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LASER CUTTING, ZERO WASTE AND VIRTUAL PROTOTYPING – SUSTAINABLE INNOVATIONS IN FASHION DESIGN

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Zero Waste is a sustainable concept that aims to eliminate waste by optimizing resources and reusing materials. In the fashion industry, it involves efficient tailoring techniques, recycling and the use of advanced technologies to minimize waste. By integrating innovative technologies and processes, the environmental impact can be significantly reduced. This approach not only supports sustainability, but also opens up new aesthetic and functional directions in clothing design. The paper presents a theoretical and practical study of the use of innovative technologies used in the modern fashion industry.

Key words: *laser cutting, 3D prototyping, zero waste.*

INTRODUCTION

The fashion industry is one of the largest contributors to global pollution, generating huge amounts of textile waste every year [1]. Traditional production practices lead to significant waste of materials, which necessitates the need for sustainable solutions. The Zero Waste concept addresses this problem through design and production methods that reduce or completely eliminate waste [2].

An innovative solution to achieve this goal is the use of laser cutting technology. This allows for extreme precision in cutting materials, optimizing textile consumption and reducing the resulting scrap. Laser cutting minimizes material waste through intelligent pattern planning and the ability to perfectly fit the pieces of a design [3].

PURPOSE

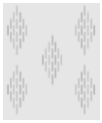
The purpose of this theoretical and practical study is to explore and demonstrate the efficiency of integrating 3D software, the Zero Waste concept and laser cutting technology in the fashion design process. Through theoretical analysis and practical implementation, the aim was to identify how these technologies can contribute to reducing material waste, improving sustainability and increasing precision in production.

RESULTS AND DISCUSSION

The initial stage of the study includes laser cutting of three types of textile materials: silk (T1), wool blend (T2) and knitwear (T3-T5), using simple patterns developed for this purpose (Table 1).

Table 1

Laser-cut material samples

	T1	T2	T3	T4	T5
Design					
Sample					

The laser-cut samples were visually evaluated. It was observed that the final result is influenced by the physical characteristics of the fabric, the cutting pattern and its positioning in the composition. The knitted sample (M5) was selected for the creation of the collection.

Based on the results, using 3D prototyping software [4, 5], a collection of virtual models was created, applying the Zero Waste principle through laser cutting technology (figure 1).

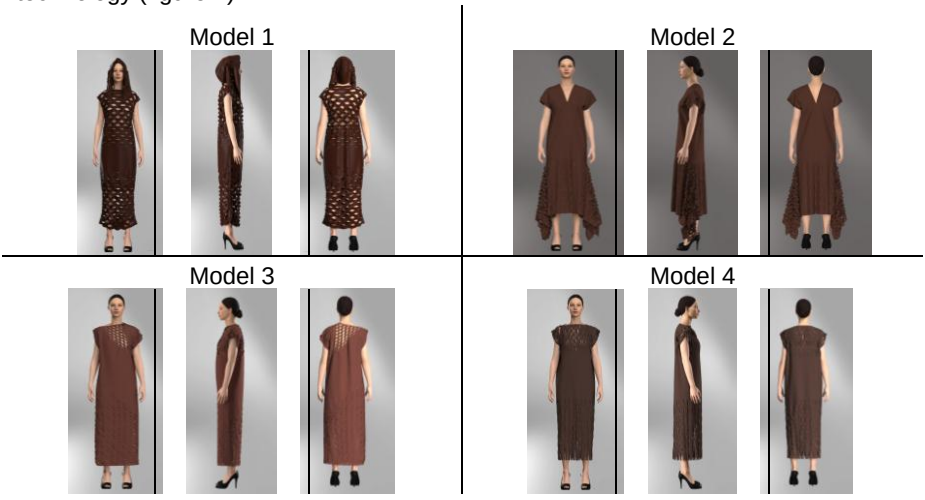


Fig. 1. Collection of virtual models made based on the sustainable concept

Model 2 was made using laser cutting technology (figure 2). Its design was based on the Zero Waste principle. The result is a sustainable product, demonstrating the benefits of integrating advanced technology into the clothing design process.

Fig. 2. Final Model

CONCLUSIONS

3D software, the Zero Waste concept and laser cutting are innovative technologies used in the fashion industry to improve the efficiency, sustainability and precision of clothing design and production processes. Following the theoretical and practical study, it was observed that the implementation of these technologies brings multiple advantages such as:

1. 3D software allows for the optimization of patterns, and laser cutting minimizes material losses, supporting the Zero Waste principle.
2. Laser cutting technology ensures a high level of precision, which leads to superior quality finished products.
3. 3D software allows for virtual testing of designs, reducing the need for physical prototypes and saving time and resources.
4. The Zero Waste concept and laser cutting help protect the environment by reducing waste and carbon emissions associated with traditional production.
5. Modern technologies stimulate creativity, allowing designers to explore new shapes and structures without compromising sustainability.

Although the use of 3D software and laser cutting brings multiple benefits, there are also some significant disadvantages. First, the high initial costs are a major obstacle. Second, there are limitations in materials. Not all types of materials can be effectively cut with lasers, and some may require technical adjustments or changes in the production process to accommodate this technology. Finally, the use of these advanced technologies requires specialized technical training, and personnel must be properly trained, which involves additional time and resources. The entire process is also a complex one that requires collaboration between fashion designers, software engineers and technicians operating the cutting equipment.

Despite these challenges, the long-term benefits of using these technologies for the environment and innovation in clothing design are undeniable. Their implementation not only reduces the environmental impact of the fashion industry, but also contributes to the evolution of creative processes, giving designers more freedom and the opportunity to explore innovative solutions.

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ЛАЗЕРНЕ РІЗАННЯ, НУЛЬ ВІДХОДІВ ТА ВІРТУАЛЬНЕ ПРОТОТИПУВАННЯ – СТАЛІ ІННОВАЦІЇ В ДИЗАЙНІ МОДНОГО ОДЯГУ

Zero Waste – це стійка концепція, яка спрямована на усунення відходів шляхом оптимізації ресурсів і повторного використання матеріалів. В індустрії моди це передбачає ефективні методи пошиття, переробки та використання передових технологій для мінімізації відходів. Завдяки інтеграції інноваційних технологій і процесів вплив на навколишнє середовище можна значно зменшити. Такий підхід не тільки підтримує сталість, але й відкриває нові естетичні та функціональні напрями в дизайні одягу. У роботі представлено теоретичне та практичне дослідження інноваційних технологій, які використовуються в сучасній індустрії моди.

Ключові слова: *лазерне різання, 3D прототипування, безвідходність.*