architecture.

Iterative Function is a standard-based and open-source enterprise web service development and deployment platform. The 2ee platform provides the transaction, security, and message services required by enterprise software and also provides a complete multi-layer distributed application model. Its emergence provides an efficient overall solution for the development of enterprise applications [7]. Users only need to develop business components according to the iterative function specification and hierarchical modularization so as to build a stable and reliable enterprise-level Web service system. The iterative function provides a multi-layer distributed application model, which can be divided into four levels: customer layer, web layer, business layer, and enterprise information system layer, as shown in Figure 2.

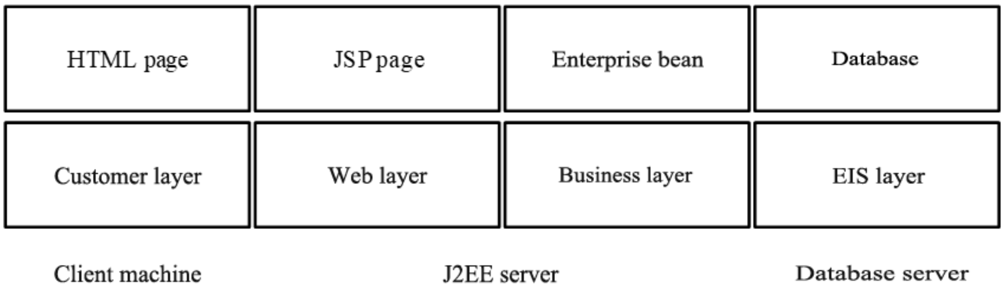

Figure 2.
Iterative function distributed model.
Note: HTML (Hypertext markup language), JSP (Java server pages), EIS (Executive information system).

The creative system is oriented towards the textile field and provides network-based vector textile pattern creative design functions for enterprises in this field [8]. The system also provides information management for textile goods data and user authority management. The overall architecture of the system is shown in the Figure 3.

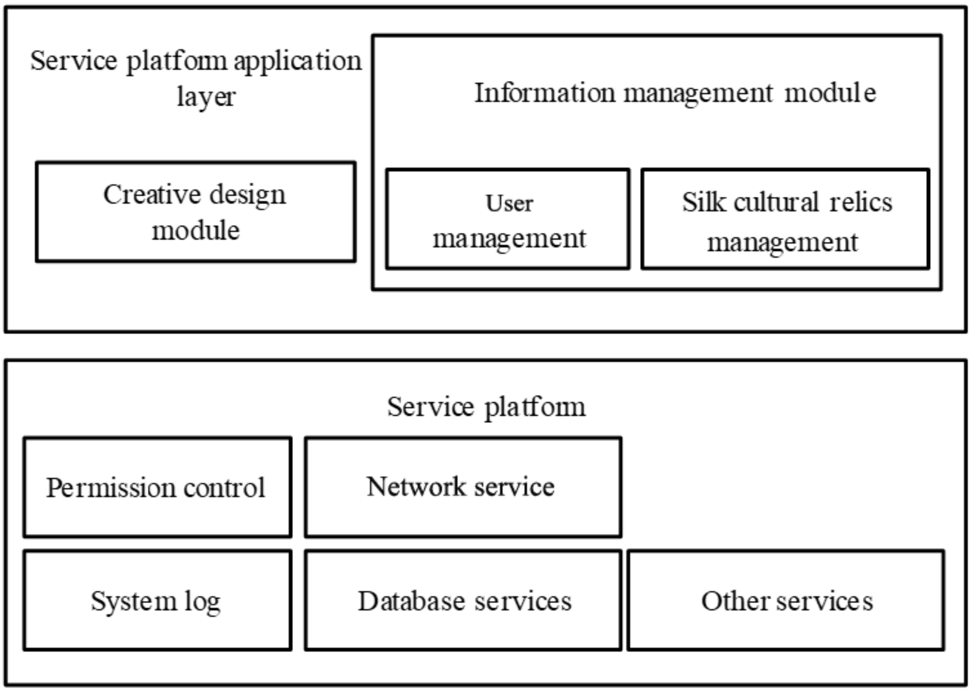

Figure 3.
System hardware structure.

The framework of a vector creative design system based on textile goods information is composed of three parts. Among them, the creative design block provides web-based vector pattern design services. The information management module is divided into two parts: textile goods management and user management. The textile goods management function provides services such as input, view, deletion, and update of textile goods information. The user management function provides user information management services and permission control services [9]. The service platform provides system-basic services for other modules, such as data exchange and network access between modules. Data transmission is the link connecting each module in the system, and the stability and efficiency of data transmission are the preconditions for the normal operation of the system. In the web-based vector graphics pattern processing system, vector transmission occurs not only between the back wall components but also between the front-end page and the back-end components [10]. If the data exchange mode of transmitting the whole vector graph is adopted, the data transmission process of the system will become slow and unstable, which will greatly affect the reliability and practicability of the system. The digital description method of textile pattern in the system is given; that is, the textile pattern is divided into two parts: pattern structure law and pattern unit. We use the mathematical model as the object of data exchange because the pattern structure law and pattern unit data are on the server and accessible by various system components [11]. In order to solve the problem of data transmission between any functional modules in the system, we need to formulate a unified data exchange interface. Vector pattern data transmission mainly occurs in the following two places: one is the data exchange between background components, and the other is the data exchange between back-end and front-end pages, as shown in the Figure 4.

