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Research on the Application of 3D Printing Technology in Fashion Design

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Abstract:

The clothing industry is developing more and more rapidly. In order to meet the needs of the modern social background and the development of the times, the technology used by clothing designers is becoming more and more technological. In recent years, 3D printing technology has gradually been added to the clothing industry. In addition to effectively realizing the complex structural design in clothing design, it can also add more possibilities and opportunities to the future of clothing design.

Keywords:

Fashion Design, 3D Printing, Future

1. Introduction

In the 1990s, 3D printing technology first appeared in the United States, which aroused great interest and attention, and attracted scholars from all walks of life to conduct related research. Moreover, it has developed rapidly in recent years and has begun to integrate into all aspects of life. 3D printing technology can turn blueprints on computers into real objects, and has been used in medical industry, industrial design, engineering construction, aerospace, clothing, footwear, education, archaeology and other fields, bringing convenience to people's lives. As a rapid prototyping manufacturing method, some people once believed that 3D printing technology will promote the third industrial revolution [1]. Today, clothing is not only limited to the practical function of covering the body, but also has both fashion and functionality, and this requirement has gradually occupied a very important position in the textile industry. With the development and application of 3D printing materials and technologies, the apparel field is actively exploring the application of 3D printing technology and product development, and promoting the further development of the apparel industry.

2. 3D Printing Technology Overview

3D printing is a kind of additive manufacturing, also known as three-dimensional printing or three-dimensional printing, which is academically called rapid prototyping technology. 3D printing is to create a 3D model diagram on the computer through Solidworks, SKetchUP, 3DMax and other software according to people's needs.

When printing, input the drawn model into the 3D printer in Stl format, and set the printing speed and layer thickness according to actual needs. The printer will automatically layer the constructed 3D model map and convert it into several layers of separate sheets. During the printing process, the entity is constructed by stacking and accumulating printing materials layer by layer.

3D printing is subdivided into more than a dozen technologies due to the different types of raw materials used and accumulation methods. Among them, there are mainly 5 mature technologies, namely: Stereolithography (SLA), Laminated Entity Manufacturing (LOM), Selective Laser Sintering (SLS), Fused Deposition (FDM) and 3D Inkjet Printing (3DP).

Stereolithography (SLA) uses a photopolymerized lamination method to project a UV laser into a water tank containing a liquid photocurable resin to cure it to form a manufactured entity; Laminated entity manufacturing (LOM) uses a lamination method according to The model shape cuts plastic, metal and other thin-layer sheets, and finally obtains the real object; the selective laser sintering method (SLS) adopts the lamination method of particle sintering, and the powder or particles applied on the machine tool are repeatedly irradiated and sintered to form a 3D printed entity ; Fused deposition method (FDM) uses extrusion lamination method to melt filamentous thermoplastic material in printer and output from nozzle to make it pile up to obtain solid; 3D inkjet printing (3DP) uses jet lamination The method sprays a color ink and a liquid solidified substance from a nozzle onto the raw powder to obtain the desired.

Each 3D printing method has its specific applicable material form according to its forming principle. The most commonly used methods in the apparel industry are selective laser sintering (SLS) and fused deposition (FDM). SLS mostly use powder or fine particle materials. This method has a simple manufacturing process and has the characteristics of a wide range of printing raw materials, low material prices, fast forming speed and high utilization rate. However, the printer is expensive and bulky. training. Fused deposition method (FDM) mostly uses filamentary hot-melt materials, which have many types of forming materials and high strength of formed parts, but low processing accuracy and relatively rough surface of the finished product. Most of the current 3D printing products use this method. Therefore, the fused deposition method (FDM) once became the mainstream method in the 3D printer market [2].

At present, there are more than 100 3D printing materials, which can be divided into four categories: metal materials, ceramic materials, polymer materials and composite materials. The common ones on the market are thermoplastics, eutectic system metals, edible materials, and alloys, titanium alloy, stainless steel, aluminum, thermoplastic powder, metal powder, ceramic powder, gypsum, paper, plastic film, light hardening resin, etc [3]. However, the lack of printing materials is also a fundamental factor restricting its development. Compared with other industries, the development of 3D printing technology in the field of clothing is relatively slow, mainly because it is still difficult to produce fabrics and clothing that meet the requirements of wearing comfort, softness and fit, and easy washing.

3. The Development Status of 3D Printing Technology in Clothing Design

3.1. Development Status of 3D Printing Clothing Design at Home and Abroad

In recent years, the new wave of 3D printing has rapidly swept the world, and it has also attracted the attention of fashion designers and fashionistas around the world [4]. As early as 2010, some designers have used 3D printing technology and applied it to clothing design. Designers can realize some designs that cannot be achieved by traditional cutting and crafting through 3D printing technology. With the continuous development of 3D printing technology and the continuous innovation of materials, more and more complex clothing designs can be printed and made into finished products.

