



ARTIFICIAL INTELLIGENCE IN FASHION DESIGN: GENERATIVE SYSTEMS, DIGITAL FASHION AND TRANSFORMATION OF THE CREATIVE PROCESS

Scientific paper
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ABSTRACT: Artificial Intelligence (AI) is becoming one of the key drivers of innovation in the process of designing, manufacturing, and marketing fashion products. Contemporary fashion design is characterized by short development cycles, rapid changes in trends, and increasing demands for product personalization. Under such circumstances, designers face the need to process large amounts of information while simultaneously developing innovative aesthetic solutions. One of the most significant applications of AI in fashion is generative design. Generative systems use neural networks to create new visual content that is not a direct copy of existing products. This paper presents the application of AI in the development of a fashion collection using the AI assistant Grok. The results show that the use of artificial intelligence can accelerate the creative work process, but it cannot replace the creative process itself, which is based on knowledge and experience.

Ključne reči: Artificial Intelligence, fashion, generative design, AI tools.

VEŠTAČKA INTELIGENCIJA U MODNOM DIZAJNU: GENERATIVNI SISTEMI, DIGITALNA MODA I TRANSFORMACIJA KREATIVNOG PROCESA

APSTRAKT: Veštačka inteligencija (Artificial Intelligence – AI) postaje jedan od ključnih pokretača inovacija u procesu projektovanja, proizvodnje i plasmana modnih proizvoda. Savremeni modni dizajn karakterišu kratki razvojni ciklusi, brze promene trendova i rastući zahtevi za personalizacijom proizvoda. U takvim okolnostima dizajneri se suočavaju sa potrebom da obrađuju velike količine informacija i istovremeno razvijaju inovativna estetska rešenja. Jedna od najznačajnijih primena AI u modi jeste generativni dizajn. Generativni sistemi koriste neuronske mreže kako bi kreirali nove vizuelne sadržaje koji nisu direktne kopije postojećih proizvoda. U ovom radu je prikazana primena AI u razvoju modne kolekcije korišćenjem asistenta Grok. rezultati pokazuju da primena veštačke inteligencije može ubrzati proces kreativnog rada, ali da ne može zameniti sam kreativni proces iza koga stoji znanje i iskustvo.



Ključne reči: *veštačka inteligencija, moda, genrativni dizajn, AI alati.*

1. INTRODUCTION

The contemporary development of digital technologies has significantly influenced the transformation of creative industries, with the fashion industry occupying a particularly prominent position. Artificial intelligence (AI) has become one of the key drivers of innovation in the design, production, and marketing of fashion products. Through the integration of machine learning algorithms, generative models, and big data analytics, AI enables designers to make more efficient decisions, enhance creative processes, and gain a deeper understanding of consumer needs.

Contemporary fashion design is characterized by short development cycles, rapidly changing trends, and increasing demands for product personalization. Under such conditions, designers face the challenge of processing vast amounts of information while simultaneously developing innovative aesthetic solutions. Artificial intelligence serves as a tool that bridges the creative process with a data-driven analytical approach, enabling more informed and efficient design practices.

2. THE WAY ARTIFICIAL INTELLIGENCE INTERPRETS FASHION

For a human designer, fashion design is a creative process inspired by culture, emotions, social change, and personal experience. In contrast, AI perceives a garment as a combination of attributes, including silhouette, proportions, cut, colors, textures, materials, decorative elements, and the ways in which these features appear across a large number of existing examples. By analyzing millions of images, fashion collections, and consumer behavior data, AI algorithms learn the relationships between individual stylistic elements and generate new combinations that are statistically meaningful.

In other words, while a human designer may create a dress inspired by Mediterranean architecture or a childhood memory, AI analyzes the characteristics of the Mediterranean style, its dominant colors, shapes, and textures, and then generates visual proposals that correspond to the specified parameters. For this reason, artificial intelligence is often described as a system that "recognizes patterns" rather than one that possesses creative intuition [1].

