
Development of Art Fashion by Integrating Digital Art and Digital Textile Printing

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Abstract

Fashion and art are essential elements of human life because they enrich people's daily lives. As art has a business model of small-scale production and fashion has a business model of mass production, there was no point of contact between the two. However, these two areas are approaching with the spread of digital art in the art world and the emergence of digital textile printing technology in the fashion world. Combining digital art and digital textile printing creates new possibilities for art to enter our everyday life as art fashion. This paper describes our attempt to create fashion from digital art under the concept of "wearing art" through joint research between a university and a company.

Keywords: Digital art, Digital textile printing, Art fashion

1 Introduction

The introduction of digital textile printing technology has emerged in fashion [1][2]. For a long time, garments have been made by analog methods such as manual design production, textile printing, and sewing [3]. Digital textile printing seeks to digitize the printing process. This technology can significantly change the entire fashion production process. On the other hand, artists have mainly created artworks by hand in the art world. Recently artworks using digital technology have become widely recognized [4]. Digital art is art created by using a computer instead of manual painting. As a video art creation method using a computer, artworks using CG (computer graphics) have become popular [5][6]. On the other hand, some artists, such as Naoko Tosa, one of the authors, use much digital technology but have been obsessed with the production method of using natural phenomena instead of CG [7].

By combining this digital textile printing and digital art, there is a possibility of innovating the world of art and fashion. We are conducting joint research based on industry-academia collaboration to realize this. This paper describes the detailed process of developing art fashion by integrating art and fashion.

2 Digital Textile Printing of Clothes

It is necessary to carry out so-called dyeing to color the raw material fabric when making fashion products. There are two types of dyeing: "dyeing [8]," in which the fabric is dipped in a dyeing solution, and "printing," dyes and pigments are printed and fixed on the fabric. Printing is usually used when it is required to draw a detailed design on the fabric and is a traditional method of drawing patterns on fabric by hand. There are two methods. One is to draw on the fabric one by one. In developing high-class Kimonos [9], drawing patterns by artisans is still used. The other is to make a textile screen that corresponds to the design and then pour the dye into the screen, enabling mass production.

In contrast to the conventional analog printing method described above, a printing technology that incorporates digital technology has been born. This method is called "digital textile printing" [10][11]. Digital textile printing is a technique for printing various designs and images on fabric. Various methods have been conventionally developed for printing high-quality digital images on paper [12][13]. Although there are differences in the properties of paper and fabric, the purpose of printing various color patterns and fixing them is the same. The ability to print on fabrics by developing inks suitable for textiles made digital textile

printing technology development possible.

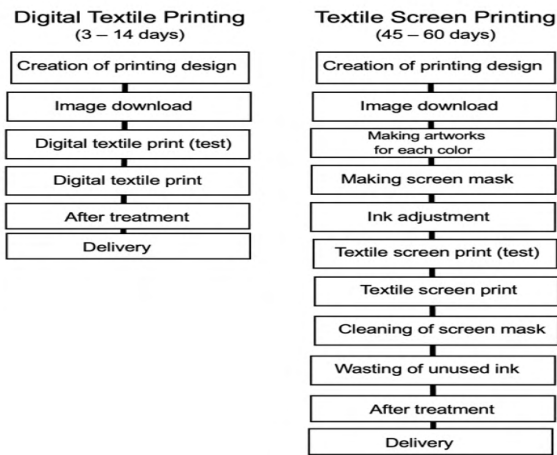


Figure 1: Comparison of digital printing and analog printing processes [11].

The printing method for the paper includes an inkjet method and an electrophotographic method [12]. Also, the printing method for fabric includes a direct inkjet method and a thermal transfer method [10]. In the direct inkjet method, pigments and dyes are treated as ink, and ink particles are directly sprayed onto the fabric for dyeing. Printing on silk, polyester, rayon, cotton, etc., is possible using different inks. On the other hand, the thermal transfer method uses a sublimable dye. It utilizes the fact that the dye vaporized by heating enters the polyester fiber and exhibits a color development reaction.

Figure 1 compares the analog printing and digital textile printing processes. While the analog printing process requires 45 to 60 days, the digital printing process takes only 3 to 14 days, making it possible to reduce the process significantly. In digital printing, the fact that there is no need to create the printing plate required for analog printing has the merit of significantly reducing the process.

Digital textile printing has the characteristic that it is suitable for low-volume, high-variation, and short-delivery production. At the same time, analog printing requires much water to clean the textile screen [14], and there is a problem with waste ink. As digital textile printing does not have such a problem, digital textile printing is expected as a technology that can contribute to reducing the environmental load.

