

## Revolutionizing fashion prototyping: the power of 3D technology in first sample development

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### Review\*\*

*The fashion design industry has undergone a significant transformation in recent years due to the adoption of 3D technology in pattern making and fashion design. Pattern makers and fashion designers are utilizing virtual prototyping to optimize the creation of initial samples, resulting in numerous advantages that extend beyond conventional fashion production. One of the most significant advantages of this innovative approach is the precision and efficiency it offers in pattern making. By constructing and modeling patterns within virtual 3D software programs and subsequently testing them on 3D avatars tailored to desired size and proportions, pattern makers can achieve an unparalleled level of accuracy. The reduction in physical samples dramatically decreases material waste, contributing to a more environmentally friendly production process. The ability to visualize and experiment with designs on digital avatars allows designers to visualize their sketches and have max control over the design process. This enables creative exploration, allowing for the testing of a wide range of colors, textures, and styles with remarkable ease. In this paper the pivotal role that 3D technology plays in reshaping the creation of initial samples in the fashion industry is emphasised. Its implications extend far beyond the design studio, with significant benefits, including precision, cost-effectiveness, sustainability, and creative potential. The main goal of this thesis is to explore these subjects in greater depth and demonstrate the transformative impact of 3D technology on fashion prototyping, offering the potential for a future characterized by efficient, economical, and environmentally friendly fashion manufacturing.*

**Keywords:** digitisation; dress; textiles; preservation; collections; material culture

### Pregled\*\*

Industrija modnog dizajna doživjela je značajnu transformaciju posljednjih godina uslijed uvođenja 3D tehnologije u izradu prvog uzorka i dizajn odjeće. Konstruktori krojeva i modni dizajneri koriste virtualno prototipiranje kako bi optimizirali izradu prvih uzoraka, donoseći brojne prednosti koje nadilaze tradicionalnu proizvodnju u modi. Jedna od najvažnijih prednosti ovog inovativnog pristupa jest preciznost i učinkovitost u izradi prototipa. Izradom i modeliranjem krojeva unutar virtualnih 3D softverskih programa te njihovim testiranjem na 3D avatarima prilagođenima željenim dimenzijama i proporcijama, konstruktori postižu neusporedivu razinu točnosti. Smanjenje fizičkih uzoraka drastično smanjuje otpad materijala, pridonoseći ekološki prihvatljivijem proizvodnom procesu. Mogućnost vizualizacije i eksperimentiranja s dizajnom na digitalnim avatarima omogućuje dizajnerima da svoje skice pretvore u vizualne prikaze te imaju maksimalnu kontrolu nad procesom dizajna. Time se potiče kreativno istraživanje, omogućujući testiranje širokog spektra boja, tekstura i stilova s iznimnom lakoćom. U radu je naglašena ključna uloga 3D tehnologije u izradi prvog uzorka u modnoj industriji. Njene implikacije nadilaze dizajnerski studio, donoseći značajne prednosti poput preciznosti, isplativosti, održivosti i kreativnog potencijala. Glavni cilj ovog rada je dublje istražiti te aspekte i demonstrirati transformativni utjecaj 3D tehnologije na izradu prototipa, nudeći perspektivu budućnosti obilježene učinkovitošću, ekonomičnošću i ekološki održivom proizvodnjom odjeće.

**Ključne riječi:** digitalizacija; odjeća; tekstil; očuvanje; zbirke; materijalna kultura

## 1. Introduction

The clothing industry is driven towards a permanently accelerating fashion, offering its products faster, cheaper, and in bigger abundance than ever. This demand has resulted in the search for new techniques that will add value in the product development process [1]. The traditional methods in fashion design and pattern making have persistently faced challenges concerning inefficiencies, imprecisions, and significant material wastage, resulting in high production costs and extended lead times. Relying on physical prototypes and manual adjustments often leads to errors and needs significant additional work or adjustments. These challenges present obstacles in meeting the demands of an ever-evolving industry. However, the introduction of advanced 3D technology has emerged as a potential solution to address these longstanding issues. By leveraging virtual prototyping, pattern makers and designers can now create, refine, and test patterns on custom 3D avatars, promising precise fits and reduced errors, fundamentally reshaping the design and production processes.