Ten years ago, China has gradually carried out exploration and research on 3D printing technology, and has achieved certain research results in recent years. At present, 3D printing research is mainly carried out in major universities in China in the form of school research as the main business and supplemented by enterprises. The research content focuses on the development of 3D printing equipment materials and software, and 3D printing application research. For example, in 2014, Qingdao Uni's first self-developed multi-function 3D clothing printer was unveiled at Qingdao International Fashion Week. At the same time, the famous Chinese underwear brand “Aimer” also released a series of underwear using 3D printing technology [5]. From this, we can see that the clothing using 3D printing technology in China has begun to enter the market.

3.2. The Advantages of 3D Printing Technology in Clothing Design

3.2.1. Eco-friendly

With the rapid progress of science and technology, it has also brought great opportunities to traditional industries, and will also promote the progress and development of traditional industries. Many auxiliaries used in traditional clothing production process will affect the safety, health and ecology of textile and clothing [6]. Using 3D technology to print clothing, first of all, most of the raw materials are degradable and recyclable, and secondly, the processing of the products is completed in a programmed way, eliminating part of the production process, thereby reducing the energy consumption and hazards in the clothing production process. Reduced fabric waste and environmental pollution. Make the production of clothing more ecological and environmentally friendly.

3.2.2. Save Production Costs

3D printing has a short manufacturing process. Compared with traditional processing and manufacturing, it can reduce manufacturing costs and shorten processing cycles. It also allows consumers to intuitively see the effect of finished products in the modeling process, reducing intermediate links. This not only accurately conveys the needs of consumers, but also reduces the waste of many raw materials, saves manpower and time, and thus saves production costs [7].

3.2.3. Break Down Traditional Barriers

Many clothing design concepts are subject to technical conditions, and it is difficult to show the designer’s unrestrained ideas and innovative structural design, especially in the production process, it is even more difficult to complete complex patterns and craftsmanship. Through accurate modeling and fine processing, 3D printing technology can fully meet the designer's requirements for model accuracy and complexity, realize more innovative design concepts, present a complete design

concept, and break through traditional processes and fabric structures. The limitations of the clothing design help the development of clothing design, and also promote the clothing market to move forward.

3.2.4. Personalization

The number of people who pursue personalization is increasing, and the traditional clothing production model cannot meet the needs of consumers. This feature is highly compatible with the rapid prototyping of small batches of non-standard parts that 3D printing is good at. 3D printing technology can directly print clothes that meet the needs of consumers through modeling, which is especially suitable for small batch production.

3.3. The Bottleneck of 3D Printing Technology in Clothing Design

Judging from the current 3D printing clothing, although its technology has gradually matured, the current technology cannot achieve the performance of traditional fabrics, and the style and shape of clothing are also limited by printing materials. Clothing technology has not been able to be put into the market smoothly, mainly there are the following three problems.

3.3.1. Lack of Professional Modeling Software for Clothing Design

At present, the 3D modeling of clothing mainly adopts the current general 3D design software. However, clothing products have their own characteristics, and the existing general design software is difficult to meet the needs of clothing model design in some aspects. The development of special clothing design modeling software is more conducive to the imagination of clothing designers [8], and it is also the current demand in the clothing field.

2.3.2. Requires a More Refined Molding Process

Although there have been many successful cases of 3D printing clothing, most of the products require secondary processing. How to maintain the complex structural design in 3D printed clothing, but also realize the fine molding process, is to be matched. Therefore, the further development of a molding process suitable for the wearing characteristics of clothing is the key to ensuring that 3D printing technology can be fully utilized.

2.3.3. Materials to be Further Enriched

Among the many 3D printing materials, very few are suitable for clothing printing, and there is a lack of low-cost soft materials [9], which is also the biggest constraint on the application of 3D printing in clothing. At present, suitable materials have not yet been found to replace traditional clothing fabrics.

4. Artistic Expression of 3D Printing Technology in Clothing Design

4.1. Color

For 3D printed clothing, the color change depends on the material itself and the appearance after processing. As the most obvious visual expression language in the creative design of clothing, color adds a lot of room for imagination to clothing. Traditional 2D flat printing is in pixels, while 3D printing is composed of voxels, so it

can resolve color changes under volumetric content. The current main coloring methods are:

The first is the water pattern transfer method. The printed fabric is placed in the reagent water of the corresponding color, so that the color slowly penetrates. However, the style structure of 3D printed clothing is relatively complex, and the uneven color penetration is also a limitation that this technology cannot fully realize. one of the factors. The second is to draw on the 2D printing inkjet technology and use the spray gun to spread the color on the surface of the material, but the 3D printed clothing is composed of millions of voxels, and there are many voxels to be considered in the printing process, so it is temporarily impossible to achieve industrial application. The third is to use the deposited resin droplets of different colors and cure them by ultraviolet light to realize the change of material color and transparency.

