

Upcycling Clothes with the Traditional Technique Felting from Wool

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Abstract—The development presents the possibilities for applying the traditional technique of wool felting in sustainable design for women's outerwear. Various innovative approaches proposed by fashion designers aimed at increasing the sustainability of the industry have been examined. It has been established that one of the most popular methods, which allows for the use of available resources, is the so-called upcycling. This is a process through which, by means of creative activity, new functionality and higher value are given to used items and production waste. A study was conducted on the possibilities for applying the traditional technique of wool felting to implement upcycling in clothing. Experimental samples were created using different textile materials and felting techniques. A comparative analysis was made. A new approach for implementing upcycling in women's outerwear has been proposed

Keywords - Sustainable fashion, wool felting, Upcycling

I. INTRODUCTION

In recent years, there has been a trend towards increased public responsibility for environmental and resource protection. The fashion industry, as one of the most polluting industries, has adopted its own sustainability strategy. The international community has become aware of the negative impact of the sector caused by the dominant business model of 'fast fashion' and has started to build a new culture of production and consumption by supporting companies producing sustainable products.

In response to the need to solve global climate problems, fashion designers have proposed various innovative approaches. One of the most popular and enabling the use of available resources is so-called upcycling. This approach is seen by a number of researchers as a means of increasing producer responsibility and creating a new kind of environmentally conscious consumption [1]. Its main advantage is identified as the use of already manufactured products, which reduces material costs, increases the sustainability of the products and reduces the carbon footprint of the fashion industry.

There are a number of developments for upcycling of clothing. The authors suggest different methods for its implementation. In [2], the possibility of upcycling denim garments by the method of remodelling the articles in order to design formal wear is investigated. The creation of Upcycling - articles with the methods of decorating and different techniques of textile dyeing are presented in [3].

The possibilities of implementing Upcycling of women's outerwear by the so-called semantic method in which the basic purpose and shape of the articles are preserved and by using hand-machined embroidery techniques they are given a new look and a higher value are explored in [4].

A study of the relationship between materials and upcycling methods in the fashion industry found that the

most commonly used techniques are: patchwork, refashioning, redesigning, various types of appliqués and decorations [5] - Fig.1.

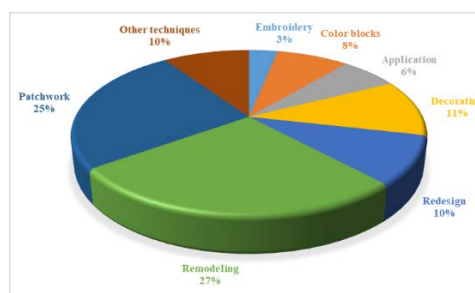


Fig.1. Relative shares of upcycling techniques used [5]

Safeguarding the intangible cultural heritage of each country also has an important place in the concept of sustainable development. This includes the preservation of different types of crafts and shifts the focus from mass production to small-scale handmade products.

Wool felting is an ancient technique for creating textiles which, thanks to its affordability and environmental friendliness, has experienced a renaissance in recent years. The main raw material for felting is sheep's wool, which is a natural, biodegradable and renewable resource. Its ability to be felted by washing, without the use of sophisticated devices, machines and technologies, is exploited.

Combining the two approaches would make it possible to create a new product at a higher cost with minimal energy and material consumption, in line with the concept of sustainable development in the fashion industry.

The aim of this work is: to investigate the possibilities of applying the traditional technique of wool felting to carry out upcycling of women's outerwear.

II. METHODS AND RESULTS

2.1. UPCYCLING

According to the United Nations, the world's garment production has doubled in the last twenty years, reaching 15 billion items annually [1].

Global climate problems and the fact that 95% of the clothes that are thrown away are usable, necessitate a qualitatively new approach to extend the life of textile waste. One of the fastest, widely available and easiest ways to do this is so-called upcycling. This is a process by which used items and production waste are given new functionality and higher value through creative activity. Creative reuse has grown significantly in countries such as the United States, where the number of products labeled "upcycled" has increased by between 300% and 900% in recent years [1].

In recent years, many famous fashion designers, in creating their collections, use upcycling to reduce their

negative impact on nature and to respond to the concept of sustainability in the fashion industry.

One of the most striking examples of the application of upcycling in the fashion industry is the "Patchwork di Sicilia" collection of the world famous brand Dolce & Gabbana - Fig.2. Miu Miu, Chloe, Stella McCartney, Vivienne Westwood and others also present upcycling patterns and collections - Fig. 3.



Fig. 2. Collection "Patchwork di Sicilia" [6]



Fig.3. Upcycling models of Vivienne Westwood [7]

Apart from big brands, many people who don't work in fashion are also interested in applying upscaling to their everyday lives. This is mainly due to the fact that it is easily accessible, allows for the expression of creativity, out-of-the-box thinking and builds a new culture of consumption.

Using the traditional technique of felting to implement upcycling would enable the range of products to be expanded, intangible cultural heritage to be preserved and their added and artistic value to be enhanced.

2.2.WOOL FELTING

Wool felting is a technique for creating nonwoven textile material that archaeologists believe dates back to 8000 years ago. No scientifically reliable data have been found on exactly where it originated. It is believed to be a technique that people mastered simultaneously in different parts of the world and its nationality cannot be determined.

Our ancestors were also familiar with this ancient technique for creating textiles and it occupied an important place in their material culture. Old Bulgarian written monuments dating back to the 10th - 11th centuries attest to the making of felt in Bulgarian lands. The preserved examples are from the 17th, 18th, 19th and the first half of the 20th centuries.

