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DIGITAL FASHION – A SUSTAINABLE ALTERNATIVE FOR THE FUTURE

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Abstract: *Digital fashion is becoming a viable and sustainable solution to the ecological challenges faced by the clothing industry. This article explores how 3D technologies can serve as a sustainable means of design and production, helping to reduce environmental impact through the lowering of carbon emissions, water consumption, and textile waste. By replacing physical prototypes with virtual simulations, digital fashion enables an efficient, flexible, and waste-free creative process. The article presents arguments supporting the transition from traditional to virtual fashion: optimizing production costs, shortening the development time of collections, enabling design personalization, and increasing brand competitiveness in the digital market. Moreover, this transition allows for rapid adaptation to market demands and encourages responsible consumption. Special attention is given to the evolution of digital fashion in the Republic of Moldova, highlighting its integration into university curricula, particularly at the Faculty of Design of the Technical University of Moldova, as well as the first local industry initiatives in this direction. Concrete examples are provided regarding the use of CLO 3D, Style3D and CAD solutions, which contribute to developing students' digital skills and improving production efficiency. Although the digital transition faces challenges related to technological access and professional training, the article argues tha, through strategic investment and educational innovation, digital fashion can become a key pillar of sustainability in the fashion field.*

Key words: *digital fashion, sustainability, 3D design, virtual prototyping, CAD systems*

1. INTRODUCTION

Digital fashion represents a revolution in the fashion industry, offering innovative solutions that reduce the negative environmental impact. Through the use of 3D technologies, clothing design can be created and tested virtually, eliminating the need for physical prototypes and significantly reducing resource consumption. In a global context where the fashion industry is responsible for approximately 10% of carbon emissions and generates millions of tons of textile waste annually [1], the adoption of digital fashion becomes a necessity for a sustainable future.

The concept of digital fashion has evolved alongside advances in graphic technologies and artificial intelligence, driven by the need to optimize design and production processes. A relevant example is the use of 3D prototyping software, which enables the creation of virtual garments with realistic details, thus reducing material waste and the need for physical testing [2]. These tools allow designers to experiment with shapes, colors, and textures without generating waste, leading to increased efficiency and a reduced ecological footprint. Beyond environmental benefits, digital fashion also redefines the traditional economic model of the apparel industry. Platforms for selling virtual garments, such as The Fabricant and DressX [3, 4], demonstrate the emergence of a market for digital clothing, intended for both virtual environments and augmented reality [5]. This trend

reduces demand for fast fashion, thereby helping to decrease pollution caused by mass production.

However, the transition to digital fashion also presents challenges. Access to technology and the skills required to use 3D software remain obstacles for many traditional designers and manufacturers. Moreover, the energy sustainability of the servers running these technologies is a topic of ongoing debate. Nevertheless, the development of more energy-efficient practices and the increased accessibility of digital tools can contribute to the widespread adoption of this alternative.

2. ENVIRONMENTAL BENEFITS OF DIGITAL FASHION

The fashion industry has a significant impact on the environment, being responsible for approximately 10% of global carbon emissions and for the considerable consumption of natural resources such as water and energy. However, the integration of digital technologies—particularly 3D design—can address these ecological issues by optimizing production processes, reducing material waste, and lowering the carbon footprint. Figure 1 illustrates the problems generated by traditional fashion under current conditions.