3 Digital Art "Sound of Ikebana"

One of the authors, Naoko Tosa, found that fluids create a flower-like shape by giving sound vibrations to the fluids such as paints and shooting them with a high-speed camera. This method is an art production using a fluid phenomenon. The behavior of fluids is an essential subject of physics research, and research has been conducted under "fluid dynamics [15]."

It has long been known that fluids produce stunning shapes under various conditions. A typical example is the well-known "milk crown [16]." Since beauty is a fundamental art component, it is natural to consider fluid dynamics as the basic methodology for art creation [7].

Figure 2 shows the fluid art production system. When the speaker is placed face up, a thin rubber film is put on it, a fluid such as paint is placed on it, the speaker is vibrated by sound, the paint jumps up, and various shapes are created.

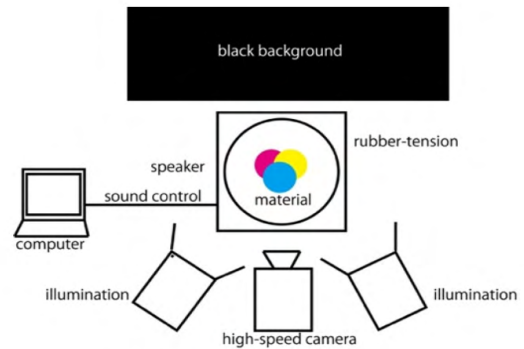


Figure 2: Fluid art creation system (top view).



Figure 3: A scene from "Sound of Ikebana."

Tosa confirmed that various fluid shapes are generated by changing the shape of sound, frequency of sound, type of fluid, viscosity of the fluid, etc., using this environment [17]. In addition, she edited the obtained video to match the colors of the Japanese seasons and created a digital art called "Sound of Ikebana [7]." Figure 3 is a scene from the artwork.

In April 2017, as part of her Japan Cultural Envoy's activities, she exhibited the Sound of Ikebana at Times Square in New York using more than 60 pieces of digital signage. When she exhibited the Sound of Ikebana around the world as a Japanese Cultural Envoy, many overseas art-related people said, "Tosa's digital art, which is expressed in an abstract form, expresses beauty that Westerners have not noticed until now, and that is the condensation of Japan's consciousness and sensibilities." After discussing this idea with many Japanese art critics, curators, researchers, etc., many people agreed.

This shows that the Sound of Ikebana is a work that touches the core of art. Based on this, she has been trying to create new shapes. She has been using a newborn baby's voice and

an Olympic athlete's voice as sound sources. Also, she has been challenged to make the Sound of Ikebana under microgravity [18]. Therefore, applying the Sound of Ikebana as the design content for art fashion is adequate.

4 Integration of Digital Textile Printing and Digital Art

4.1 Basic Concept

Digital textile printing is suitable for small-quantity production, as mentioned before. In this case, what design is printed on fabric is fundamental for digital textile printing technology and the fashion business.

Digital art can make many copies because it is easy to copy, which reduces its value as art. Therefore, in digital art, a strategy has been taken to maintain or increase the value of art by selling a limited number of copied works. For this reason, digital art is usually exhibited in museums and galleries and is the subject of collection by art collectors, just like traditional art. Therefore, the art and the apparel industry, which mass-produces and sells fashion using the same design, have been considered different worlds.

However, with the advent of digital textile printing technology, the business possibility for small-quantity production and sales has emerged in the fashion world. This small-quantity production/sales concept is the primary driving force for connecting digital art and digital textile printing. Furthermore, the connection of art with fashion means that ordinary people can wear art as clothing in their daily lives. Since art is an item that exists only in the world, it has been only exhibited in museums and galleries, so it was difficult for art to permeate the public beyond a small number of art lovers and collectors. The fact that art can be linked to fashion means that art, that has been closed to the little world of exhibitions at museums, galleries, and the collections of art collectors, will be more widely incorporated into the public.

Also, the connection with art opens new possibilities for the fashion world. Until now, fashion has been premised on having a copy. Therefore, even expensive clothing has been treated as a consumable item. The fact that art becomes fashion means that clothing, a consumable item, will improve its position as art.

Overturning the conventional concept that clothing is a secondary value, we aim to increase the value of people's life by "wearing art" in their daily lives and leading a prosperous life. This way, the connection between digital art and digital printing is a win-win relationship.

4.2 Realization of Art Fashion Using "Sound of

Ikebana"

Based on the concept described in 4.1, an attempt led by Naoko Tosa to apply her art represented by the Sound of Ikebana to fashion started as joint research between academia and industry. Applying digital art to fashion is the first experience for us who belong to a university or a company. However, to fully utilize the feature that digital textile printing requires a shorter time than analog printing, we started joint research to complete joint research between Kyoto University and Seiko Epson. Specifically, the following environment and processes were created and carried out.