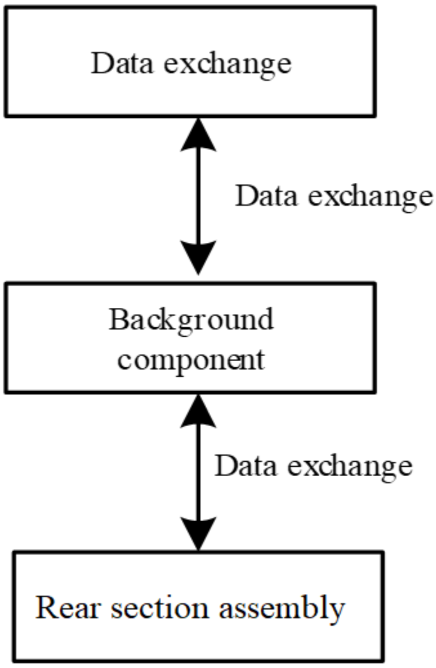

Figure 4.
System data exchange diagram.

Because the back-end components of the system are written in Java, this paper uses the object-oriented characteristics of Java to design the data structure of the pattern model. Data transmission interface between various components in the background of the system. The background architecture of the system is written in Java, so we use Eclipse software as the main development tool [12]. Eclipse is a famous free integrated development environment (IDE). The software itself is written in the java development language, so it has excellent cross-platform characteristics. The BM Company originally created Eclipse as commercial software. Its source code will be made public in 2010 and contributed to the open source community [13]. With the support of the Eclipse Foundation and the open source community, Eclipse software has become the preferred development tool for many software developers because of its rich functional features. Because of its lightweight software organization architecture, Eclipse can use rich plug-ins to extend its functions, so it has strong flexibility. This paper uses Eclipse 44 (Lua) as the system development tool.

2.2. Optimization of System Software Function Structure

The pattern creative design system based on the Internet combines iterative function, SVG (Scalable Vector Graphics) vector technology, and iterative function platform technology and realizes the vector pattern creative design function under BS（Black-Scholes）mode through the data sharing service provided by the database. The functional architecture of this part is shown in the Figure 5

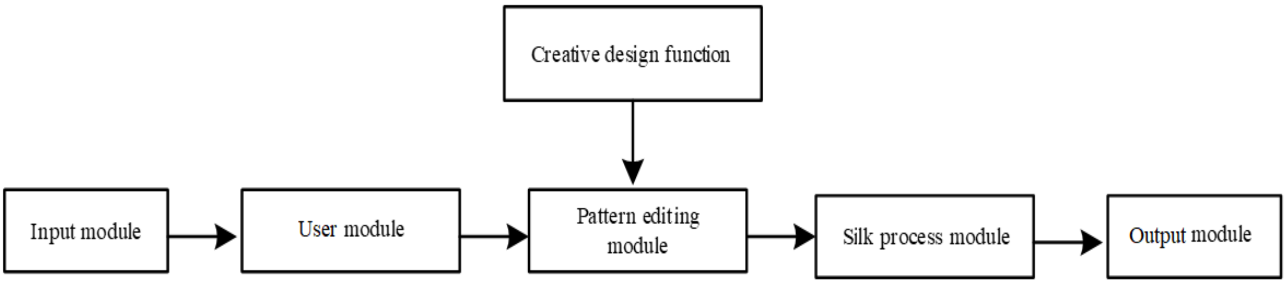

Figure 5.
System function architecture.

As the core function module of the system, the pattern design function has the following characteristics: the process characteristics of a textile pattern, good human-computer interaction and clear functional logic [14]. The vector diagram can be directly exported to facilitate the later process. The rich textile pattern unit library, the creative design function of pattern, and the function distribution of creative design of pattern are shown in the Figure 6.

