The Application of Digital Printing Technology in Garment Design
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**Abstract.** The current policy of the Conversion of New and Old Kinetic Energy in China. The vigorous development of the computer image recognition technology, as well as the growing diversity of the clothing demand, make the development of digital printing technology more and more urgent. Based on digital image processing, computer image recognition, fractal algorithm and ICC color management illustrates the principle of digital printing and technical advantages. The application of digital printing technology in design elements such as pattern, color, fabric and style is analyzed. And the future development trend of digital printing technology is forecasted.

**Introduction**
In recent years, the booming development of computer technology and digital technology has promoted the improvement of textile and apparel industry, especially the development of digital printing technology has become more prominent under the current policy of the conversion of New and Old Kinetic Energy in China's industry and differentiated clothing demand. Digital printing, with its unique advantages of color richness, pattern diversity, high product identity and process saving, meets the quick reaction mode of clothing industry, which many varieties, small batch, short cycle and quick delivery. For example, "fast fashion" clothing brands such as H&M and Uniqlo. The development of digital printing technology not only conforms to the policy of the conversion of New and Old Kinetic Energy, but also promotes the development of "green textile".

Therefore, the principle and technical advantages of digital printing are analyzed based on digital image processing, computer image recognition, fractal algorithm and ICC color management. The development trend of digital printing is predicted based on the current application of digital printing in clothing design.

**Principle of Digital Printing Technology**
Digital printing[^1] refers to using the principle of computer image recognition to input the image taken or scanned into the computer in the form of digital. Then the image processed by the color tracing system is translated into lattice information by the RIP[^2] and transmission to the digital printing machine. Finally, a printing method of printing pattern is obtained by controlling the piezoelectric ink-jet nozzle[^3] to press the ink on the fabric through the process of heat transfer treatment and so on. The combination of digital image processing technology, computer image recognition, digital fractal algorithm[^4] and ICC color management[^5] enables the complete and clear presentation of digital printing patterns and colors on fabrics.

**Digital Image Processing**
Digital image processing is to first by the digital camera, scanner and other equipment after sampling digital image, and then through the image smoothing, image sharpening, gray level transformation process such as pretreatment of image noise reduction optimization. At last, the image after pretreatment is operated with such operations as gradual change, linear deepening, as well as filter superimposed with layers and channels, digital array combination, parameter transformation and other art design methods to obtain a variety of artistic effect patterns. Among
them, the image with different effects can be obtained by the combination of the filter and layer, as shown in figure 1[6].

![Figure 1](image.png)

Figure 1. The metal (a) and lace (b) effect produced by the combination of the filter and layer.

**Image Recognition**

The preprocessed image features are represented numerically by computer programming, that is, the extraction process of image features. For example, the contour of the image can be represented by the perimeter and area, the color depth change of the image can be represented by the difference between the wave peak and the wave trough in the color histogram. At present, neural network method, statistical method and other image recognition algorithms can be used to characterize. Through the computer image recognition can be a complete and clear identification of oil paintings, scenic pictures, abstract geometry what printing pattern material.

**Fractal Algorithm**

The fractal algorithm is applied to the effect of printing patterns showing the characteristics of surrealist art in digital printing. In essence, fractal has internal regularity, multiple self-similarity, fine mathematical structure and precise numerical calculation. The digital fractal pattern can be realized by rewriting the rule and turtle graph method of L System[7], by changing the mapping coefficient of the Iterated Function System after the compressed mapping, and by iterative transformation of the complex function number of Escape Time Algorithm[8] to generate the digital fractal pattern. The digital fractal pattern breaks the traditional restriction of pattern, composition and color, and creates the changeable digital fractal geometric modeling to meet the diversified demands of the market.

**ICC Color Management**

The core of ICC color management is the application of CMM algorithm[9] and reproduction intention for color space conversion, to convert color space to intermediate color conversion space and target color space. In order to solve the problem of color compatibility between input image and output image caused by the difference of color mode and color space between display and digital printing machine, digital printing patterns and colors can be clearly presented on the fabric. Among them, color management, linear calibration and use of colorimeter to generate ICC characteristic curve are essential.