4.2. Modeling Structure

The modeling structure design of clothing includes not only the external contour modeling and internal structure, but also the dispersing, rearranging and combining of other parts such as collar and sleeve to form a new visual form. The traditional clothing design mainly completes the change of the shape through the dart lines, pleats and stitches in the structure, while the 3D printing technology realizes the three-dimensional effect through the layered printing of different levels. The traditional design principle shows the endless imagination in the space by highlighting the structural shape of a certain part and different design elements. The advantage of 3D printing in clothing style structure is that it can achieve more effective development in conjunction with computer software, making it more convenient to adjust and modify the version and other related work, and solve problems while adjusting problems. In addition, large-scale, high-efficiency production with higher efficiency can be realized. At the same time, the convenience brought by 3D printing can also enable everyone to design clothing according to software and technology, and truly show their own needs and personalized characteristics to achieve more effective intentions. In addition, the problem can be solved only by adjusting the details during the layout modification process, and the data in all aspects can be completely separated from the drawings, and the development can be realized while solving the problem. The problem of piracy can also be effectively controlled through encryption.

4.3. Material

Traditional clothing fabrics are mainly made of cotton, linen, wool, silk and chemical fiber products, and different changes in clothing fabrics are realized through fabric dyeing and printing, while 3D printed clothing is mainly plastic in the production process, mostly resin, silica gel, plastic, fiber The water-lipid compound composed of other materials is used as the material, but the plastic texture is relatively hard, which is quite different from the traditional clothing material and structure under the original model. This situation has changed after 2015, mainly based on the derivative technology of 3D printing technology, but the material used is a new type of material [10]. After the user designs an ideal model with design software, the technology is realized through 3D printing. Clothing construction, using the unique template in the technology to construct clothing, so that the clothing can fit the actual situation, realize the technical update of 3D printing clothing, make it in line with reality, and realize clothing design and manufacture by interweaving liquid materials.

Designers can combine the special texture effects presented by these special materials with technology, and mix and match various materials to create futuristic artistic fashion.

5. Typical Cases of 3D Printing Technology in the Field of Clothing

The brand Iris van Herpen was founded by the designer of the same name from the Netherlands. The design style belongs to surrealism, and the designed works are full of futuristic sense. The Iris van Herpen 2019 autumn and winter haute couture show combines clothing and 3D printing to bring a different visual feast. With the theme of "hypnosis", this season's clothing cooperated with American sculptor Anthony Howe to create Anthony's installation on the show. This series of clothing is full of three-dimensionality and rich layers, while maintaining a sense of lightness and fluidity. Combined with the rotating movement of the "Omniverse" sculpture installation on the show, it drives the "feather wings" on the model wearing a dress to rotate, as if hypnotic Treatment site. Once again, Iris van Herpen's sculptural artistic design and dramatic artistic expression continue, and it also reflects the charm of 3D printing technology in clothing. As shown in Figure 1.

Figure 1. *Iris van Herpen 2019 autumn and winter haute couture clothing.*

Macedonian fashion designer Irina Tosheva collaborated with MK3D to design and produce a 3D printing series of clothing "Riza", and launched a series of 3D printed clothing accessories. Inspired by traditional Balkan clothing and architectural aesthetics, the collection is strongly influenced by the designer's combination of 3D printed accessories and clothing. The collection has four themes - rose pink, jade, lavender and pale yellow, and was featured in Skopje, Macedonia Fashion Week. In order to highlight the details, the designer uses 3D printing accessories in the same color as the clothing, chooses a simple clothing style, and applies the printed accessories to the chest, back, sleeves and other positions, which increases the three-dimensional sense of flat clothing, so that the overall clothing visually gives a relief engraving effect, as shown in Figure 2.

Figure 2. *Irina Tosheva "Riza" Collection.*

6. Conclusions

The combination of science and fashion has become the most important feature of textiles and clothing in the new era. More and more designers are beginning to pay attention to the influence of technology. It has become a popular trend to create fashionable products using 3D printing, laser cutting and digital printing technology. The innovation of new materials and the integratiaon of traditional fabrics have brought more possibilities to clothing. The continuous research and development, reform and innovation of 3D printing textile materials make it continuously improve and improve on the basis of comfort and stretchability.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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