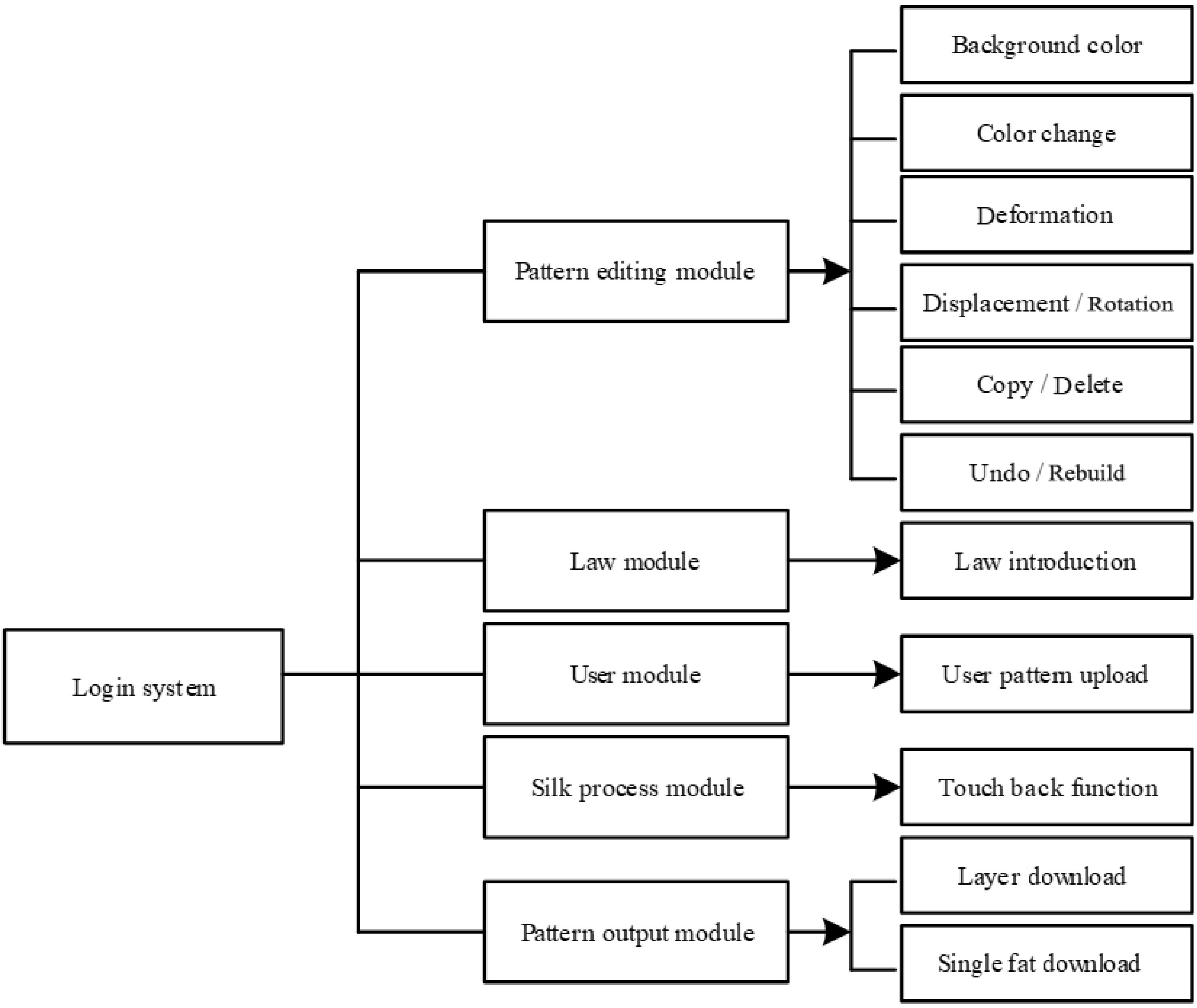

Figure 6.
Creative design function system of system pattern.

Iterative function system is an important branch of fractal theory. Its basic idea is that a fractal has self-similarity between local and whole, that is, local is a replica of the whole, but it is different in size, position, and direction. Ifs system regards the image to be generated as a collage of many self-affine small blocks similar to the whole (self-similar) or similar to the whole after certain transformations. Iterative function system has great advantages in computer simulation of natural scenery [15]. It can simulate various natural landscapes, such as plants, mountains, rivers, clouds, and smoke. Iterative function is also called a string rewriting system. An iterative function includes the following concepts: character table: the set of characters with different meanings (such as l and R) in an iterative function, represented by V. Axiom: also known as initial element, it is a string composed of characters in the character table, or the word "words" is represented by W. production: also known as rewriting rule, it refers to a character or string (W) from the characters in the character table.

It is expressed as P: a → W, w can be an empty word or a itself; turtle shape: the drawing method of the iterative function can be shown by the turtle's movement on the beach in two dimensions. At each point in its movement, the state is given by the current position vector t and the forward direction angle a (T,a). The drawing method is: "F": step forward in the current direction and draw a line; "F": step forward in the current direction without drawing a line; "+": rotate an angle counterclockwise. "": rotate an angle clockwise. "[": press the current information on the stack. "]: push the" ["time information out of the stack 2. Assume that the letters L and R form the string V, and do not limit the times of L and R in the string v. The letters L and R correspond to their own productions, also known as rewriting rule [16]. For example, the production l → LR corresponding to the letter L indicates that the character LR is used to replace L in the next rewriting; the production RL corresponding to the letter R indicates that l is used to replace r in the next rewriting. Suppose that the axiom of the rewriting process is the initial element 0 of rewriting, and l represents 5. The rewriting process is shown in Figure 7.

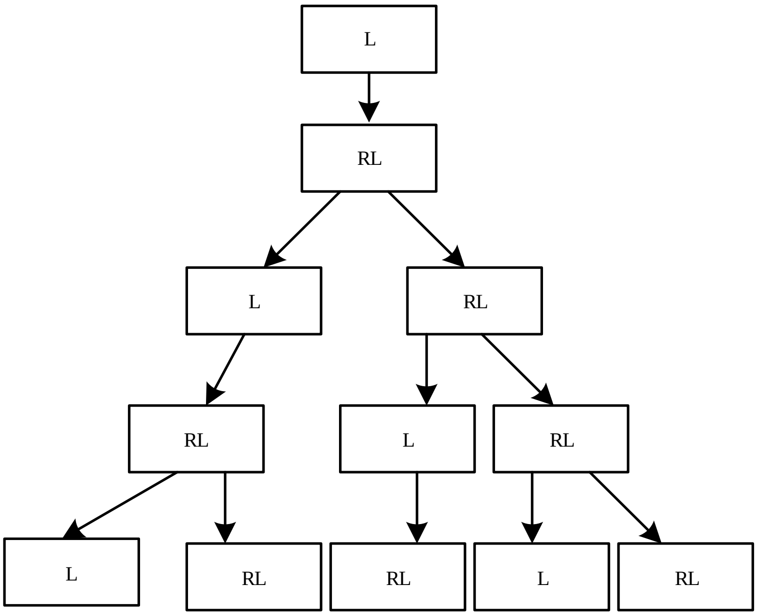

Figure 7.
Schematic diagram of rewriting 4 times.