**Technical Advantages of Digital Printing**

Digital printing technology has the advantages of diversified printing patterns, high efficiency of printing production, environmental protection of production process and strong market competitiveness.
Pattern Diversity

By computer image recognition technology and digital image processing technology, the clear images of easy to identify. With the help of design software and fractal software, the image particles are exquisite, the color is lifelike, the transition color is more natural, the line shape and contour of the pattern are clearer, and the color separation degree is more obvious. At the same time, the restriction of pattern and color collocation is broken, by means of segmentation, recombination and other design methods, the diversification of pattern layout is realized.

Environmental Protection and Efficient

By digital printing technology, the process of proofing and sealing was simplified, the production process of scratch printing, drawing and color mixing paste and so on is eliminated, which shortens the production cycle. The equipment of digital printing covers a small area and saves production space. Automatic operation saves labor cost. The dye is sprayed directly on the fabric, which reduces the possibility of waste water pollution and realizes the efficient production of environmental protection.

Industrial Competitiveness

The data in the computer system is free from the worry of inventory, which can guarantee the reproduction of printing, strong identity between products, small color difference, and the pattern and color produced by digital printing technology is difficult to imitate, thus guaranteeing the market competitiveness of original brands. It can undertake order of short version, custom-made printing, so it takes absolute advantage to occupy the clothing market of many varieties and small-amount.

Application of Digital Printing in Garment Design

In 2004, the British brand "Basso & Brooke" applied digital printing technology to garment design for the first time. Up to now, digital printing technology has been integrated into design elements of clothing style, color, fabric, pattern and so on. Thus obtain the novel and the individuality digital printing clothing, has become the frequent trend.

Pattern

Based on the principle of Digital Fractal Algorithm, Fractal Designer Painter, Fractal Explorer and other fractal software were used to design patterns, layouts and colors of patterns. Can be used to plane composition, two square continuous, four square continuous to design diversified printing patterns. Mary Katrantzou, known as the "queen of digital printing", adopted two-square continuous and quadrilateral continuous composition method to match abstract geometric patterns in the 2017 fashion show of haute couture, which produced dizzying visual effects and won the attention of the audience.

Color

With the help of Photoshop, CorelDraw, Painter and other image processing software, use techniques such as gradient, rendering and filter to make digital printing with high definition, high color saturation and delicate image particles. Color should accomplish match color to coordinate, cool and warm comfortable, and need the popular trend that combines color, tie-in popular color adorns, cater to dress aesthetic trend on color, also can raise visual appeal by increasing color contrast.

Fabric

Digital printing technology is combined with Seamless Splicing Technology, 3D Printing Technology and many other technologies, by distributing large areas of printed patterns on the garment surface, or in the center of the chest and back to print a separate pattern, as well as in the collar, sleeve and other small areas of dotted printing. Then, the fabric is designed twice through the
technological methods of layering, folding, splicing, hollowing-out, tassel, polishing \[14\] to realize the diversification of digital printing fabric.

**Style**

CorelDraw, Painter, CAD and other drawing software are used to design the external profile and internal structure lines of the clothing, mainly adopts the garment profile type A, H, X, Y, O and so on, as shown in figure 2 \[15\]. The collar type adopts shawl collar, lapel collar, one word collar, without collar and other new collar type. The sleeve type has sleeveless, single sleeve, etc. Combine these styles with the design elements such as fabrics and patterns to make the digital printing clothing style diverse and varied.

![Figure 2. The main type of garment profile.](image)

**Digital Printing Technology Forecast**

Digital printing technology will develop towards intelligence and chain. The development of digital printing technology is closely related to the development and update of computer image recognition technology, digital image processing technology, professional software and supporting facilities. The future direction of development includes realize the intelligent industrial chain mode of clothing from design to production. With Customer to Business model linked together, realize the intelligent production of virtual products to real products. Combined with Seamless Splicing Technology, 3D Printing Technology and other technologies, the high-tech content of clothing, such as scientific nature and defensive war, increases the added value of clothing and extends the industrial chain.

**Conclusion**

Digital printing technology based on computer image recognition, digital image processing, digital fractal algorithm, ICC color management and other aspects of digital printing pattern recognition and processing, to the greatest extent, the image of digital printing is presented completely and clearly on the fabric, and the digital printing technology is applied to the design of clothing pattern, fabric, style, color and other elements, which makes the garment production diversification and individuation. Conform to the many varieties, small batch, short cycle, fast delivery mode of apparel industry, promote the development of "fast fashion" clothing brand.

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