The making of felt was widespread until the 1920s - 1930s in rural areas with developed sheep farming. Strandzha is one of the regions where this ancient art is still practised. The Koprivshtensk felts are known for their high artistic value, and tradition dictated that every girl should have a felt carpet for her first wedding night [8, 9].

There are two main techniques for making felt:

Wet felting: this is the oldest, traditional manual method, which is based on the ability of the wool to fuse under the right temperature, mechanical action and alkaline environment. The reason for this phenomenon is the swelling of the fibers as well as the difference in the coefficient of friction at their base and tip. This technique makes it possible to produce flat decorative parts and volumetric products.

Dry felting: dates back to the Roman Empire. Needles with a special serrated profile are used to make this type of stuffing. Through mechanical action, the fibres are interwoven and spatial structures are formed between the individual layers. This method makes it possible to produce complex three-dimensional figures, various types of decorations and appliqués with wool.

Modern felting techniques are based on traditional ones. The new trends are mainly aimed at combining wool with different types of fibres. In recent years, the technique of nuno felting, which consists in felting wool and different types of fabrics, has also gained popularity. Nuno felting can be carried out with wet and dry felting.

2.3.EXPERIMENTAL WORK

2.3.1. UPCYCLING WITH WET FELTING

One of the basic principles of upcycling is that it is carried out on the basis of an existing article. This makes it possible to preserve the textile materials while maintaining their quality and not spending energy and raw materials on processing them. The application of the felting technique determines that the functional purpose of the initial product will be preserved and that a higher added value will be achieved through the new artistic design. The presence of a base article determines that the felting technique to be used can be defined as a variation of the nuno felting technique.

In order to analyse the possibilities of applying the wet felting technique in upcycling the articles, 3 scarves with different fibre composition and structure were decorated. The characteristics of the initial samples are presented in

Table I.

TABLE I
CHARACTERISTICS OF WET FELTING SAMPLE

№	Fabric structure	Fibrous composition	Weight g/m ²	Wefts count - in 1cm	Worps count - in 1cm
1	Plane weave	100% Cotton	70 /m ²	10 / 1cm	12/10
2	Plane weave	100% Viscose	60 g/m ²	10 / 1cm	14/10
3	Plane weave	100% Polyester	50 g/m ²	31 / 1cm	15/10

Wet felting was carried out in an alkaline environment at a temperature of 40°C and mechanical impact with a vibratory grinder - 12 000 rpm. Each section was processed for 1minute. Stages of the experiment work and the finished specimens are presented in Fig. 4., Fig. 5 and Fig. 6.



Fig. 4. Sample 1 Wet felting



Fig. 5. Sample 2 Wet felting



Fig. 6. Sample 3 Wet felting

Organoleptic analysis of the samples was carried out. It was found that the bonding sites between the wave and the tissue deform and form 3D - structures. This leads to the conclusion that this technique has a limited field of application for upcycling, as it can be mostly applied for decorating different types of scarves and leftover fabric pieces.

2.3.2. UPCYCLING WITH DRY FELTING

To explore the possibilities of applying dry felting for upcycling clothing, four experimental samples were created, divided into two main groups:

- Flat textile material knit - Sample 1, Sample 2;
- Flat textile material woven - Sample 3, Sample 4.

Each group includes two samples made from different yarn compositions, linear density, density by loop row and column (for knits), and by warp and weft for wovens. The goal is to analyze their influence as initial factors on the final result. The characteristics of the initial samples are presented in Table II.

TABLE II
CHARACTERISTICS OF DRY FELTING SAMPLE

№	Fabric structure	Fibrous composition	Weight g/m ²	Wefts / course count - in 1cm	Worps / Weles count - in 1cm
1	Single jersey	100% Cotton	235g /m ²	10 / 1cm	7 / 1cm
2	Single jersey	100% Wool	320 g /m ²	10 / 1cm	7 / 1cm
3	Plane weave	100% Cotton	72 g/m ²	31 / 1cm	35 / 1cm
4	Twill Weave	100% Cotton	259 g/m ²	24 / 1cm	30 / 1cm

The appearance of the studied samples before and after upcycling with dry felt on wool is presented in Fig. 7, Fig. 8, Fig. 9. and Fig. 10.



Fig. 7. Sample 1 Dry felting



Fig. 8. Sample 2 Dry felting



Fig. 9. Sample 3 Dry felting



Fig. 10. Sample 4 Dry felting

The analysis of the appearance of the fabricated specimens revealed that the surface at the interface between the wool and the fabric did not change its parameters and structure. After washing the specimens at a temperature of 30°C in an alkaline environment, the decorated areas improved their homogeneity and appearance. This leads to the conclusion that washing is a type of additional wet felting. The combination of the two felting techniques

enables the production of upcycled products with high artistic value and stable physical parameters.

III. CONCLUSION

Application of the «upcycling» method for prolonging the life cycle of clothes allows to preserve natural resources, reduces the carbon footprint of the fashion industry and the amount of textile waste. An important advantage of the "upcycling" approach is the use of already produced products. This reduces the cost of a new product, since it does not require additional costs of materials, and already produced products are preserved.

Application of the traditional felting technique for the realization of «upcycling» clothes significantly expands the range of products and preserves the cultural material heritage of the country. A combination of two approaches allows you to create a new product with a higher cost and minimal energy and material costs.

The proposed approach can be applied to increase the cost of unrealized production, which will allow to reduce the losses of production companies, as well as to create product lines and small family businesses.

Implementation of the method of upcycling clothes using felting techniques corresponds to the EU concept of sustainable fashion industries and the development of creative industries. The availability of the proposed approach will contribute to a significant impact on the environment, since many people will be able to extend the service life of their clothes by demonstrating their talent.

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