The generation process of an iterated function fractal image is the process of string rewriting. The fractal graph of a conventional iterative function involves several basic concepts: rewriting, character tables, axioms, and production. An iterated function fractal graph is made by expressing the first part of the graph with a character table and string, which is called an axiom. Then, the set rules are used to replace the axiom characters in the right order. Repeat this process to obtain the iterated function fractal graph [17]. We choose an example to describe the composition mechanism of the fractal graph of an iterative function. Use the ternary formula *L*=<*V*, *P*> to express the constructed things. Take the symbol set *V*= {*F*,10,-1}, "*F*" represents the line segment of predetermined unit length drawn horizontally to the right and the rotation angle *α*= 60 °, "+" means 60 ° to the right, and "" means 60 ° to the left. If the starting symbol element *w*=*f*, the rule set P= {*f*→*FF*++*f*-*f*,+one} is generated, and the recursion depth is n, the Koch curve can be generated. As shown in the Figure 8.

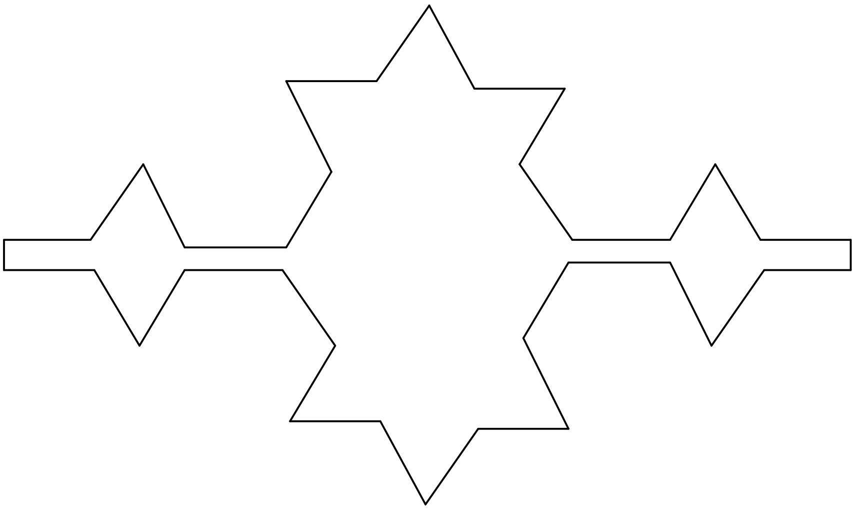

Figure 8.
Koch curve of textile pattern.

Iterative functions are used to simulate plant morphology. Later, as people learned more about fractal geometry, its geometric meaning was added to the description of plant morphology, making the iterative function more complex [18]. The basic composition principle is to use a ternary formula to represent the object to be constructed Equation 1.

$$L=<G,W,P> \quad (1)$$

Among them, G is a character set, which is composed of" F ", "[", "]", "+", "-" and other characters. They are graphic commands used to interpret strings; W is the starting symbol element to determine the starting state of the string, and P is the generation rule set. When generating a fractal pattern, everything is carried out according to the instructions of *G*: *F* means one step forward; "[" means to save the current state; "]" means to pop up and return to the original state; "+" means running a certain angle in a clockwise direction; "-" means running a certain angle counterclockwise. In the ternary formula

$L = <G, W, P>$, there is only one P, that is, there is only one rule, which is the iterative function of a single rule [19]. The iterative function of a single rule without branches, that is, the generated fractal graph has no branches, and there is no "[,]" in the rules. Compared with the branchless iterative function, there is "[]" in the branching iterative function rule. Set initial angle θ= 0 °, angle increment δ= 60 °, koch curve single regular iterative function is expressed as Equation 2:

$$\begin{cases} \omega : F\delta \\ P : F\theta \rightarrow F - F + + F - F \end{cases} \quad (2)$$

Set the initial angle to $\theta = 0$ °, angle increment $\delta = 90°$ The multi rule iterative function of 90 ° wreath fractal image is expressed as Equation 3:

$$\begin{cases} \omega : FXF \\ P1 : H \rightarrow XYXYX \\ P2 : X \rightarrow FX + FX + FXFY - FY \\ P3 : Y \rightarrow +FX + FXFY - FY - FY \end{cases} \quad (3)$$

Note: The characters XY and F represent the same meaning, that is, move forward and draw a line. Set the initial angle to θ= 0 °, the angle increment δ= 60 °, Peano curve multi-rule iterative function is expressed as Equation 4:

$$\begin{cases} \omega : X \\ P1 : X \rightarrow X + YF + + YF - FX - FXFX - YF \\ P2 : Y \rightarrow -FX + YFYF + + YF + FX - FX - Y \end{cases} \quad (4)$$