The application of 3D technology in fashion design and pattern making serves as a revolutionary tool in optimizing the creation of first samples. This innovative technology has established a significant presence within the textile and fashion sector, notably influencing the work of pattern makers and designers. The adoption of virtual prototyping through 3D software programs has allowed for enhanced precision and efficiency, addressing critical challenges faced in the traditional pattern-making process. 3D virtual prototyping technology enables pattern makers to test the fit of products thus not only reducing the number of samples being made and reducing raw material and labor cost, but also reducing the amount of time it takes to get clothes to market. This means apparel companies can make the most of market trends, increasing profit by cutting down returns due to poor fit [2]. This application area serves as a pivotal arena for innovation, cost reduction, and environmental sustainability, positioning itself at the forefront of technological advancements within the fashion sector.

The core of this research is to analyze the transformative impact of 3D technology specifically in the creation of first samples or prototypes in pattern making and fashion design. This research delves into how virtual prototyping, using 3D technology, influences pattern accuracy, production costs, and environmental sustainability within the textile and fashion industry. It seeks to understand the shift from conventional methods to advanced 3D technology,

assessing its multiple advantages, including precision, efficiency, cost-effectiveness, and minimized material waste in the context of creating first samples. Moreover, the research aims to highlight the crucial role of pattern makers and designers in utilizing 3D technology to achieve unparalleled accuracy in the development of these first samples, thereby shaping the future landscape of fashion design and production.

## 2. Method

3D software has revolutionized the textile and fashion industry, offering innovative solutions for design, production, and presentation. Specifically designed for the textile and fashion sector, these advanced tools, such as Clo3D, Browzwear, Optitex, and Style3D, bring a new dimension to design processes.

In the textile industry, 3D software allows for the creation of virtual fabric simulations, enabling designers and manufacturers to visualize how different materials will drape, fold, and behave in various garment designs. This digital representation of fabrics aids in decision-making during the design phase, reducing the need for physical samples and thus cutting down on material waste. The production of a digital garment yields 97% less CO<sub>2</sub> than that of a physical garment, and the end product never ends up in a landfill. Many retailers are already experimenting with digital sampling of new designs to reduce wastage in the production process [3]. Moreover, 3D software offers tools for pattern making, facilitating the creation and adjustment of patterns before physical prototyping, enhancing precision and reducing production costs.

The 3D concept is an important development in the design process. It allows designers to unleash their creativity in a real-life visualization of designs that could previously only be imagined through 2D sketches [4]. Designers can visualize their concepts on virtual avatars, experimenting with colors, textures, and styles, leading to quicker iterations and more accurate representations of their creative vision. These tools have streamlined the design-to-production process, significantly reducing the time required to bring a product from concept to market. Furthermore, these innovative software have revolutionized the way fashion collections are presented, allowing for lifelike visualizations and dynamic animations. The advanced capabilities in virtual prototyping and realistic simulations have transformed the traditional fashion show into a digital and interactive experience, making it an ideal tool for researching the impact of 3D technology in the fashion design process.

Here, Style3D will be used to provide insight into how first prototypes can be made using these advanced tools. Style3D proves to be a transformative tool for both pattern makers and designers in the creation of first samples. Pattern makers benefit from enhanced precision in crafting and testing patterns within a virtual 3D space, ensuring an accurate fit of the pattern before physical production. This precision drastically reduces material waste, as errors are identified and rectified at early stages. The software's real-time simulations allow swift adjustments, saving time and effort typically expended in manual modifications, streamlining the iterative process for pattern makers. For designers, Style3D fosters a realm of creative exploration. It empowers designers to experiment extensively with various styles, colors, and textures, encouraging innovation within a virtual environment. The software's high definition visualization enables designers to see how their creations will appear in real-world scenarios, refining designs before the production phase. Additionally, the direct cloud connection feature facilitates seamless sharing of 3D sketches among team members, fostering efficient collaboration and expediting the design-to-production cycle. Overall, Style3D significantly elevates the efficiency, precision, and collaborative potential for both pattern makers and designers, revolutionizing the creation of initial prototypes in the fashion industry.

