

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

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**Abstract**—Recently digital art using digital technology has emerged and has been well recognized. On the other hand, digital textile printing technology has recently emerged in the fashion world, making it relatively easy to produce small-lot, high-mix garments. Combining this digital art with digital textile printing creates new possibilities for art to enter our everyday life as clothing. In this paper, we will describe the contents of our attempt to create fashion from digital art under the concept of "wearing art" through joint research between companies and universities.

**Keywords**—digital art, digital textile printing, art fashion, wearing art

## I. INTRODUCTION

The introduction of a technology called digital textile printing has emerged in fashion. For a long time, garments have been made by analog methods such as manual design production, textile printing, and sewing. Digital textile printing seeks to digitize the printing process. This technology can significantly change the entire fashion production process.

In the art world, on the other hand, traditionally artworks have mainly been created by hand by artists. Recently artworks using digital technology have become widely recognized. Digital art is art created by using a computer, as opposed to manual painting. As a digital video art creation method using a computer, artworks use CG (computer graphics) has become popular. On the other hand, some artists, such as Naoko Tosa, one of the authors, use much digital technology but has been obsessed with the production method of using natural phenomena instead of CG.

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 this integration of art and fashion.

## II. 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," in which the fabric is dipped in a dyeing solution, and "printing," in which 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. There are two methods, one is to draw on the fabric one by one, and the other is to make a textile screen that corresponds to the design to make and then pour the dye into the screen enabling mass production. In the patterning of high-class Kimonos, drawing patterns one by one by artisans is still used.

In contrast to the conventional analog printing method, a printing technology that incorporates digital technology has emerged. This is called digital textile printing [1]. Digital textile printing is a technique for printing various designs and images on fabric. Various methods have been conventionally developed for printing high-quality images on paper. Although there are differences in the properties of paper and fashion fibers, the purpose of printing vivid and various kinds of colors and fixing them so that they do not fade is the same. The ability to print on fabrics by developing inks suitable for textiles led to digital textile printing technology development.

The printing method includes an inkjet method and an electrophotographic method for paper. Also, the printing method for fabric includes a direct inkjet method and a thermal transfer method. In the direct inkjet method, pigments and dyes are treated as ink, and ink particles are directly sprayed onto the fabric for dyeing. A model series called Monna Lisa (Fig. 1) of Epson is a typical example, and it is possible to print on silk, polyester, rayon, cotton, etc., using different inks. On the other

hand, the thermal transfer method uses a sublimable dye, which is highly sublimable and utilizes the fact that the dye vaporized by heating enters the inside the polyester fiber and exhibits a color development reaction. A model called SC-F series of Epson is a typical example.



Fig. 1. Epson's Monna Lisa ML8000 (<https://www.epson.jp/osirase/2020/200929.htm>.)

Figure 2 shows a comparison of the analog printing and digital textile printing processes. While the analog printing process requires 45 to 60 days, the digital printing process takes 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.

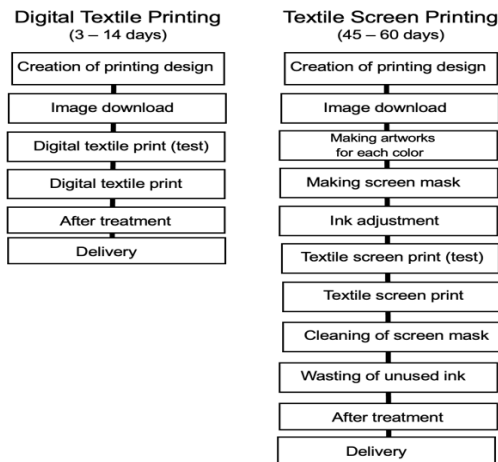


Fig. 2. Comparison of digital printing and analog printing processes [1].

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 a large amount of water to clean the textile screen, and also 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.

### III. 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 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 the name of "fluid dynamics [2]." It has long been known that fluids produce beautiful shapes under various conditions. Since beauty is a fundamental component of art, it is natural to consider fluid dynamics as the basic methodology for art creation.

Figure 3 shows a specific 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.

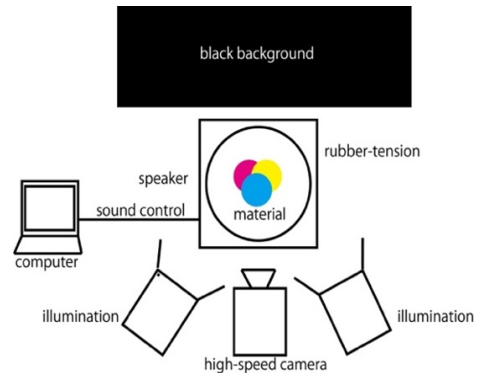


Fig. 3. Fluid art creation system (top view).

Tosa confirmed that various fluid shapes are generated by changing the shape of sound, frequency of sound, type of fluid, the viscosity of the fluid, etc., using this environment [3]. In addition, she edited the obtained video to match the colors of the Japanese seasons and created a digital art called "Sound of Ikebana [4]." Figure 4 is a scene from the artwork.



Fig. 4. A scene from "Sound of Ikebana."

When Tosa exhibited the Sound of Ikebana around the world as a Japan Cultural Envoy, many overseas art-related people said, "Tosa's digital art, which is expressed in an abstract form, expresses beauty that is the condensation of Japan's consciousness and sensibilities."

This shows that the Sound of Ikebana is a work that touches the core of art. She has been trying to create a new shape by using the voice of a newborn baby and the voice of an Olympic athlete as a sound source and also by making it under microgravity [5][6].

