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DIGITAL DESIGN OF TRANSFORMABLE CLOTHING FOR GIRLS

Purpose. *The aim of the research is to highlight the possibilities of using Style3D software for the digital design and prototyping of transformable clothing for girls. The study seeks to explore the capabilities of three-dimensional modeling and virtual simulation for representing the shape, construction, and appearance of clothing products designed for children. Particular emphasis is placed on integrating transformable elements into garment structures and visualizing the effects of construction modifications in a digital environment. The use of a virtual prototype enables the examination of design solutions before the physical product is manufactured. Thus, the research highlights the contribution of Style3D to optimizing the design process and developing functional and adaptable clothing products.*

Keywords*: children's clothing, clothing collection, digital prototyping, transformable elements, digital simulation.*

Objectives. The research objectives focus on examining the possibilities offered by Style3D in the digital design of transformable clothing for girls. The study aims to use three-dimensional modeling tools for the virtual representation of clothing products. An important objective is the integration and visualization of transformable structural elements within the garment configuration. The research also seeks to analyse visual appearance and material behavior through digital simulation. Finally, it highlights the role of the virtual prototype in verifying and adjusting design solutions before the physical garment is manufactured.

Methodology. The research methodology is based on a review of the specialized literature on digital design and three-dimensional garment prototyping, as well as the practical application of Style3D software [1–3]. The design process involves constructing a digital model of the garment and creating a three-dimensional representation of its components. The software tools are used to visualize the shape, proportions, construction details, and relationships between the garment components. Virtual simulation enables the examination of the garment's appearance and material behavior within the digital environment. Design solutions are evaluated in terms of the functionality of the transformable elements and the

aesthetic coherence of the product. This approach makes it possible to identify and adjust specific construction features at the virtual stage, before producing the physical prototype.

Research results. The digital design of transformable clothing for girls involves the use of three-dimensional modeling tools to develop, visualize, and evaluate construction solutions. In this research, Style3D software is used to create a virtual representation of the garment and examine its transformation possibilities. This approach enables the simultaneous analysis of aesthetic appearance, structural form, and the relationships between the product components. The results are presented through the three-dimensional model, transformation variants, and virtual simulation, highlighting the contribution of digital prototyping to the design process.

The digital design process for transformable clothing can be structured into several stages, from concept definition to virtual prototype evaluation [4, 5]. Research on 3D garment design highlights the advantages of rapid model modifications and the virtual evaluation of design solutions before physical prototypes are produced. Within this approach, Style3D is used as a tool for the three-dimensional visualization and simulation of the garment.

Table 1 – **Stages of the Digital Design of Transformable Clothing**

Stage	Main activity	Expected outcome
1. Conceptualization	Defining the product's appearance and function	Design concept
2. Model development	Creating the digital garment model	Initial 3D model
3. Integration of transformations	Representing alternative construction variants	Alternative configurations
4. Virtual simulation	Visualizing the shape and material	Virtual prototype

During the conceptualization stage, the specific characteristics of transformable clothing for girls were analysed, with an emphasis on functionality, aesthetic appearance, and the possibility of modifying the product configuration. Design solutions were identified to enable the integration of multifunctional structural elements while maintaining the stylistic unity of the garment. The stylistic direction, colour palette, and principles governing the transformation of the garment were also established. The design concept was developed with consideration for the specific requirements of girls' clothing and the possibility of creating several usage variants. At this stage, the main characteristics of the product were outlined, providing the basis for the development of the three-dimensional model. The proposed concept guided the subsequent stages of digital design and prototyping in Style3D, as shown in figure 1.