### 3. Adjusting the virtual avatar

Adjusting the virtual avatar in 3D software for the first sample base size is the first step in the garment production process. The desired avatar (male, female, boy, girl, child) can be customized and tailored to match the desired body measurements, allowing for a more accurate representation of various body types. Designers and pattern makers can adjust specific measurements such as height, chest, waist, hips, and more (Fig.1), providing a realistic base size for initial sample creation. This customization not only reflects diverse body shapes but also ensures that the clothing fits accurately and proportionately on the virtual avatar, resembling the intended real-world fit.

Moreover, in Style3D, the capacity to modify the avatar's proportions and dimensions goes beyond basic measurements. Designers have the flexibility to fine-tune the smallest details, such as sleeve length, necklines, or specific body contours, offering a highly customizable and detailed representation. This level of customization facilitates a more comprehensive evaluation of how a garment will appear on the desired body type, contributing to better design precision and reducing the need for extensive adjustments during the physical sample creation stage. Adjusting the avatar to the initial sample base size in 3D software plays a fundamental role in ensuring accurate and well-fitted designs, thus streamlining the overall production process.

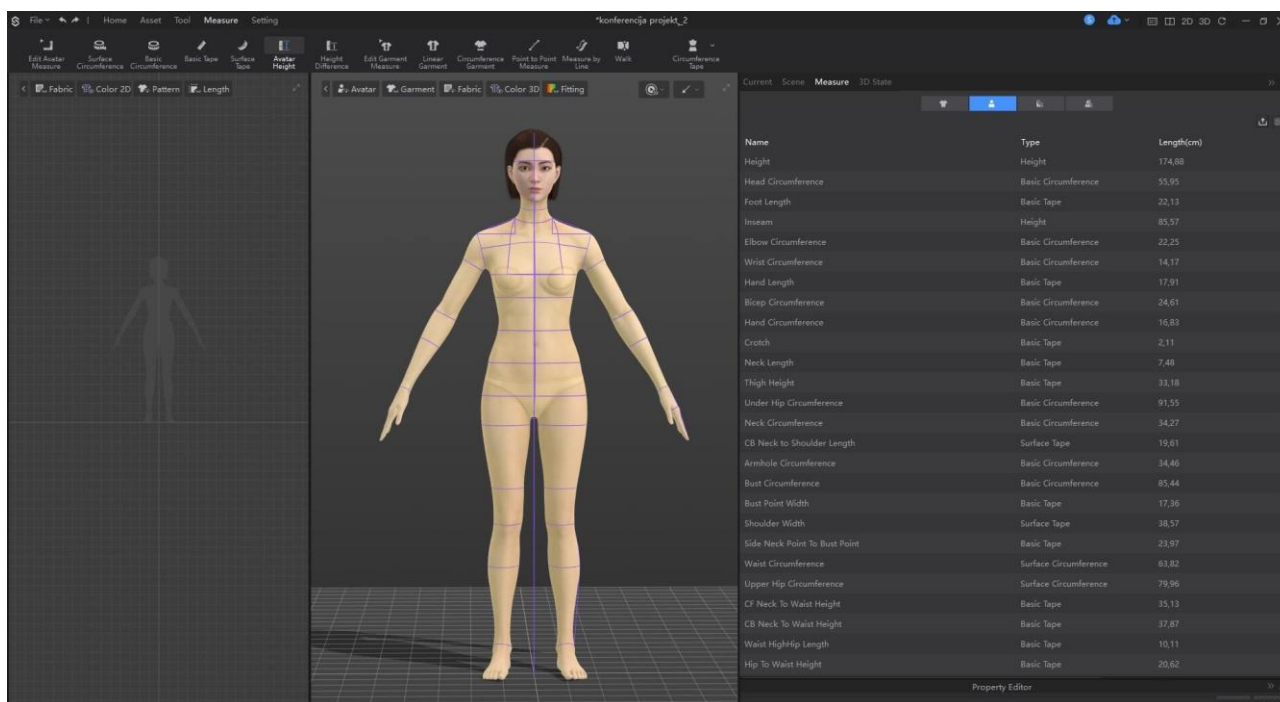


Fig.1 Style3D interface for adjusting the body measurements of the female avatar

#### 4. Pattern making in 3D software

Pattern making is one of the most vital parts of product development in the apparel or other textile industry. However, the traditional 2D pattern-making method is tedious, abstract, and time-consuming [5]. Pattern making in 3D software not only simplifies the design process but also plays a pivotal role in creating the first sample or prototype. Tools available in software like Style3D offer a comprehensive approach, allowing pattern makers to swiftly and accurately construct initial garment patterns in a virtual environment. The software provides an efficient platform for precise pattern development, enabling the customization of patterns according to various body sizes and styles. This digital tailoring ensures that the first sample closely aligns with the intended design, significantly reducing the need for extensive adjustments during physical prototyping.