Although the material forms in nature have certain laws to follow, they are not fixed and have certain morphological randomness. No two plants in the world grow in exactly the same way. Therefore, from the perspective of simulating the effects of plants, under the premise of retaining the main characteristics of things, in order to achieve detail and visualization, random iterative function is introduced [20]. In the L-system, step V and angle increment ω and rewriting rule P can be random. Through the random selection of rewriting rule P_i, a more vivid and natural fractal pattern can be generated. The advantage of this is that the simulation effect is more vivid and realistic, which is closer to the real shape of things. The random iterative function is an ordered set of four elements, and its expression is Equation 5:

$$G = \{V, \omega, P_i(i = 1, 2, \cdots, k), \pi(P_i)\} \quad (5)$$

Where d_1, d_2, d_3 and ternary formula are the same, where p is a randomly generated rule set, m (P_i) is a function representing the probability of each rule being called, and there is *a* (P_1) +*a* (P_2) +...+a (P_l) =1. In a determined iterative function, each letter representing the precursor (*L*, *F*, *F*, etc.) has only one determined successor, that is, the rewriting rule. Each different letter symbol in the string is replaced by the corresponding rewriting rule? Many drawing software programs can automatically generate patterns of cloud effect. The color of the cloud pattern is different in depth and soft in transition. This characteristic of cloud pattern is similar to the color halo effect caused by different dye penetrations in the tie dyeing process. Therefore, a cloud formula can be used to simulate the color unevenness and halo effect in tie dyeing pattern. The simulation of cloud generation using the fractal generation algorithm. For a given cloud contour polygon m (X_i, Y_i, Z_i), 0, 1... *N-1*, e polygons can be generated after e-sublinear transformation. For each linear transformation, assuming that the point before the transformation is (a, b, c) and the point after the linear transformation is $p(x', y', z)$, the linear transformation equations are Equation 6:

$$\begin{bmatrix} x' \\ y' \\ z \end{bmatrix} = \begin{bmatrix} a_1, & b_1, & c_1 \\ a_2, & b_2, & c_2 \\ a_3, & b_3, & c_3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \quad (6)$$

The vertex values of several clouds with polygons are subject to translation transformation, rotation transformation, scale transformation, etc., and equations with similar formulas are generated. According to the obtained equations, the coefficients *C* (*a*, *b*, *C*, *d*) *j*=1, 2, and 3 in the equations can be determined. Each coefficient can be obtained by solving the simultaneous linear equations. After e different transformations, the cloud geometric model generated by the fractal iterative algorithm generates e polygon models and also obtains e groups of different linear transformation coefficients, C_I, *I*=0, 1, and E_{-1}. In order to ensure the convergence of the iterative set, each linear transformation must be set as a compressed proportional transformation, and each group of linear transformations must be set with a probability P. It is used to represent the probability of e cloud geometric models in a fractal dimension image, where *I*=0, E_{-1}, and make it meet the following conditions in Equation 7:

$$\sum_{i}^{E} P_i = 1 \quad (7)$$

In the random iteration function, there are several different generation rules for the same letter symbol; that is, the same precursor letter corresponds to several different successors. When the program runs, which one will be replaced depends on its probability distribution x (P_i). In programming, the rewriting rule is determined by generating a random number. The random iterative function takes into account the influence of random factors in the formation process of plant morphology, which can show the expressiveness of the iterative function. The graphics generated by the iterative function are more expressive and closer to the real state of the simulated things. The existing fractal patterns are classified according to the performance theme, style, shape, color, and composition. See the fractal pattern classification index below for the classification and display of fractal patterns, as shown in the Figure 9.

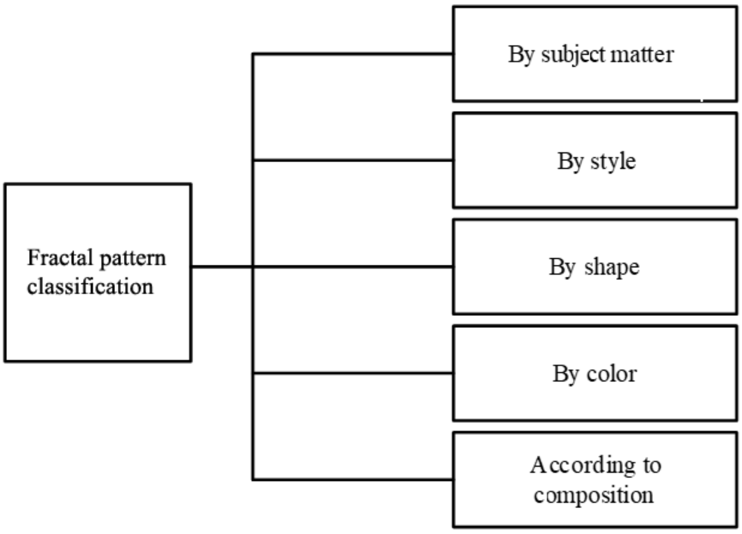

Figure 9.
Fractal pattern classification.

Fractal patterns are generated through complex programs and expressed in a series of themes that are more easily accepted and appreciated by people, such as animals, plants, natural scenery, and so on. Among them, animals and plants are the most abundant patterns in fractal patterns. In a series of fractal patterns, we found that some of these patterns are very similar to our common animals and plants, some are very similar to natural scenery, and some are very similar to geometric figures.

