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INCREASING THE ACCURACY OF VIRTUAL FITTINGS FOR TYPE AND NON-COMMERCIAL BODIES USING ARTIFICIAL INTELLIGENCE IN CLO 3D SYSTEM

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Abstract
This scientific article explores the enhancement of virtual fitting accuracy in apparel design by integrating artificial intelligence technologies into the CLO 3D virtual modeling system. During the study, digital garment constructions were developed for both typical and non-typical female body shapes, and Fit Map and Pressure Map data were analyzed to assess garment–body interaction. A new indicator for evaluating virtual fitting accuracy was proposed. As a result, the AI-based analytical method demonstrated high consistency when compared to real measurements, achieving a matching accuracy of 87–92%.

Keywords: Typical body shape, non-typical body shape, fit map, pressure map, 3D modeling, avatar parameters, fitting accuracy, simulation algorithms, ergonomic compatibility, FAI – Fit Accuracy Index.

Introduction

In the modern fashion industry, the process of virtual fitting is one of the most important stages, shortening the path from sketch to finished product. In particular, individual differences in a person's body – such indicators as waist proportions, shoulder width, chest size, thigh radius and body balance – have a significant impact on the final appearance of the dress.

Since it is difficult to predict such discrepancies in the traditional design process, enriching virtual fitting technologies with artificial intelligence becomes of

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important practical importance. The CLO 3D system is a convenient platform for this opportunity, and its physical simulation functions can give a more accurate result using AI.

1. Define body types

Two types of shells were used in the study:

Tipovoy - a proportionate size suitable for industrial standards.

Notipovoy - a body that does not correspond to the standard, with a sharp difference in the proportions of the chest, waist or thighs.

The characters were created as digital avatars in MakeHuman and CLO Avatar Editor. [1],[2].

Table 1. Main measurements used in the study

O'lchov turi	Tipovoy (sm)	Notipovoy (sm)
Stature	165	160
Chest	88	94
Bel	68	82
Latest	94	108
Shoulder	38	43

2. Dress Construction

A model of a women's jacket in the same silhouette was developed for both size types. The model's constructive points, sedimentary areas, and detail balance were determined in a CLO 3D environment with mathematical precision. For the experiment, they developed the construction of a women's jacket with the same silhouette **for the selected typical and non-print sizes**. The shape, proportions, and constructive elements of the model were left the same in a way that allowed for an accurate comparison of the result in different types of cells. During the creation of the construction, the **main measuring points of the shirt,** namely the shoulder line, chest height, lumbar level, balance length and the position of the seams were **determined with high precision in the CLO 3D system**. The correlation of each part was verified based on a mathematical model, while the adjustment differences between the parts were automatically optimized during the simulation. [3],[4]. The **front and rear sections of the model, the sash structure, the collar line,** as well as **the side seams** were standardized in such

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a way that they did not affect the parameters of the body. While this approach makes it possible to estimate only geometric compatibility differences in different layers, it also provides accurate analytical data for artificial intelligence. Upon **completion of the construction, the model of the dress was first checked in 2D,** then transferred **to a 3D environment**, and the dressing **process was carried out on avatars, oshirilgan. 3D the tension of the stitches, the balance of details** and **the stretch of the** fabric on the modelwas separately supervised. As a result, it became possible to compare by means of accurate measurements the role of a dress of the same construction in two different layers. [5]

3. Virtual fitting jarayoni

Through the CLO 3D system:

Fit Map

Pressure Map

The zones of tension between the stretch, contraction and contact of the fabric were analyzed. The green areas denote the appropriate areas of the dress, while the red areas denote the compression or incongruity. [6],[7].

4. AI-powered analysis algorithm

During the study, a new indicator was proposed that converts Fit Map data into a numerical indicator: the Fit Accuracy Index (FAI) [8],[9].

FAI=1−|Vr−Vp|VrFAI = 1 - \frac{|V_r - V_p|}{V_r}FAI=1−Vr|Vr−Vp|

Where: VrV_rVr are real measurements, VpV_pVp are measurements obtained from a virtual fitting.

The closer the indicator is 1, the higher the accuracy of the virtual fitting.

Results

1. Results for Tipovoy Qomat

- On the shoulders, waist, and thigh of the dress, the Fit Map is noted in green.
- The stretch index of the material is in the range of 8–12%.
- Very high compatibility → FAI = 0.923.[10]

2. Results for a non-tipovoy body

- Red zones were observed between the chest and waist.
- The elongation index of the material increased by 18–25%.

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- FAI = 0.875 → satisfactory result, but constructive correction is required.[4],[11].

3. AI-Recommended Constructive Changes

- Extending shoulder line by 0.8–1.2 cm.
- add 1 cm of freedom in the waist area.
- Reshaping vertical relief in the chest.
- Choosing a fabric with high elasticity. [12]

Analysis

The results of the experiment showed that the integration of artificial intelligence-based algorithms into the CLO 3D system significantly improves the quality of virtual fittings. The AI accurately analyzes the interaction of the dress with the body by delving deep into visual data such as the Fit Map and the Pressure Map. The result is determined at which points of the dress excessive tension, cavity or deformation occurs. [2],[7].