Based on this information, AI constructs mathematical models that describe the relationships between different design characteristics. When tasked with generating a new design, the system does not create from personal experience or inspiration; instead, it combines patterns learned from existing data.

This approach differs significantly from the human creative process. A fashion designer may draw inspiration from a work of art, a social event, or personal emotions, whereas AI identifies statistical regularities and generates new combinations based on previously analyzed examples.

3. GENERATIVE DESIGN AS A NEW PARADIGM OF CREATIVITY

One of the most significant applications of AI in the fashion industry is **generative design**. Generative systems use neural networks to create new visual content that is not a direct copy of existing products.

In the traditional design process, a designer produces numerous sketches before selecting the most successful solution. Generative artificial intelligence enables the creation of hundreds or even thousands of design variations within a very short period. The designer then assumes the role of curator and creative decision-maker, selecting, modifying, and further developing the most promising concepts. Such systems make it possible to explore a wide range of creative directions in a limited time, significantly accelerating the initial stage of collection development.

This process is transforming the role of the designer. Instead of independently generating every design idea, the designer guides a system that produces a large number of potential solutions. As a result, creativity is partially shifted from the act of creation itself toward the processes of selection, interpretation, and evaluation of AI-generated outcomes. [2]

Generative models can create new garments based on a text prompt, a sketch, or a mood board. For example, a designer may enter a prompt such as *"an oversized beige linen blazer with dropped shoulders,"* and the system can generate dozens of visual concepts within seconds. In addition to text prompts, designers can also use sketches or photographs as input. Based on the provided reference, AI creates a realistic visualization of the garment on a virtual model under specified conditions. Furthermore, conceptual designs can be generated by combining images with textual descriptions or simply by providing a mood board as a source of inspiration (Figure 1) [3].

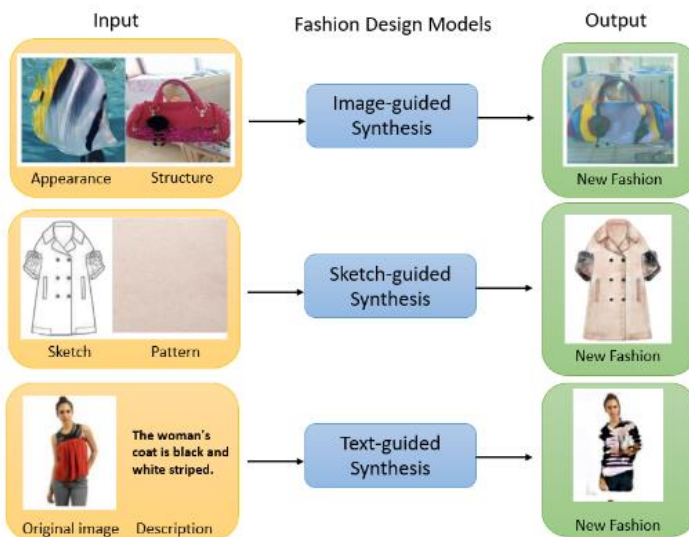


Figure 1: Examples of generative design



3.1. AI Tools for Generative Fashion Design

In contemporary fashion design practice, several key AI tools are widely used to generate sketches and visual concepts. Among the most prominent are Midjourney, DALL·E, Stable Diffusion, and Adobe Firefly.

Midjourney is frequently used to create highly aesthetic and conceptual fashion illustrations, making it particularly valuable during the inspiration and collection development stages. DALL·E enables the precise generation of fashion items based on detailed text prompts and is well suited for the iterative exploration and refinement of design ideas. Stable Diffusion, as an open-source model, offers greater control over the image generation process and is often employed in professional design studios to develop customized models tailored to specific fashion styles. Adobe Firefly integrates with professional design software such as Adobe Photoshop and Adobe Illustrator, allowing AI-generated elements to be incorporated directly into established design workflows [4].