4.2.1 Development of Art Fashion Creation Environment

As mentioned earlier, there are two types of digital printing, the direct textile printing method, and the thermal transfer method. We adopted the thermal transfer method suitable for small-quantity production because it does not require post-treatment such as drying. Seiko Epson installed an inkjet printer for sublimation transfer (Epson Sure Color F6350, Fig. 4: left) and a thermal transfer device (ZEUS PZ-13011D, Fig. 4: right) in the Tosa laboratory at Kyoto University. In addition, we installed several sewing machines for sewing and built an environment in the laboratory where we can achieve the whole fashion-producing process from design to sewing. Figure 5 shows the entire experimental environment.



Figure 4: Inkjet printer for sublimation transfer (left) and thermal transfer device (right).



Figure 5: Students are making fashion.

4.2.2 Creation of Fashion Design Using Digital Art

The distinguishable feature of this project is that Naoko Tosa, a professor at Kyoto University and an artist, manages the

whole fashion-making process from design production to sewing in collaboration with students. This project to make digital art into fashion quickly became possible by having the artist manage the entire process of creating digital art into fashion.

As mentioned earlier, digital art, the basis of the design, is mainly the Sound of Ikebana. This art uses physical phenomena and is evaluated by foreigners to express Japanese beauty. Usually, as a Japanese design, really "Japanese" designs have been used, such as flowers loved in the four seasons of Japan as cherry blossoms and autumn leaves. Also, ancient buildings in Kyoto, such as Kinkaku-Ji (Golden Temple), Ginkaku-Ji (Silver Temple), etc., have been often used. On the other hand, the Sound of Ikebana has been accepted by many people in Japan and abroad because it has an abstract and organic shape. At the same time, as mentioned earlier, it makes people feel the beauty of Japan [7].

4.2.3 Pattern making

Pattern making is generating a pattern by taking the clothes to make (jacket, dress shirt, etc.) and their size into consideration. As neither Tosa nor the students have experience in this part, we decided to ask an outside person called a pattern designer to do this. Currently, we outsource this part to a freelance patternner. In the case of a custom order, the patternner measures the size of each part of the customer's body and makes a pattern. Then Tosa places her art image on the paper pattern sent from the patternner as digital data and decides the most attractive arrangement. This work is achieved on the personal computer.

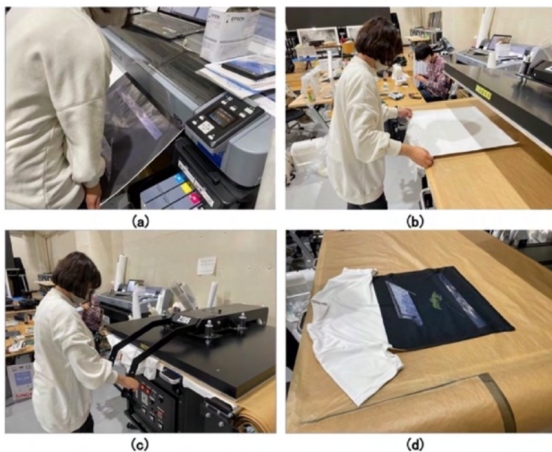


Figure 6: Process of printing on fabric (a: output from the printer, b: place the output result inside out on the thermal transfer device, c: thermal transfer, d: result printed on T-shirt).

Currently, the pattern-making part is outsourced. However, the

patternner changes the basic pattern according to each customer's size. This means it is possible to automate this part and include it in in-house production, which is a future issue.

4.2.4 Printing

Digital data in which the art image is placed on the paper pattern data can be printed. This digital data is printed on special paper with the sublimation transfer printer described earlier and then thermally transferred onto the fabric with a thermal transfer device. The process is shown in Fig. 6. Figure 7 shows an example of a printed result according to the pattern.



Figure 7: Results of printing to match the shape of the pattern.

4.2.5 Cutting and sewing

The final garment is completed by hand-sewn or sewn the cut fabric with a sewing machine. Figure 8 shows a student sewing with a sewing machine.



Figure 8: Sewing work.



Front

Back

Figure 9: An example of the completed dress shirt.

4.2.6 Final product

With the above process, clothes with the design of fashionable digital art are completed. Figs. 9 shows an example of the completed dress shirt.

