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DIGITAL PROTOTYPING – A SUSTAINABLE DIRECTION IN CONTEMPORARY FASHION

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3D prototyping software is an innovative solution that revolutionizes the design and production process, allowing the creation of virtual samples without wasting physical materials. Through digital garment simulation, designers can adjust the silhouette, texture, and colors in real time, eliminating the need for physical prototypes and significantly reducing textile waste. The paper comes to present that 3D technologies not only optimize the creative process, but also contribute to a more sustainable fashion industry, in which resources are used more efficiently and production becomes more responsible.

Key words: sustainability, digital design, e-prototyping

INTRODUCTION

Fashion industry is considered one of the largest polluters in the world by the UN Conference on Trade and Development. The environmental damage is only increasing as the industry grows. The production and distribution of the fibers and garments used in fashion all contribute to different forms of environmental pollution, including water, air, and soil pollution [1].

Digitalization is the means by which the fashion industry can reduce these harmful effects and respond more quickly to sustainability needs. Digital technologies allow for the optimization of design, production and distribution processes, reducing material waste, saving resources and minimizing carbon emissions.

An analysis of digital fashion innovations [2] highlights that one of the priority themes in this field is **digital design and e-prototyping**. These come as an essential direction for optimizing creative and production processes, offering sustainable and efficient solutions for the fashion industry.

PURPOSE

The purpose of this study is to analyze the benefits of using 3D prototyping software in the design and manufacturing process of clothing products. By investigating this topic, we aim to highlight the advantages of these technologies in optimizing design and streamlining production, as well as identifying the potential negative impacts associated with their use.



RESULTS AND DISCUSSION

The first CAD systems, the PRONTO system (1957) and the Sketchpad system (1960), were used by large companies in the aerospace and automotive fields due to the high price of computers. It was not until the 1980s that they became accessible to designers once PCs became more widely available [2], which led to a wide use of different applications. Thus, in the fashion industry there are a number of software applications used in the fashion field (fig. 1).

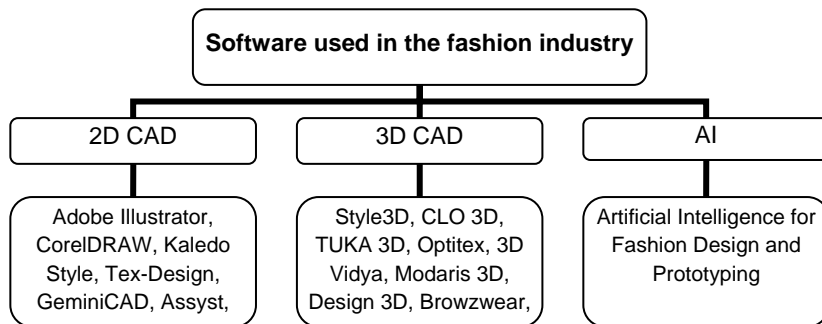


Fig. 1. Fashion software classification

The use of these software applications allows the fashion industry to optimize design, prototyping and production processes, thus contributing to increasing efficiency and reducing environmental impact. Thus:

- 2D CAD solutions are used to create technical sketches, patterns and production specifications, providing designers with a precise and fast way to create and modify models. These tools help standardize processes and reduce errors in the initial stages of design.

- 3D CAD technologies allow the digital simulation of clothing on virtual avatars, providing the possibility to test the pattern, draping and behavior of materials before physical production. This leads to a reduction in the number of physical samples required, saving time and resources.

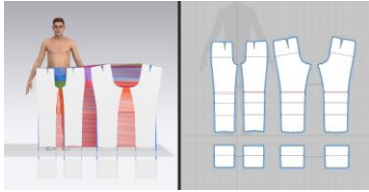





- Artificial intelligence (AI) in clothing design and prototyping plays an increasingly important role, enabling trend analysis, automatic generation of designs and optimizing the decision-making process. AI can contribute to product customization and supply chain efficiency, reducing overproduction and material waste.

Software applications used in fashion help digitize the creative process, optimize production, and reduce environmental impact. They allow designers to visualize and test virtual models before manufacturing, contributing to efficiency and precision. The following are the main directions of use of 3D CAD systems in the fashion field and their impact on design, production and sustainability processes (table 1):



Table 1

The main directions of using 3D CAD systems

The main directions	Examples
1. Digital design and prototyping [3] <ul style="list-style-type: none"> - Allows the rapid creation of 3D models of garments, reducing the need for physical prototypes. - Provides flexibility in testing different shapes and cuts. - Reduces collection development time and production costs. 	
2. Modular design [3] <ul style="list-style-type: none"> - Creates garments made up of interchangeable modules. - Allows for customization and reuse of design elements. - Helps reduce waste and extend product life 	
3. Simultaneous diversification [4] <ul style="list-style-type: none"> - Allows testing and comparing multiple design options at the same time. - Helps make quick decisions based on multiple material and color options. - Facilitates the adaptation of products to different markets and consumer preferences. 	
4. Personalized design [3] <ul style="list-style-type: none"> - Allows the creation of clothes to the exact size of each customer. - Facilitates adjustments and customization of products at no additional cost. - Provides brands with flexibility in creating collections and quickly adapting to market demands. 	
5. Sustainability [5] <ul style="list-style-type: none"> - Minimizes material waste through digital simulation and testing. - Reduces the need for physical samples and optimizes fabric consumption. - Supports the circular economy through the reuse of digital designs. 	
6. Production process optimization [6] <ul style="list-style-type: none"> - Reduces production time and minimizes human errors. - Contributes to the automation and digitalization of the fashion industry. 	



CONCLUSIONS

Digital Prototyping in fashion optimizes design and production processes. However, the most important benefit remains sustainability, as it minimizes material waste, optimizes resources and reduces the ecological footprint, thus contributing to a more responsible future of the fashion industry.

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ЦИФРОВЕ ПРОТОТИПУВАННЯ – СТАЛИЙ НАПРЯМ СУЧАСНОЇ МОДИ

Програмне забезпечення для створення 3D-прототипів – це інноваційне рішення, яке революціонізує процес проектування та виробництва, дозволяючи створювати віртуальні зразки без витрачання фізичних матеріалів. Завдяки цифровому моделюванню одягу дизайнери можуть коригувати силует, текстуру та кольори в режимі реального часу, усуваючи потребу у фізичних прототипах і значно скорочуючи текстильні відходи. У роботі показано, що 3D-технології не тільки оптимізують творчий процес, але й сприяють більш стійкій фазі функціонування індустрії моди, в якій ресурси використовуються більш ефективно, а виробництво стає більш відповідальним.

Ключові слова: стійкість, цифровий дизайн, електронне прототипування.