Together, these tools form the foundation of the contemporary digital fashion design ecosystem, where the creative process is accelerated and expanded through the automated generation of visual concepts.

In addition to these professional platforms, numerous AI tools offer free access with limited functionality. Popular examples include Grok AI Assistant, Google Gemini, and ChatGPT. While all of these platforms provide a free tier, unrestricted access to their advanced features typically requires a paid subscription.

3.2. The Role of the Designer in the Generative Design Process

In the context of generative design, the role of the fashion designer is undergoing a significant transformation. The designer is no longer solely the creator of every sketch but instead becomes the creative director of the system, defining the generation parameters, interpreting the results, and selecting the most successful design solutions.

This model is often described as a **human-in-the-loop** approach, in which humans and artificial intelligence collaborate throughout an iterative creative process. The designer provides the initial concept or design brief, AI generates multiple variations, and the designer then evaluates, refines, and further develops the most promising concepts. In this way, the creative process becomes collaborative and dialogic rather than strictly linear.

3.3. From AI-Generated Sketch to Technical Pattern

One of the most important aspects of contemporary generative fashion design is the transition from a visual sketch to the technical realization of a garment. AI-generated images are no longer used solely as sources of inspiration; they are increasingly becoming a foundation for the development of garment patterns and technical documentation.

In advanced digital design systems, such as CLO 3D and Browzwear, it is possible to transform 2D visual concepts into 3D garment models. These systems enable the simulation of materials, fabric drape, and garment behavior on a virtual body. Based on an AI-generated sketch, a designer can develop an initial pattern, which can then be digitally tested and refined. [5]



The process of transforming a sketch into a pattern requires the interpretation of visual elements such as seam lines, sleeve construction, panel arrangement, and garment volume. Although artificial intelligence can provide initial construction guidelines, the final technical development still requires the expertise of a fashion pattern maker or garment constructor.

This hybrid approach significantly reduces product development time, as part of the experimental phase is transferred into a digital environment before physical production begins.

3.4. Applications in the Fashion Industry

In the contemporary fashion industry, generative AI systems are applied across various stages of product development. During the **concept development** phase, AI generates a wide range of visual directions and creative possibilities. In the design phase, these concepts are further developed into concrete garment models, while in the production phase they serve as a foundation for technical documentation and manufacturing preparation. Major fashion companies use these systems to accelerate collection development and reduce prototyping costs. Instead of producing a large number of physical samples, designers can first test and refine ideas within a digital environment, which enables greater efficiency, faster decision-making, and more sustainable production processes.

3.5. Limitations of Generative Fashion Design

Although generative artificial intelligence offers significant advantages, it also has certain limitations. AI systems depend on the data on which they are trained, meaning they may reproduce existing aesthetic patterns and styles without a deeper understanding of the cultural context of fashion.

Furthermore, generated designs often require additional human intervention in order to be adapted to technical and production standards. AI can create visually appealing concepts, but it does not always guarantee their structural feasibility or practicality in garment construction.

4. AI AS A TOOL FOR FASHION TREND FORECASTING

Trend forecasting represents one of the most important activities within the fashion industry. Traditionally, fashion predictions were based on the work of experts who analyzed fashion shows, artistic movements, social changes, and consumer behavior.

Artificial intelligence significantly transforms this process. Today, algorithms can analyze:

- social media posts,
- influencer images,
- users' online search data,
- sales data,
- fashion blogs and magazines,
- content from fashion events.



Such systems enable the identification of changes in consumer preferences before they become dominant in the market. For example, the frequent appearance of certain colors, materials, or silhouettes in the digital environment may indicate emerging fashion trends. This approach allows companies to reduce production risks and optimize the development of future collections [6].

5. PERSONALIZATION AND DIGITAL TRANSFORMATION OF THE CUSTOMER EXPERIENCE

A very common application of artificial intelligence in the fashion industry is the personalization of products and services. AI systems analyze individual user data, including previous purchases, clothing preferences, body characteristics, and digital behavior.