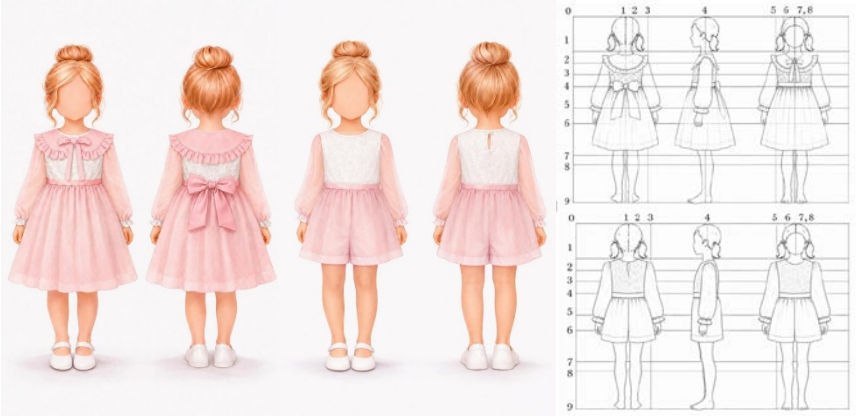


Fig. 1. **Model sketch and diagram of construction levels**

Three-dimensional modelling is an important stage in digital design, as it enables the garment to be examined before its physical production. In Style3D, the virtual model makes it possible to observe the silhouette, proportions, construction details, and appearance of the materials. During the three-dimensional model development stage, the digital construction of the garment was carried out in Style3D in accordance with the established concept. The shape, proportions, and structural components of the product were defined to achieve a coherent three-dimensional representation.



Fig. 2. **Digital construction of the initial model in Style3D**

An important aspect of transformable clothing design is the identification of components that can be modified, detached, or reconfigured. These solutions make it possible to create several usage variants and change the appearance of the product without manufacturing an entirely new garment. In the Style3D environment, design alternatives can be represented through virtual models, facilitating the comparison of configurations and the assessment of their aesthetic coherence.

During the transformation integration stage, the structural elements that enable changes to the appearance and configuration of the garment were identified and modelled: the skirt, shorts, sleeves, collar, and decorative bow. These elements were integrated into the digital model, with the aim of preserving the garment's aesthetic unity and structural coherence. By representing the different variants in Style3D, the possibilities for transforming the product and adapting it to different usage requirements were demonstrated.



Fig. 3. **Representation of the garment's transformable structural elements**

Virtual simulation in Style3D helps to assess the appearance of a garment before a physical prototype is produced. Three-dimensional visualization makes it possible to observe proportions, fabric drape, and the way in which construction details influence the overall shape of the garment. Modifications made to the digital model facilitate the comparison of design solutions and the selection of the variant considered most suitable from both aesthetic and structural perspectives. However, virtual simulation does not entirely replace physical product testing, particularly with regard to comfort, seam strength, and the functionality of transformation mechanisms.

Progressing through the four stages of digital design—conceptualization, model development, integration of transformations, and virtual simulation—enables a three-dimensional representation of the garment to be created and the

proposed design solutions to be examined. The results demonstrate the possibilities offered by Style3D for developing transformable clothing for girls. At the same time, determining the effectiveness of digital prototyping requires an analysis of its advantages, as well as the limitations that may affect the transition from the virtual model to the physical product.



Fig. 4. **Virtual simulation of the garment prototype in Style3D**

Digital prototyping using Style3D offers significant advantages in the design process for transformable clothing for girls. One of its main benefits is the ability to visualize the garment in three dimensions before manufacturing it. Virtual representation facilitates the analysis of the silhouette, proportions, construction details, and the integration of transformable elements into the garment structure. This allows designers to assess the overall appearance of the model and identify potential visual inconsistencies during the design stage.

Another advantage is the ability to modify and compare design alternatives without repeatedly producing physical prototypes. Adjusting the shape, structural components, and transformation solutions enables the digital model to be optimized and can help reduce material consumption and the time required for product development. Virtual simulation also facilitates the observation of material behaviour, fabric drape, and volume formation, providing useful information for assessing the garment's aesthetic appearance. In the case of transformable clothing, visualizing different configurations makes it possible to examine how structural modifications affect the model's appearance and stylistic coherence.

Nevertheless, digital prototyping also has certain limitations. Simulation results depend on the accuracy of the three-dimensional model, the configured material properties, and the parameters used in the software. Consequently, the

virtual representation does not fully reproduce the garment's behaviour under real wearing conditions. Furthermore, comfort, freedom of movement, seam strength, and the durability of transformation systems cannot be confirmed solely through the analysis of a digital model.

For children's clothing, practical testing is particularly important for evaluating the functionality and safety of structural elements. Fastening systems, detachable components, and transformation mechanisms must be examined through the production and testing of a physical prototype.

Conclusion. The use of Style3D offers opportunities for the digital design and prototyping of transformable clothing for girls through three-dimensional modelling and virtual simulation. Digital representation facilitates the examination of the garment's shape, visualization of construction details, and comparison of transformation variants. Integrating these tools into the design process can contribute to more efficient garment development and reduce the need to physically produce every intermediate variant. However, validating functionality and comfort requires additional verification through physical prototyping and testing. Thus, Style3D is a useful tool for supporting the design process, but it does not entirely replace the practical evaluation of the garment.

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