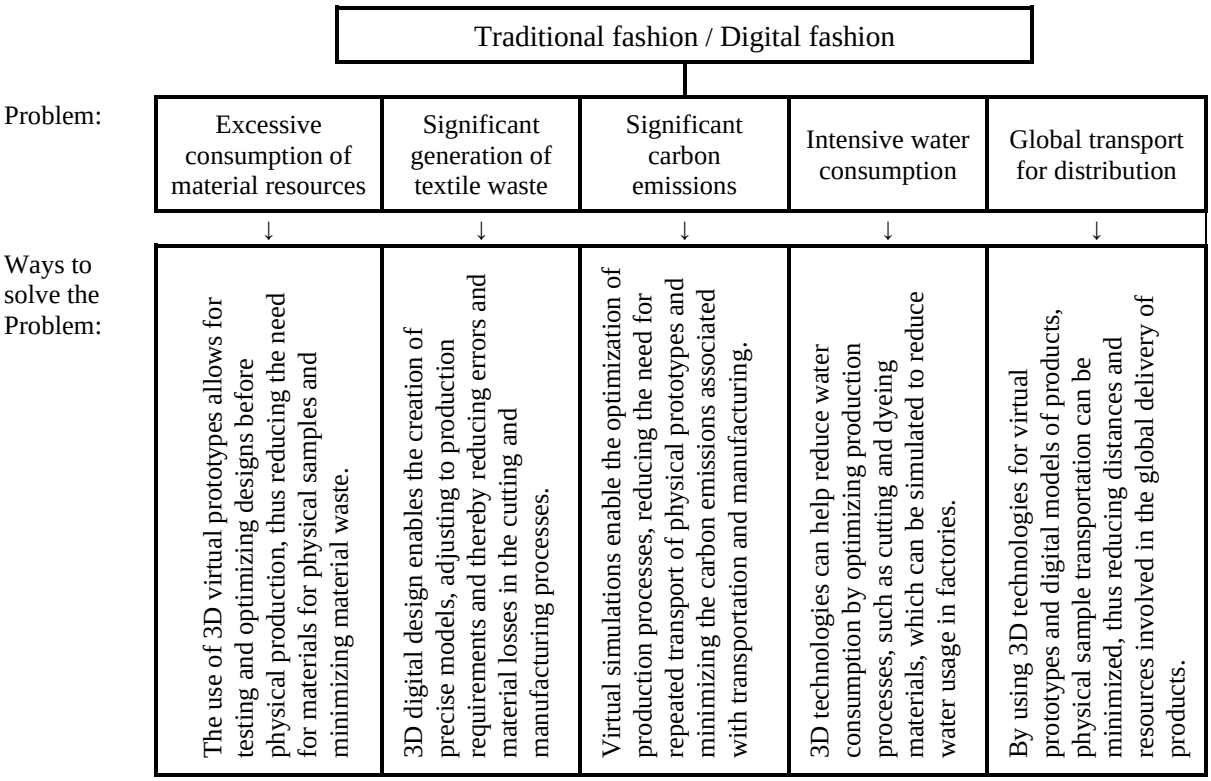


Fig. 1: *Problems caused by traditional fashion*

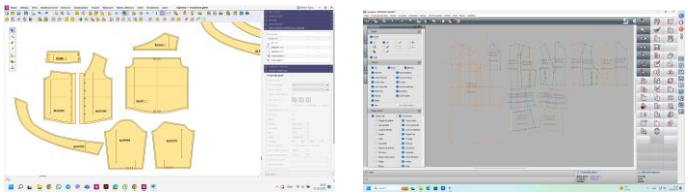
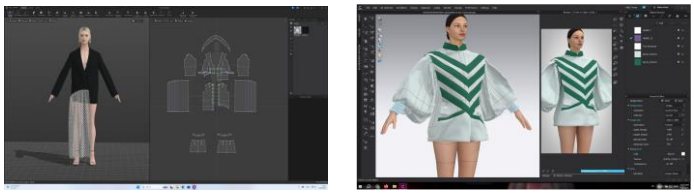
An important aspect is that digital models can have a significant impact on production costs. According to a report by McKinsey & Company (2025), the digital design process can reduce production costs by up to 30%, thereby saving considerable financial resources for brands and companies of all sizes. [6] This is due to the elimination of many physical production stages, thus reducing the need for physical samples.

3. DIGITAL FASHION IN THE REPUBLIC OF MOLDOVA

In the Republic of Moldova, digital fashion is beginning to make its presence felt, highlighted by innovative initiatives and collaborations. When analyzing the fashion sector, two main directions for the use of digital fashion can be observed.

The first direction is higher education in the fashion field, where digital fashion is gradually being integrated into study programs. Specialized universities are starting to include courses focused on computer-aided design (CAD) and 3D simulations for clothing for personalized avatars. [7] These tools not only develop students' digital skills, but also provide a sustainable framework for creative experimentation without the physical consumption of resources. Digital fashion thus becomes an essential element in the training of future professionals. In this context, I would like to emphasize that at the Faculty of Design of the Technical University of Moldova, there is an increasing openness to integrating digital technologies into the curriculum. Students are introduced to specialized software, such as CLO 3D and Style3D, which enables them to design collections in a virtual environment, visualize patterns on 3D avatars, and experiment with textures and volumes in a sustainable way (Table 1).

Table 1: *Results of using 2D and 3D software at the Faculty of Design*

Type	Examples
CAD Systems (GeminiCAD, AssystCAD)	
3D Prototyping Software (Style3D, CLO3D)	

The second direction is the integration of digital fashion into the manufacturing industry, where the focus is on streamlining design, prototyping, and promotion processes. Local brands and workshops are beginning to use 3D technology to reduce the time required for collection development, eliminate the need for physical samples in the early stages and create realistic visual content for digital marketing. In this context, digital fashion directly contributes to cost optimization and increased market competitiveness. Some brands and creative workshops in the Republic of Moldova have started adopting digital technology in the processes of designing and developing products. With the support of ZIPHOUSE Fashion Innovation Hub, [8] they are experimenting with the application of digital solutions in the creation of innovative garments. The results of these initiatives were showcased at the Moldovan Brands Runway SS24 event, which highlighted the integration of digital art into fashion shows, setting a new standard for future editions and demonstrating the creative potential of Moldovan fashion on the international stage. [8]

However, at the level of production within local enterprises, digital technologies are predominantly used in the stages of pattern making, construction verification, and frame creation, which helps optimize material consumption and reduce execution errors.

4. CONCLUSIONS

Digital fashion brings a range of significant benefits to the apparel industry, particularly through its ability to reduce ecological impact, streamline production processes, and stimulate creative innovation. The use of 3D technologies and computer-aided design software allows for the elimination of physical prototypes, conserving resources and shortening the time required for collection launches. Moreover, the integration of digital fashion into education and industry contributes to the development of professionals who are better equipped to meet the demands of the contemporary market. Additionally, it serves as a sustainable solution that reduces waste, supports the circular economy, and fosters more responsible production practices. However, the transition to digital is not without difficulties. Limited access to advanced technology, a lack of technical skills among industry professionals and the need for significant initial investment present tangible barriers. Furthermore, many companies remain hesitant to adopt new technologies, either due to fear of failure or a lack of understanding regarding the long-term benefits. This reluctance slows down the innovation process and keeps the industry entrenched in traditional, less efficient models of production.

Therefore, for digital fashion to become a fundamental component of sustainability in the fashion industry, technological development alone is not enough. A shift in mindset is equally necessary, both within companies and educational institutions. This shift must encourage experimentation, embrace innovation, and promote the adoption of sustainable practices. Only by fostering a culture of openness to digital transformation can the fashion industry fully realize the potential of digital fashion, ensuring it becomes a key player in shaping a more sustainable and efficient future.

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