2.3. Realization of Textile Pattern Design

The system mainly includes three modules: the fractal pattern information module, the fractal pattern display module, and the data addition and deletion module. In the fractal pattern information module, fractal patterns are classified according to five angles, including different types of patterns, which makes it convenient for users to select the required pattern type according to their needs: In the fractal pattern display module, it is convenient for users to visually see the display of pictures after selecting the required type of pattern, so as to realize the query of entity pictures: In the database addition and deletion module, the data update function is realized. The database addition module can timely add new patterns, while the database deletion module can facilitate the deletion of old or wrong information in the database. After the design phase of the system, we designed the framework of the system, as shown in Figure 10.

The visual effect of textiles means that in the process of dyeing and weaving, the pattern with the textile effect is copied onto textiles by some method so as to achieve the same visual effect as textiles. Therefore, the visual expression of textile patterns needs to be realized through artistic creation, the reproduction of the dyeing process, and tissue processing. When analyzing visual effects, all texture effects must be applied to dyed textiles, and these texture effects must be adapted to the structure and dyeing characteristics of textiles. With the advancement of digital technology and textile technology, it has become a reality to realize the visualization of textiles through profiling technology. In recent years, in the international exhibition held in Shanghai, in addition to the traditional display materials and pattern visual effects, a variety of composite materials and new patterns have been used to make the patterns more transparent and lightweight. Digital technology and rich materials provide infinite performance space for the optimization of the visual effects of digital expression forms of textile patterns and open up a broader world. There are various cloth patterns, different patterns, and vivid textures. The biggest advantage of digital software is its convenience and flexibility. In the process of visual effect analysis of digital expression of textile patterns, there is no need to consider the output accuracy, and the graphic size can be adjusted arbitrarily.

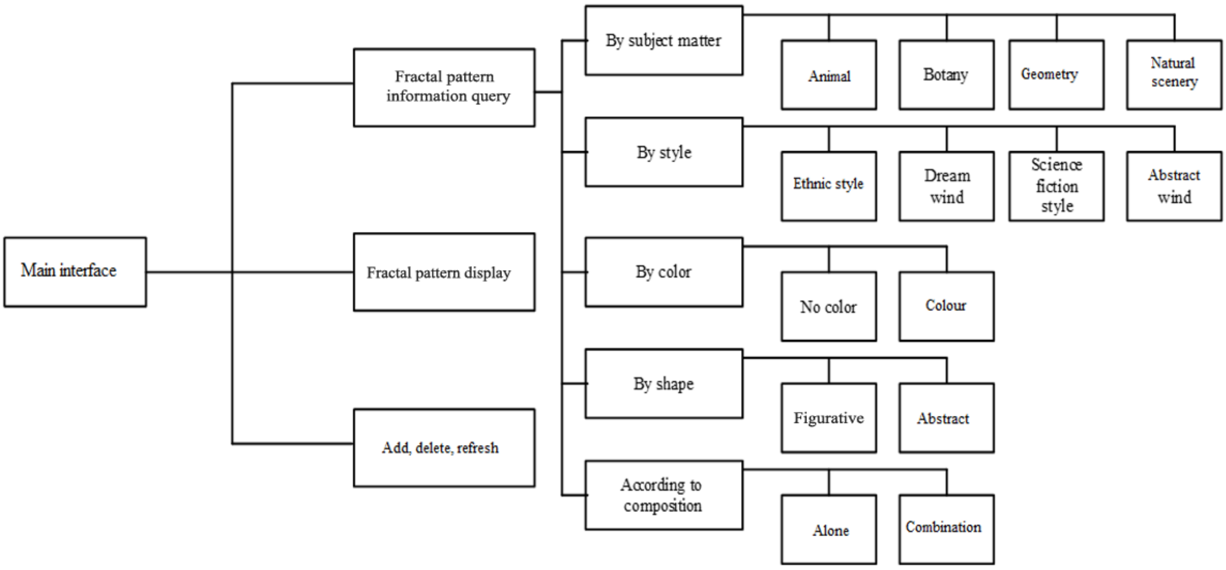

Figure 10.
Functional model of textile visual effect display.

Digital drawing software not only has small space requirements and fast operation speed but also saves a lot of design costs for designers. Using modern digital technology to quickly express the visual effect of textile pattern design and more intuitively meet the needs of pattern design is a new topic for the development of the textile industry. In the process of visual effect analysis, digital technology can be used to express the design of textile patterns. Some drawing tools, graphics, and image processing functions provided by digital technology software can be used to draw patterns directly for visual effect analysis. Scientifically select and determine textile theme patterns, such as bed patterns or visual or abstract interior patterns. Comprehensively considering the structural characteristics of textiles, select the organizational form and style of patterns, such as continuous or loose, scattered pattern points, expression methods, and colour matching, so as to improve the dryness and practicability of textile art. The practice of textile pattern design of fractal pattern mainly seeks design inspiration from the existing natural artistic style and daily life according to the artistic visual characteristics of fractal pattern, establishes a new way of artistic expression, and expounds the design practice process of textile pattern in the form of textile pattern with Chinese classical style and pastoral style as the inspiration sources.

