A Pilot Study of Upcycling Methods for Fabrics of Sustainable Fashion

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Abstract. In recent years, with the improvement of people's environmental protection concepts, sustainable fashion has achieved better development in clothing and related industries. From spinning, weaving, dyeing and finishing to the fashion design, garment making, retail, use and disposal of the whole life cycle of clothing, effective actions can be taken to reduce energy and material consumption and reduce environmental pollution, to achieve sustainable fashion. This research focused on the upcycling methods of fabric materials. By means of innovation methods such as three-dimensional space reconstruction, fabric texture redefinition, and this study tried to establish an upcycling system for fabrics and materials, to promote the status of sustainable fashion and reduce the impact of fashion industry on the environment.

1. Introduction

Life cycle assessment is an important environmental management tool that evaluates the environmental impact of a product from the “cradle to the grave” throughout its whole life cycle [1, 2]. When a life cycle analysis of apparel products is conducted, fiber production, spinning, weaving, garment manufacturing, transportation and distribution, consumer use and end of use, material and energy flow throughout the life cycle of the apparel product have to be traced and analyzed [3], see Figure 1. The flow is traced and quantified to discover the impacts of apparel products bringing to the environment. As the material components of the garment product, the fabrics and accessories are the most important part to link the material and energy flow [4]. Under the guidance of LCA, how to effectively use fabrics, reduce waste of fabric, improve the performance of fabrics and increase the added value of fabrics in the design and manufacturing process of garment production, these are effective methods to decrease the environmental impact from apparel products.

**Figure 1.** The life cycle of apparel products

In general, scraps from yarn, fabric and garment production and post-use garments are at the end of its life cycle. If this kind of materials can enter the new cycle of other products, or can up-cycle to some better products, this will give new life to these waste textiles, greatly reduce the flow of material...
and energy, and effectively decrease the environmental impact from garment products. This study will focus on waste textiles and try to find out methods to upcycle them, and improve the sustainable development of apparel products.

2. Research Method
The concept of upcycling is to upgrade a product that in low-level to a higher-level product, after technical processing. The earlier upcycling actions was adopted mainly in the paper industry. Some waste paper had been processed for more valuable paper product [5]. The upcycling the textiles and apparel industry can be carried out on many levels [6]. For example, some textiles with less value are innovatively designed to creative and fashionable products. The use of low-value items can reduce the pressure on landfills and the impact on the environment. From the economic aspect, the upcycled resources with added value can improve the utilization efficiency of material and energy flows which had been consumed in the past production.

In this study, textiles products with less values, including all kinds of scraps from yarn, fabric and garment production, post-use garments and other textiles, can be utilized as materials of upcycling practice. As shown in Figure 2, turning it to artwork, redefining fabric texture and reconstruct three-dimensional space reconstruction are the main methods to be practiced.

3. Results on Upcycling Methods for Fabrics of Sustainable Fashion
For the first method, as textiles has been individual artworks for thousands of years like embroidery painting, it still has been art collections nowadays. The newly creative upcycling textiles may have the possibility to be art works. Besides, due to the insufficiency in some textile design, many fabrics in the market are outdated and lack of innovation in design and has single texture. These kinds of fabrics can be creatively redesigned from a two-dimensional texture perspective or a three-dimensional space to become a new fabric that can be used for further creative fashion design. A group of students majored on Fashion Design had been supervised in the research to practice these cycling methods. Achievements can be observed in the following results.

3.1. Results on art work of textiles
As shown in Figure 3, in this 28.5×28.5cm work, Xinjie simulated the moment of a cherry dripping into milk. The material he used was only idle and waste materials, such as white cotton threads, hard cardboard, foam board, paper bowl and small red fabric. Hard cardboard, foam board, and paper bowl were used to set up the overall prototype. The milky texture was made of the white cotton threads. The small red fabric made the little cherry. The whole work has a dynamic vision and can be regarded as a creative three-dimensional artwork with textiles.
3.2. Results on fabric texture redefinition
The redefinition of the fabric texture can be expressed by the tearing, reshaping, superposition, and contrast among different fabrics or materials. This work focused on fabric texture redefinition, see Figure 4. Denim, lace, gear accessories and chains had been used. At first, the denim was broken through by a knife and the edges of the holes were respectively tasseled or torn. Then the lace was sewed under the denim. The contrast of the fabric texture had been formed by exposing the lace in the hole of denim. In addition, the gear accessories and chains were decorated on denim which had created another texture contrast between metals and textiles. The whole work is well designed in fabric texture redefinition which can be utilized in creative clothing design.

(Designed by Sihan Huang, Supervised by Huang Chao)

As shown in Figure 4, the redefinition of fabric texture was mainly hand made by yarns. Acrylic yarn and cotton yarn were adopted to hand weave the fabric based on polyester mesh to simulate the shape of altocumulus. Shiny beads were dotted in it which imitated the sunlight that penetrated the clouds. This redefinition method by means of ordinary materials creates a new fabric texture that greatly enhances the added value of the materials.
3.3. Results on three-dimensional space reconstruction
Due to the difficulty of creativity and production, fabrics with space effects are relatively rare in clothing industry. The reconstruction of the three-dimensional space focuses on the utilization of fabrics or other ancillary materials to create the spatial shape of the fabric. As shown in Figure 5, the pleated gauze and acrylic woven ribbon were wrapped into the desired twisted shape and attached to a zipper. The wrinkles and twisting effects reflected the dynamic flow of fabrics and reconstructed three-dimensional space. Such a fabric application will significantly enhance the texture and effect of the clothing design.

4. Conclusion
From the above research, it can be found that in the garment manufacturing supply chain, useless or low-value yarns, fabrics and other auxiliary materials, using innovative art design, two-dimensional texture redefinition and three-dimensional space reconstruction methods, can be greatly upgraded the life cycle of these materials and reduced their impact on the environment. These actions have
relatively economic benefits and environmental protection effects for the textile industry and garment industry. The sustainable fashion industry may not only be regarded to control the flow of material and energy, but the upcycling design of the material is more sustainable and practical.

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