Based on this information, it is possible to generate personalized recommendations or even create garments tailored to a specific user. This process represents a shift from mass production toward a model of mass customization, in which products are adapted to the specific needs and preferences of each individual customer [7].

6. SUSTAINABILITY AND PRODUCTION OPTIMIZATION

The fashion industry faces significant environmental challenges, including overproduction and textile waste. Artificial intelligence contributes to sustainability through the optimization of pattern-making processes, accurate demand forecasting, and the reduction of production surpluses.

Furthermore, AI systems enable the analysis of the environmental characteristics of materials and the recommendation of more sustainable alternatives, supporting the development of circular fashion practices. [8] By creating digital samples and garment prototypes, greater efficiency can be achieved without the unnecessary consumption of time and resources required for producing physical clothing prototypes.

7. ADVANTAGES AND DISADVANTAGES OF USING AI IN FASHION DESIGN

Advantages

- Acceleration of the creative process

AI enables designers to generate a large number of conceptual solutions within a short period of time. It saves time when transferring ideas onto paper or digital platforms and allows easy modification of aesthetic and functional parameters of garments. Designers can quickly experiment with different shapes, materials, colors, and design directions.

- Visualization of garments before production

AI enables the visualization of garments on realistic digital models within predefined environments, under specific lighting conditions, and with selected materials before the physical product is created. While the use of CAD systems and 3D avatars requires



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knowledge and application of specialized tools, generative design allows product visualization through simpler interaction using text prompts or image-based input.

- Environmental benefits

Through digital management of the garment development process, negative environmental impacts can be reduced, as physical waste generated during the early design and prototyping stages is significantly minimized. Digital samples and virtual prototypes reduce the need for unnecessary material consumption.

Disadvantages

- Lack of emotions and personal expression

Every form of art is based on emotions and the artist's personal experience, which represents the essence of creativity and enables the transfer of feelings to the audience. AI relies on algorithms and logical processing, which may reduce the emotional sensitivity, individuality, and personal expression of the designer.

- Aesthetic homogenization

There is a risk that AI, relying on existing trends and previously analyzed data, may lead to greater uniformity in design and a reduction in originality. Generated concepts may increasingly reflect dominant patterns rather than completely new creative approaches.

- Copyright and authorship issues

One of the key questions regarding AI-generated design is: who is the author of the final result? Is it the designer, the company, or the algorithm itself? Since AI systems learn from existing works, concerns also arise regarding potential copyright infringement and the use of protected creative content.

- Potential loss of creative professions

There is concern that excessive automation could reduce the need for certain creative roles, especially during the early stages of the design process. At the same time, the development of new professions is expected, such as AI fashion designer, digital fashion curator, generative design specialist, and virtual clothing developer.

- Data ethics and privacy

AI systems rely on large amounts of user data, which raises important questions regarding privacy, data protection, and the ethical use of personal information [9].

8. MATERIALS AND METHODS

For the purposes of this research, fashion sketches from a collection inspired by braids were used. After the concept of the braid as a visual and cultural code had been further developed, the next step in the process was its translation into specific visual forms. The creation of the initial sketches represented a critical moment in which the abstract idea was transformed into material shapes, lines, and rhythm. The sketches enabled experimentation with different compositions, structures, and patterns, serving as a foundation for the further development phase of the design.

The sketches were created on paper using various techniques, including pencil, markers, and colors, which allowed for the exploration of textures, details, and different variations of the braid motif. Their purpose was not only to convey the basic form of the motif but

also to examine the ways in which it could be adapted to a contemporary textile and fashion context (Figure 2).



Figure 2: Models sketches: a - Model 1, b - Model 2, c - model 3, d - model 4, e - model 5.

A fashion designer transforms their ideas into sketches, creating a visual representation of the concept. The appearance of the model in the sketches depends on the designer's knowledge and experience in translating their vision onto paper. In many cases, additional explanations and technical drawings are required in order for the garment to be accurately produced under real-world conditions.