Alongside pattern precision and swift adjustments, advanced features such as body pressure analysis, garment stress analysis, garment deformation analysis, and thermal insulation analysis empower designers and pattern makers to assess critical parameters and the fit of the garment on the digital avatar. These specialized tools offer in-depth insights into how a garment interacts with the digital model. Body pressure analysis allows for the examination of how the garment applies pressure on various parts of the body, ensuring optimal comfort and fit. Garment stress analysis enables a detailed evaluation of stress points, aiding in identifying potential weak areas in the garment's structure. Furthermore, garment defor-

mation analysis provides a comprehensive understanding of how the garment drapes and moves on the avatar, offering crucial insights into the design's behavior in different positions and movements. In addition, thermal insulation analysis allows designers to assess the garment's insulation properties, crucial for performance or outerwear apparel. By simulating real-world conditions (Fig.2), these analysis tools not only refine the fit and functionality of the garment on the avatar but also contribute to the overall quality, comfort, and performance of the final product. This comprehensive approach in pattern making, with tools that analyze various parameters and fit on the avatar, ensures that the design not only looks aesthetically pleasing but also functions optimally in practical use cases.

Moreover, the swift and responsive tools within 3D software expedite the pattern-making process, facilitating quick iterations and adjustments. Designers and pattern makers can efficiently manipulate pattern pieces, modify details, and make instant alterations that are simultaneously visible on the avatar. This accelerated process significantly reduces the time required for pattern creation, allowing for a faster transition from the initial design concept to a tangible prototype. The real-time visualization of these adjustments on digital avatars ensures a more accurate representation, contributing to the creation of a well-fitted first sample, all while minimizing material waste and production costs. In essence, 3D software not only revolutionizes pattern making by enhancing speed and precision but also significantly contributes to the creation of accurate and well-fitted first samples in the fashion industry.