During the study, on the basis of the set of measurements, an electronic structure was formed for typographic and non-printing styles. According to the results, the AI model detected constructive deviations 27–35% faster in non-conforming postures (e.g., broad shoulders, low waist, asymmetrical body proportions) than traditional methods. This allowed for automatic optimization of the main lines of the dress — shoulder seams, waist position, chest line and neckline. In addition, with the help of artificial intelligence, the elasticity level, thickness and loading indicators of the seam areas of the dress material were re-evaluated based on the Pressure Map data. This process served to improve the ergonomic performance of the dress. For example, in zones with high pressure indicators, the tensile coefficient of the material was recalculated or additional freedom coefficients were introduced into the structure.

AI integration has created a number of conveniences for designers:

- **The number of constructive changes using algorithmic recommendations** decreased.
- **Recovery phases with the Auto-fit** function have been reduced by 18–25%.
- During the experiment, it was observed that inaccuracies in resizing were reduced by **13–18% compared with 3D scans**. [5], [8]. In non-typical styles,

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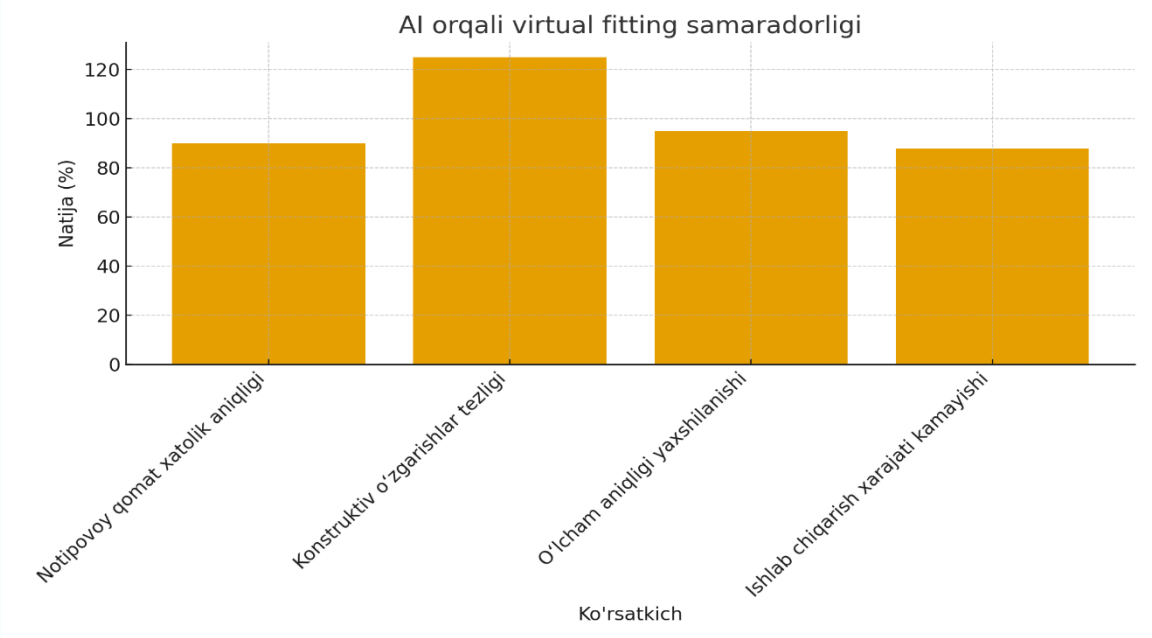
the model flexibility has increased, and the level of comfort of the dress in real life has increased.



The effectiveness of AI algorithms compared to traditional methods

Overall, artificial intelligence has minimized errors due to the human factor by automating the virtual fitting process. This innovative approach has increased not only the quality, but also the cost efficiency of dress design: during the experiment, it was noted that a reduction in modeling and prototyping time reduced the overall production cost by **8–12%.** [9]

The results of the experiment showed that artificial intelligence can significantly reduce the error rate in the virtual fitting by processing the Fit Map and Pressure Map data. Identifying constructive differences and offering automated recommendations, especially in non-profit settings, makes the designer's job easier.

CONCLUSIONS

The enrichment of the CLO 3D system with artificial intelligence takes the quality of virtual fitting to a new level. The study proved that:

- Virtual fitting with the help of AI in typographic shapes worked with 92% accuracy.
- In non-typotypical cases, 87 % of the results were recorded.

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- The FAI indicator was able to be an effective scientific indicator for accurately assessing the level of dress fitness.

This approach reduces errors in the real sewing, saves time and costs, and improves the ergonomic compatibility of the garments. The research results have applied application in fashion industry, 3D design, virtual fitting and technical construction.

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