4.2.7 Implementation of a fashion show

The clothes made from Naoko Tosa's digital art mentioned above are new. Anyone can wear art in their daily lives by making the art, which used to be exhibited and appreciated only in art galleries and museums, in fashion. We believe that in the fashion industry, an established and conservative industry, an artist and amateur students have proposed a new fashion production method that makes clothes almost by themselves. How will the public accept such a new attempt?

As a test case to evaluate our trial, we got the opportunity to utilize Naoko Tosa's solo exhibition held in Harajuku, Tokyo, for two months. In this solo exhibition, she invited celebrities from various fields to have a talk show with her every weekend (Fig. 10). She held a mini fashion show before and after the talk show.



Figure 10: A scene of the talk show.

A fashion show has been established as an opportunity to announce new fashion works by fashion brands and designers and as a place to advertise them. Fashion shows other than these are limited to those held internally as a place for graduation work by graduates of fashion-related schools. It is an event with a high threshold for people like us who have little connection with the fashion industry. However, we decided to organize it as it is worth trying because making digital art into fashion is a new attempt.

To hold a fashion show, it is necessary to hire fashion models. We asked relatively inexperienced free models through a designer we knew. Fortunately, they agreed with the concept of this fashion show and accepted our proposal at a bargain price. Figure 11 shows the fashion show scenes. Tosa devised a way to match the video image behind the fashion model with the clothes the model wears. As this was a fashion show directed by an amateur, at first, such a setting confused the models. However, as time passed, the matching between the video image behind and the models' clothes improved, and the

visitors highly evaluated the show. We also got offers to buy the clothes from several visitors and people who knew about the event on SNS.



Figure 11: Scenes of the fashion show.

5 Future Possibilities

5.1 Realization of "wearing art" fashion

As mentioned earlier, the fashion industry has been a world of selling clothes with new designs to consumers. It is a world of anticipating changes in consumer tastes and creating and selling clothes based on designs that match them. The fashion industry is a society based on "design thinking [19]."

On the other hand, art does not adapt to changes in society and consumers' tastes in a short period but anticipates changes in the sensitivities and aesthetics of society and consumers in the future and presents them to society and consumers. Although traditional fashion was based on "design thinking," incorporating art into fashion means trying to create fashion based on "art thinking [20]."

To appeal that our attempt is trying to create a new trend in fashion, based on the concept of "wearing art" fashion, we must clarify and appeal its difference from conventional fashion.

5.2 "Wearing art" fashion branding

To show that the world accepts the concept of "wearing art," selling clothing that makes art into fashion must be successful. Establishing a fashionable clothing brand of Tosa art is necessary for our attempts to succeed. In other words, it is necessary to differentiate art fashion with "wearing art" as a flag from fashion based on conventional design. There are issues such as where to narrow down the customer and set the price for that purpose. For this, it is necessary to take the following processes.

- It is necessary to arrange many opportunities to appeal to the world a new art fashion that fuses art and fashion, for example, by organizing fashion shows in various opportunities.
- It is necessary to sell art fashion at EC sites, etc., and use it as a clue to know the possible customer and the appropriate

price range.

Fortunately, some customers who want to buy this art fashion have already appeared. For example, they are the head of the Ikebana school in Kyoto, a young promising Noh player, and prominent calligraphers who carry Japan's traditional culture. They always try to anticipate the future and introduce new things while maintaining tradition. In other words, they aim to bring about "art innovation." This shows that they deeply understand the implications of our attempts. One way is to have such people wear our art fashion at events and other occasions so that Tosa's art fashion will be recognized by society as a brand.

6 Conclusion

This paper described an attempt to make digital art into fashion by fusing digital art and digital textile printing. Art appreciation has been limited to exhibitions at museums and galleries. However, art must permeate more into society to realize a prosperous society. At the same time, it is necessary to maintain the high quality of art, not just a consumed design. Recently, digital textile printing technology has emerged as a method of drawing a design on clothes. Unlike conventional analog printing by hand, a design image is printed on clothes directly or by transfer. Digital textile printing is based on paper printing technology and can print extremely high-definition designs on garments. Unfortunately, digital textile printing has sometimes been evaluated lower than conventional manual-based analog printing because it is a new technology. By fusing these two technologies, digital art will have more opportunities to be widely accepted by society. At the same time, it will be an excellent opportunity to increase the value of digital textile printing.

Based on this idea, we have started joint research to develop art fashion between Kyoto University and Seiko Epson, led by Naoko Tosa. We created fashion using Tosa's digital art by introducing a digital textile printing system in Tosa's laboratory. The results were obtained in less than a year and successfully presented in a fashion show. In the future, by further pursuing the new directions mentioned in Section 5, we would like to discover new possibilities for digital art and digital textile printing and realize true "art innovation."

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