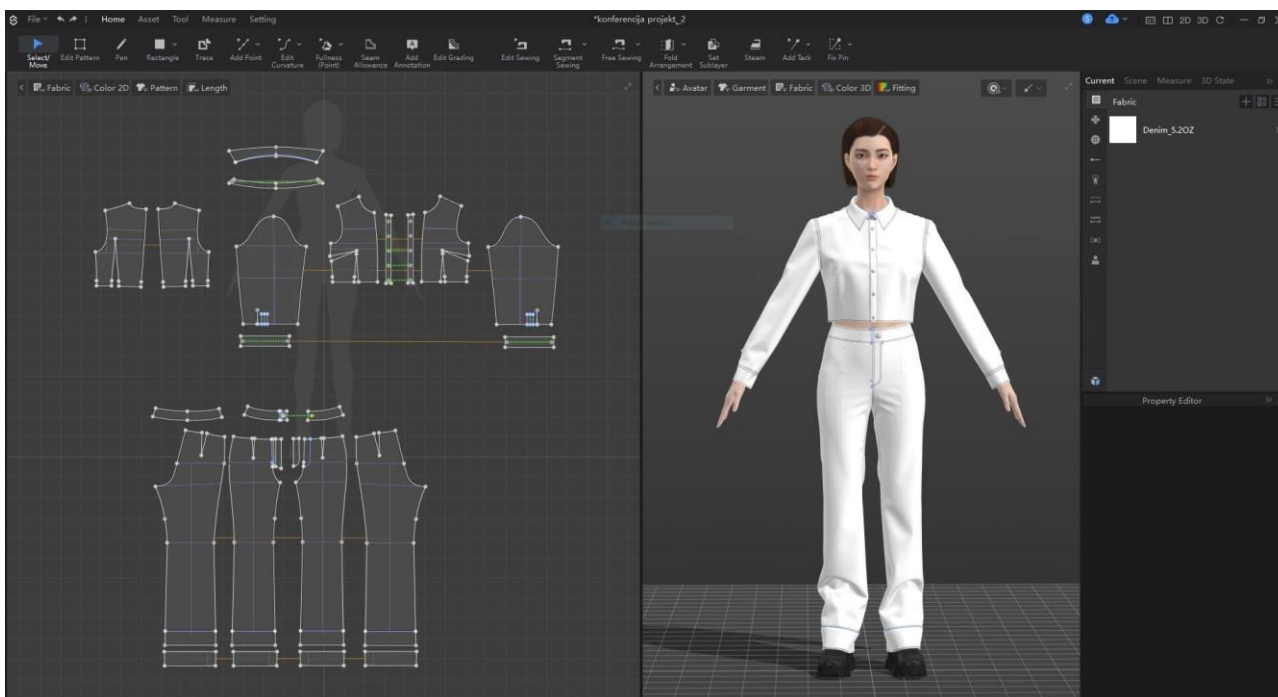


Fig.2 Style3D interface for pattern creation and real-time avatar adjustments

## 5. Design application in 3D software

In the fashion design process using 3D software like Style3D, after the construction of the first pattern, designers move on to apply colors, materials, and various design elements to create the final look of the garment. Style3D offers a diverse range of tools and features that facilitate this phase, allowing designers to experiment with an array of colors, textures, and materials to visualize the finished product (Fig.3).

The software provides a platform for designers to seamlessly apply different color schemes, experiment with fabric types, and test various textures on the digital garment model. It allows for the simulation of how the chosen materials will drape, fold, and interact with different designs. This virtual experimentation stage is instrumental in determining the visual aesthetics of the garment, aiding in the decision-making process for the final design. Furthermore, the ability to manipulate color, material, and other design elements in a virtual environment saves time by allowing swift adjustments without the need for multiple physical samples, thereby increasing efficiency in the design-to-production cycle.

In addition, Style3D enables designers to simulate various design elements, such as embellishments, prints, and trim details (buttons, eyelets, zippers etc.) on the virtual garment. This process allows for intricate detailing and accurate visualization of how these design elements will appear in the final product. By facilitating these design adjustments and detailing in a digital space, use of 3D significantly enhances the

design process, contributing to a more accurate representation of the final garment and expediting the decision-making process for designers.

## 6. Strategic utilization of first samples using 3D

Brands, fashion or otherwise, have an incredible opportunity to improve relevance and longevity through unique applications of the latest technology [6]. The utilization of 3D technology, particularly in creating prototypes, extends beyond the production phase and enters the domain of promotional strategies. Using 3D software, the creation of visually striking first samples presents an invaluable promotional opportunity for fashion brands. These digital prototypes not only serve as the foundation for physical production but also act as powerful marketing tools.

The accuracy and detailed representation of initial samples created in 3D software offer an exceptional advantage for promotional purposes. Brands can leverage these highly realistic digital models to showcase their designs before the actual production, enabling them to engage audiences with a sneak peek into upcoming collections. Utilizing these detailed representations in marketing materials, such as lookbooks, digital campaigns, or interactive experiences and animations, provides consumers with a vivid visualization of the final product (Fig.4).