In general, it can be expressed as looking for an inspiration source, selecting fractal graphics as material, comparing inspiration sources, carrying out an overall design conception according to the inspiration source, carrying out secondary design by using computer drawing software such as Photoshop, extracting design elements, making local adjustments to element composition, arrangement, and colour matching, and applying patterns to different kinds of textiles to simulate 3D effect drawings. Pattern is a comprehensive art covering a wide range. It has strong decoration and practicability in the process of practical application, enriching and beautifying our living environment. The composition of pattern refers to the organizational form of pattern in composition, which varies greatly from the content and purpose of pattern, so the organizational form of pattern also has its own characteristics. Different patterns have their own internal structures and skeletons, which need to be implemented according to different process materials and production conditions so as to obtain beautiful effects. Pattern is the basis of design. Under different historical conditions, it reflects human understanding and pursuit of aesthetic feeling. At the same time, various social, economic, and cultural living circumstances will both encourage and restrict the expression of patterns. Various pattern organization forms are gradually used after people's continuous practice and summary. Patterns are widely used, mainly decorative patterns and practical patterns such as architectural furniture decoration, textile clothing, trademark logos, and craft gifts. According to different application fields, pattern forms are mainly divided into the following categories: Table 1.

Table 1.
Composition of patterns.

Composition form of pattern		
Continuity	Two room continuous	Scattered type, overlapping type, disconnection type, horizontal type, etc.
	Tetragonal continuity	Grid type, scattered point type, overlapping type, and connected type
Discontinuity	Separate pattern	Rule classes and irregular classes
	Suitable pattern	Corner fit, edge fit, shape fit
	Filling pattern	Circle fill, triangle fill, square fill, polygon fill
	Decorative belt	Discontinuous banded pattern

As one of the decorative elements in people's daily lives, pattern plays a very important role, especially in the fabric pattern design of textile clothing. A successful pattern design, if used properly, can not only convey the external beauty of the pattern but also highlight the deep connotation of the pattern. According to the comprehensive characteristics of pattern forms, the organizational forms of textile patterns include both continuous forms and discontinuous forms. There are four commonly used patterns: two-way continuous, four-way continuous, single pattern, and suitable pattern. The composition form of the fractal pattern used in textile fabric design must also follow the principles of this kind of composition. In the process of pattern presentation, a fractal pattern has its own unique structure (parts are similar to the whole to form contrast, layers are nested with each other to form symmetry, and repeated iterations give colour changes). When reproduced in textile fabric, it can show a special artistic beauty. Different pattern forms have different application modes. Based on the different features of pattern composition forms, it is important to improve and summarize the composition forms of fractal pattern elements in textile fabric design and look for a better way to use them.

3. Analysis of Experimental Results

The experimental platform used in this paper is cpuintel e5-2637v4 (Intel Corporation of the United States), gpu4 × NVIDIA titanx (American NVIDIA company), and Ubuntu 16.04 lts system (canonical company). The model construction is based on the deep learning framework keras (the back-end compiler is tensorflow) and uses the programming language python. Considering that solving the problems of small samples and miscellaneous specifications of traditional patterns is also one of the important research directions of this paper. The training sample set contains 500 textile patterns of different sizes and specifications. The pattern automatic preprocessing module is set in the model, so the training sample patterns do not need manual preprocessing preparation.

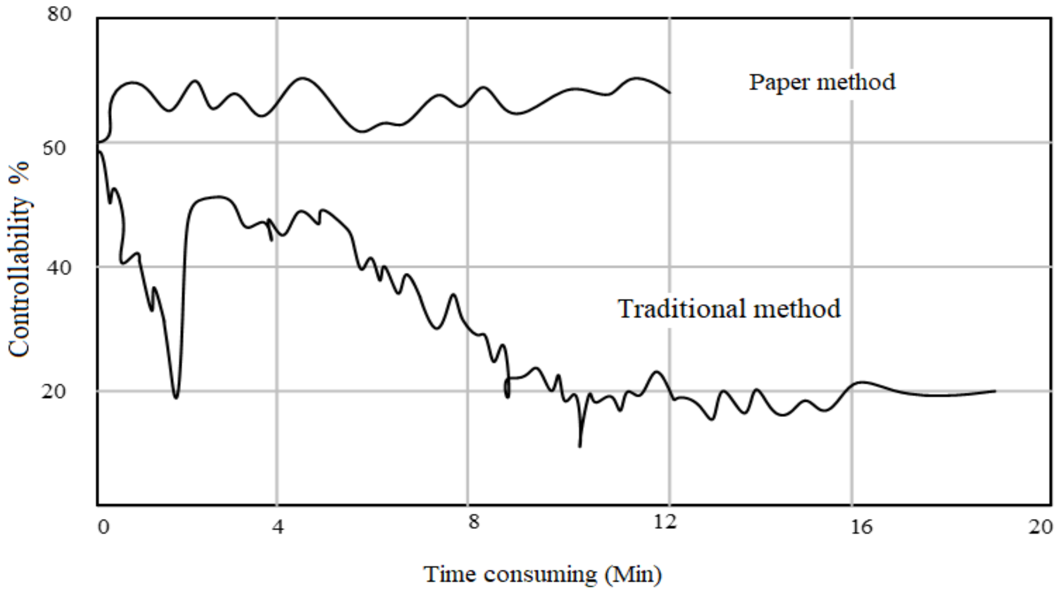

Figure 11.
Comparison test results of system operation effect.