### IV. INTEGRATION OF DIGITAL TEXTILE PRINTING AND DIGITAL ART

#### A. Basic Concept

Digital textile printing is suitable for small-quantity production. What design is printed on fabric is fundamental for digital textile printing technology and the fashion business. This shows that digital textile printing and digital art can go well together.

Digital art has been usually exhibited in museums and galleries and is the subject of collection by art collectors, just

like traditional art. Therefore, art and the business of the apparel industry, which mass-produces and sells fashion using the same design, is considered to belong to the opposite world.

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 became the primary driving force for connecting digital art based on small-quantity production/sales and digital printing. Furthermore, the connection of art with fashion means that ordinary people can wear art as clothing in their daily lives. It has been difficult for art to permeate the general public beyond a small number of art lovers and collectors. The fact that art can be linked to fashion means that art will be more widely incorporated into the general public.

Also, for the world of fashion, the connection with art opens up new possibilities. Until now, fashion has been premised on having a copy. For that reason, 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 by "wearing art" in their daily lives and to lead prosperous life. In this way, the connection between digital art and digital printing is a win-win relationship.

#### B. Realization of Art Fashion Using "Sound of Ikebana."

Based on the concept described above, 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 needs shorter time than analog printing, we started joint research between Kyoto University and Epson Solution Center. The following environment and processes were created and carried out.

##### 1) Development of Art Fashion Creation Environment

Among the two types of digital printing, the direct textile printing and the thermal transfer, we decided to adopt the thermal transfer method for small-quantity production because it does not require post-treatment such as drying. Seiko Epson Corporation installed an inkjet printer for sublimation transfer (Epson SureColor F6350, Fig. 5 left) and a thermal transfer device (ZEUS PZ-13011D, Fig. 5 right) in the Tosa laboratory at Kyoto University and built an environment in the laboratory where we can achieve the whole fashion producing process. Figure 6 shows the entire experimental environment.



Fig. 5. Left: Inkjet printer for sublimation transfer, Right: Thermal transfer device .



Fig. 6. Fashion production experimental environment.

##### 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 by using students. This project became possible to make digital art into fashion in quickly by having the artist manage the entire process.

The Sound of Ikebana was adopted as the basis of the design. Usually, as a Japanese design, designs that are really "Japanese" have been used, such as cherry blossoms and autumn leaves. Also, ancient buildings in Kyoto, such as Kinkaku-Ji (Golden Temple), Ginkaku-Ji (Silver Temple), etc., are 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.

##### 3) Pattern Making

Pattern making is a process to generate a pattern taking the clothes to make (jacket, dress shirt, etc.) and their size into consideration. As we don't have experience in this part, we decided to ask an outside person called a pattern designer to do this. The patterner changes the basic pattern according to each customer's size and size to make a pattern. This means it is possible to automate this part in future.

##### 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 and then thermally transferred onto the fabric with a thermal transfer device. The process is shown in Fig. 7. Figure 8 shows examples of obtained printed fabric.

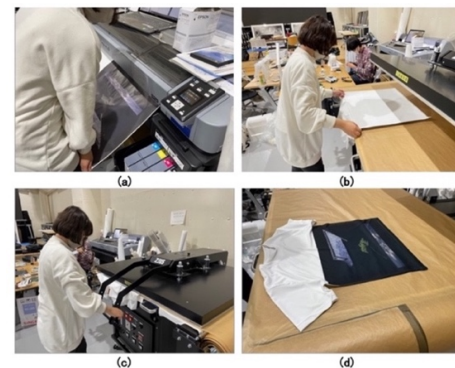


Fig. 7. Process of printing on fabric (a: output from the printer, b: place the output result inside out on the fabric of the thermal transfer device, c: thermal transfer, d: result printed on T-shirt).



Fig. 8. Results of the printing.

### 5) Cutting and sewing

The result of printing is cut according to the pattern using scissors. The final garment is completed by hand-sewn or sewn the cut fabric with a sewing machine.

### 6) Final product

With the above process, clothes that are fashionable digital art are completed. Figure 9 shows an example of the completed dress shirt.



Fig. 9. Example of completed dress shirts.

### C. Implementation of a fashion show

The clothes made from Naoko Tosa's digital art mentioned above are new types of clothes. Anyone can wear art in their daily lives. An artist and amateur students have proposed a new fashion production method that makes clothes almost by their hand.

How will the general public accept such a new attempt? To try this, we got the opportunity to hold a solo exhibition of Naoko Tosa, held in Harajuku, Tokyo, for two months. During this solo exhibition, she held a mini fashion show.

Fashion shows has been established as an opportunity to announce new fashion works by fashion brands and fashion designers and as a place to advertise them. However, she decided to organize it, as it was worth trying because making digital art into fashion is a new attempt.



Fig. 10. Scenes of the fashion show.

In order to hold a fashion show, it is necessary to hire fashion models. We asked a relatively inexperienced free model through a designer we knew. Fortunately, they agreed with the concept of this fashion show and accepted our proposal at a bargain price. Figure 10 shows one scene of the fashion show. As a result, she also got several offers to buy from several visitors and people who knew about the event on SNS.

### V. 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, as a method of drawing a design on clothes, digital textile printing has emerged. 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 the Art Innovation Industry-Academia Joint Course at Kyoto University and the Printing Solutions Operations Division of Seiko Epson Corp., led by Naoko Tosa. Introducing a digital textile printing system in the joint course, we created fashion from Tosa's digital art. The results were obtained in less than a year and successfully presented in a fashion show. In the future, we would like to discover new possibilities for both digital art and digital textile printing and realize true art innovation.

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