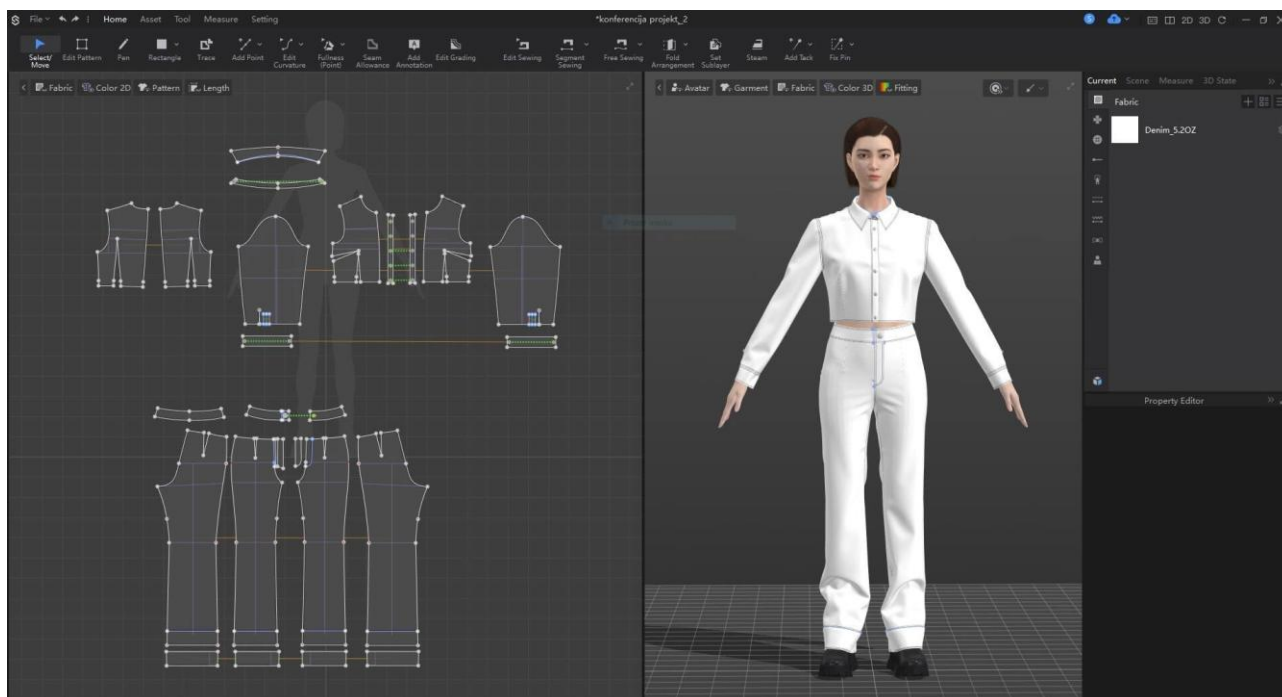


Fig.3 Style3D interface for selecting materials, textures, trims etc. in the designing process

The versatility of 3D models allows for easy adaptation to various marketing platforms, enhancing their accessibility for online stores, social media, and interactive presentations.

Furthermore, the efficiency of creating initial samples in 3D enhances the promotional timeline. Designers and brands can swiftly produce visually appealing representations and incorporate them into marketing materials much earlier in the production cycle. This early introduction of designs allows for increased anticipation and engagement from the audience, ultimately creating a sense of exclusivity and desire for the soon-to-be-released collection. By integrating the creation of initial samples with promotional strategies, 3D technology not only accelerates the design-to-production process but also serves as a potent promotional asset, influencing consumer perceptions and fostering excitement for upcoming fashion lines.

## 7. Conclusion

The integration of 3D technology in the fashion design and pattern-making process has irrefutably redefined the industry's traditional methods. This revolutionary shift addresses longstanding challenges present in the conventional approach, such as inefficiencies, imprecisions, and substantial material wastage. Through the implementation of virtual prototyping and 3D software tools like Style3D, pattern makers and designers can now create, refine,

and meticulously test patterns on customized 3D avatars. This transformative approach significantly augments the precision and efficiency in pattern construction, assuring a flawless fit and considerably reducing errors, thereby reshaping the landscape of design and production processes within the fashion industry.

The great impact of 3D technology extends beyond the design studio, infiltrating promotional strategies with exceptional advantages. Utilizing these highly realistic digital prototypes as powerful marketing tools offers brands a unique edge in captivating their audience. The realistic and lifelike representations enable early glimpses of upcoming collections, creating anticipation and exclusivity, resonating across various marketing platforms. The efficiency in generating these first samples allows designers and brands to seamlessly incorporate them into marketing materials, providing consumer engagement through vibrant and creative previews.

In essence, the strategic union of creating first samples in 3D technology with promotional strategies has transformed the way fashion collections are introduced and received in the market. This combination not only accelerates the design-to-production cycle but also serves as a powerful promotional asset, influencing consumer perceptions and creating excitement for the upcoming fashion lines. The impact resonates throughout the industry, marking a significant leap forward, ensuring fashion design and production remains at the forefront of technological innovation and resonates with the ever-evolving demands of consumers and the industry.



**Fig.4** Examples of showcasing 3D garments for promotional purposes

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