Compared with the traditional textile pattern development methods, the method proposed in this paper shows obvious efficiency, controllability, and sustainability. Compared with deep learning principles such as fractal art, uniform random network, topology, and other deep learning models such as DBM（Deep Boltzmann machine, the model built in this paper has greatly improved its performance, which is related to the advanced nature of the network itself, as shown in the Figure 11. Considering the subjectivity of the artistic creation of textile pattern digital generation, this paper not only makes an objective comparison experiment on the model but also sets up an artificial subjective evaluation experiment. There are 50 respondents in this experiment, including 30 design-related practitioners with a bachelor degree or above and 20 non-design-related practitioners. The experiment distributed 50 experimental samples of traditional calligraphy and textile patterns to the respondents. The 50 experimental samples were composed of 25 designer-created patterns and 25 model simulation development patterns. Without knowing the composition proportion of the two types of patterns, the experimental respondents discriminated and classified each picture, and finally calculated the accuracy of the discrimination results. The results are shown in Table 2.

Table 2.
Experimental results of textile effect discrimination and evaluation.

Correct rate /%	Number / Person	Proportion of people /%
100~80	2	2.00
80~60	6	10.00
60~40	43	85.00
40~20	3	5.00
20~0	0	0.00

The accuracy rate of respondents' judgment of pictures is mainly concentrated at 40% ~ 60%, and the number of people in the region accounts for 84.00%, and they show more uncertainty and guess judgment in the test process. The majority of respondents, including design professionals, were unable to tell the generated pattern from the real pattern, demonstrating the high level of authenticity of the traditional calligraphy textile pattern this model generated. Four images are selected as samples. These images all have texture-spectrum features. The impact of this feature on the image information retrieval experiment is shown in Table 3.

Table 3.
Comparison of image accuracy.

Selected pattern	Paper method		Traditional method	
	Image integrity rate %	Image accuracy %	Image integrity rate %	Image accuracy %
Textile pattern 1	97	99	79	77
Textile pattern 2	97	98	82	79
Textile pattern 3	96	96	82	72
Textile pattern 4	96	99	80	75

It can be seen from the table that the intactness and accuracy of textile patterns have been significantly improved under the guidance of this sub method. A new colour correction method for inkjet printing is proposed. The first step is to use programs like Photoshop or Illustrator to determine the original pattern's lab color value. After the pattern is printed on an inkjet printer, the lab colour value of the printed sample is tested by an x-rite 8400 colour measuring and matching instrument, and the colour difference value is calculated by the colour difference formula. Then, the data analysis function of Excel is used to establish the regression equation of the lab value before and after printing. Obtain the colour difference law of the sample under the same printing conditions, correct it according to the fitting equation, and finally control the colour difference of the pattern within 1 nbs through repeated testing and correction so as to meet the needs of inkjet printing. The following samples with 15 different colours are verified by this method.

Table 4.
Color comparison between original and sample.

Number	L_0	A_0	B_0	L_1	A_1	B_1	ΔE
1	1	4	-17	19.59	1.88	-2.85	22.87
2	3	12	4	20.93	5.15	2.63	18.97
3	8	-17	12	23.46	-8.65	4.42	18.73
4	9	37	-59	24.28	11.43	-19.33	48.65
5	20	55	-88	26.78	14.32	-28.09	70.09
6	22	42	33	39.93	45.78	31.06	19.55
7	23	-5	31	21.78	-1.05	3.58	26.75
8	33	0	0	40.78	5.46	-6.48	12.18
9	39	-42	43	45.48	-45.73	22.78	21.18
10	39	63	55	48.59	62.73	43.26	15.2
11	45	-9	50	53.88	-6.69	41.15	13.48
12	63	0	0	74.65	4.65	-1.88	13.61

The "data analysis" function of Excel is used to establish nonlinear regression. Since the regression equation in Excel is linear regression, it is necessary to convert nonlinear regression into linear regression. The values of l0, a, and B in Table 4 are the values corresponding to the original pattern, and the values of L, A1, and B are the color values tested by the x-me8400 Ashley colorimeter after printing on the fabric. In order to establish the relationship between the color value after printing and the color value of the original pattern, take L, A0, and B as regression values and l, a and B1 as independent variables to establish regression equations, respectively. A ternary quadratic equation can describe the regression equation since there are three independent variable parameters. In texture pattern creation, in addition to the above regular pattern design rules, there is also a texture pattern with an irregular texture pattern. The texture constituent units of this pattern are usually randomly distributed in the picture. Therefore, it is difficult to grasp its design law. However, the development of modern computer technology provides convenient conditions for it. The fractal pattern created based on fractal theory perfectly integrates science and art. These patterns are based on mathematical algorithms and rules, which not only show the rigor of science but also show the complex beauty of art. The introduction of these patterns can not only greatly enrich the design types of textiles but also shorten the design cycle. In addition, they also break the human conventional thinking mode to a certain extent and provide designers with the opportunity to broaden their thinking and vision. This helps designers develop new creative resources and use them as an entry point for the design of the textile industry to inject new vitality into textile art.

4. Conclusion

The fractal pattern created according to fractal theory is a perfect combination of science and art. These patterns are generated by mathematical algorithms and rules, which not only show the rigor of science but also show a complex artistic beauty. They can greatly enrich the pattern types of textiles and shorten the cycle of pattern design. At the same time, these patterns also break people's habitual thinking to a certain extent and broaden the thinking and perspective of designers. This is conducive to the designer developing new creative resources and, as a starting point for the textile industry pattern design, for the textile art to bring new vitality.

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