By applying a generative form of artificial intelligence through an **image-to-image** method, a realistic model of the garment was created, displayed on a virtual model walking on a fashion runway. For this purpose, the Grok AI tool was used (Figure 3).



Figure 3: Generated models by GROK based on model sketches from Figure 2: a - Model 1, b - Model 2, - c - model 3, d - model 4, e - model 5.

In this way, additional information about the garment that needs to be created can be obtained. This includes how the garment will fit on the body, which materials should be used, where the fastening system should be positioned, and other important construction

details. In this particular case, the greatest challenge was the integration of the braid elements — how they would appear on a realistic model, how they would fall and move, and how they would behave during wear.

In this process, the generative artificial intelligence model transformed the image of the garment on a virtual model into a video representation of the model walking on a fashion runway. In this way, the designer's sketch was developed in greater detail, providing designers, pattern makers, and garment manufacturers with valuable information regarding the production process, material selection, garment construction, placement of darts, as well as the method of creating and attaching the braid elements to the garment.

9. RESULTS AND DISCUSSION

After developing the model using the generative AI system in the Grok program and analyzing the visual information provided by AI, the next step was the selection of materials. Two types of fabrics were chosen: burgundy twill, characterized by a higher fabric weight and greater bending stiffness, and a lighter plain-weave satin, with lower stiffness and surface weight, providing better draping properties.

Patterns were developed, and the dresses were constructed as shown in Figure 4. The completed dress models were presented at the 49th Sarajevo Fashion Week. The collection consists of six thematic designs and is titled "Crimson Braid."



a



b



c



Figure 4: Collection of dresses at Sarajevo fashion week: a - Model 1, b - Model 2, - c - model 3, d - model 4, e - model 5.

Creating Model C was the most challenging task, as it involved the construction of unconventional structures and the complex layered composition of the garment. This dress model represents a contemporary sculptural interpretation of form, material, and movement, emphasizing the artistic transformation of the traditional braid motif into a futuristic fashion expression.

The garment is designed in a deep burgundy shade, creating an impression of elegance, strength, and warmth, while the symbolism of the color reflects energy and passion. The silhouette is characterized by an asymmetrical cut, with one shoulder exposed and the other supported by a delicate shoulder strap that extends into an organically curved neckline across the bust. This design element introduces dynamism to the upper part of the garment, creating a sense of fluidity and movement despite its firm, architectural construction.

Around the waist and hip area, the silhouette expands into a series of three-dimensional curves that create a structural frame around the body, resembling armor or an architectural shell. This sculptural composition enhances the expressive character of the garment and reinforces its bold, avant-garde aesthetic.

Figure 5 presents the development process of Model C, from the initial sketch, through the AI transformation phase, to the final realized garment.

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Figure 5: Development of the model c: a - Model sketch, b - Generated model, - c - Real model.

10. CONCLUSION

Artificial intelligence represents a key factor in the transformation of contemporary fashion design. Its application encompasses all stages of the creative process — from idea generation and trend forecasting to production and marketing presentation.

Generative fashion design represents a new stage in the evolution of the creative process within the fashion industry. Artificial intelligence enables the rapid generation of visual concepts, exploration of a wide range of design directions, and optimization of the transition from an initial concept to technical realization.

However, despite technological advancements, the central role continues to belong to the designer, who interprets, selects, and shapes the generated results. The future of fashion design is based on the synergy between human creativity and algorithmic intelligence, where AI functions as a tool for expanding creative possibilities rather than replacing the creative process.

Today, artificial intelligence is becoming integrated into all aspects of human life. It represents an inevitable part of the future, both in personal and professional contexts. The key question is how it will be used. Without the knowledge and experience inherent to every profession, which individuals acquire through learning and practice, AI remains limited. It cannot provide solutions beyond the ability of the user to define, direct, and meaningfully apply its capabilities.

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