GENERATIVE AI IN FASHION DESIGN: REDEFINING CREATIVITY AND INNOVATION

Azahruddin
Poornima University, Ramchandrapura, vidhani, Jaipur, 303905

Abstract

The advent of Generative Artificial Intelligence (Generative AI) is among the most revolutionary technological breakthroughs of the 21st century that has become an inseparable component of the fashion industry. The field of fashion design, which is dependent upon the human creative potential, skills, imagination, and influence, is undergoing a revolution in adopting artificial intelligence-driven creative processes. By utilizing such advanced technologies as GANs, diffusion models, transformer models, and multimodal AI systems, designers are now capable of automating ideation processes, creating new textile designs, customizing the fashion experience, optimizing fashion supply chains, and designing sustainable fashion production processes. In this chapter, we consider the theoretical background, technical aspects, and applications of Generative AI in fashion design, address the associated ethical issues, and forecast future perspectives.

This chapter explores the application of AI-based technology within the creation of conceptual sketches, virtual prototyping, fashion trend development, digital garment creation, virtual try-on, and recommendation systems in fashion. Unlike traditional CAD systems, Generative AI systems can be considered as a creative partner that produces new ideas based on the prompts, images, and customer behaviour data. This chapter also sheds light on how diffusion models and language-based models have affected the time required for the designing process, which has resulted in a reduction of costs and material usage. This research emphasizes the possibilities that Generative AI can offer when applied in fashion by presenting frameworks and discussions related to this topic.

In addition, the chapter considers problems of copyright issues, data deviation, ethical design, authenticity, cultural appropriation and job displacement. While Generative AI presents tremendous possibilities, it must be used responsibly and human-cantered, with clear governance standards and principles. The chapter offers a proposal of a collaborative, AI-enhanced framework of fashion design, where designers, AI systems, consumers and sustainability goals are balanced within a creative environment.

The results indicate that hybrid creativity models based on a combination of human intuition and machine intelligence will be important in the future development of fashion. Generative AI is not about the replacement of designers, but about the augmentation of their creativity, allowing for experimentation to be sped up, innovation to be democratized and supported by data, and art to be created more rapidly. The chapter also enriches the academic and industrial discourse by offering an in-depth analysis of Generative AI technologies in the context of fashion design and their future implications for the creative industries.

Keywords: Generative AI, Fashion Design, Artificial Intelligence, Diffusion Models, Generative Adversarial Networks, Virtual Fashion, Multimodal AI

1. INTRODUCTION

Fashion has always been related to the imagination, creativity, emotional expression and cultural identity of man. Fashion design has evolved from traditional sewing and embroidery to contemporary luxurious clothing, mirroring the changes in society, technology, and artistry. In the past 10 years, the fashion industry has become a totally different place thanks to e-commerce channels, interactive shopping experiences, smart supply chains, and data-based marketing strategies. Recent years have seen the rise of Generative Artificial Intelligence (Generative AI), which has brought forth intelligent systems that can produce original content like images, patterns, dresses, ads, and virtual models, that was previously unimagined.

Generative AI is a type of AI that can create new data or content patterns based on patterns identified with large data sets. Machines have the ability to generate realistically detailed images, designs, and texts using technologies like Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), transformer-based networks, and diffusion models. The technology is being used in the fashion industry for creating fashion ideas, creating textile patterns, trend forecasts, personalization in fashion, virtual fitting and virtual fashion avatars.

The fashion industry's specific nature lends itself well to the use of AI, given its multifaceted nature that includes its visual nature, consumer psychology, trend prediction, and history of quick product development cycles. The traditional fashion process includes fashion designing, sketching, making prototypes, selecting the fabric, making fashion patterns, arranging production and marketing. Each of these steps tends to be time-consuming, costly and resource intensive. Generative AI has revolutionized the whole design lifecycle by introducing automation and intelligent support at each step. With a few clicks, designers can create hundreds of design options in minutes, test different colour options, produce realistic digital prototypes and see consumer reactions before production.

A clear manifestation of the revolutionary capabilities of Generative AI is how it can democratize fashion creation. Previously, the high-end fashion design capabilities were restricted to luxury brands and professional fashion designers only. Nowadays, individuals such as students, freelancers, or even independent businesses can experiment with advanced design systems through natural language and interfaces driven by AI. Such democratization leads to greater consumer participation and inclusion within the fashion world.

The second major consequence that Generative AI technology has brought forth to the fashion industry is sustainability. Over the past few decades, the fashion industry has been blamed for producing excessive amounts of waste. It has also been accused of polluting bodies of water and releasing a substantial amount of carbon dioxide into the atmosphere. Through the utilization of AI, such problems can be alleviated via optimizing inventory plans and minimizing unnecessary production.

However, the rapid development of generative AI has brought some concerns about ethics, originality, copyright, and unemployment. One issue that needs to be addressed here is

whether AI-generated designs are actually original work or not and whether or not the designers of the works included for training AI should receive money for their efforts. Moreover, biased algorithms and cultures can affect fashion products in cases when the diversity of training data sets is low.

Nevertheless, Generative AI is going to revolutionize fashion in the future, providing opportunities for the cooperation of creativity and intelligence. AI is intended not to replace but rather help designers to facilitate creativity and innovation. Today, many designers have already switched from being creators themselves to being AI models' directors.

This book chapter will provide readers with a detailed overview of Generative AI and its use in fashion design. Additionally, a conceptual framework is introduced that incorporates the use of AI-driven creativity into sustainable and customer-centric fashion systems.

2. EVOLUTION OF ARTIFICIAL INTELLIGENCE IN FASHION

Fashion design technology started with the use of computer-aided design systems (CAD) in the late 1980s. CAD can also be used to convert sketches into digital files, make edits to garment patterns, speed up production times, etc. These systems have increased efficiency, but they could only be manually operated by human designers.

The next step followed with machine learning trends, stock management and customer data analysis. Recommendation engines started being deployed to fashion retailers to study consumer purchasing behaviour and give suggestions of products to users. Companies like Amazon, Zara and H&M adopted AI-based analytics in their supply chain and retail businesses.

With the advent of deep learning, fashion technology has witnessed a transformative shift, allowing for image recognition, object detection, and even style classification. With the rise of social media and its ever-fluctuating trends, the visual assessment of garments and fashion images became widely popular using a CNN. AI systems could detect types of attire, colour schemes, fabric patterns, and style aesthetics.

Generative Adversarial Networks (GANs) were introduced in 2014 by Goodfellow et al., which represents a significant leap in AI creativity. GANs are composed of two neural networks, one called the generator and one the discriminator. The generator makes fake outputs and the discriminator tells whether they are real or fake. By gradually competing against one another, GANs can generate extremely realistic images and designs.

As the application to fashion, GANs helped to create textile patterns, garment variations, and virtual fashion collections automatically. Designers can provide style parameters and then get a number of different design alternatives generated from AI. The image quality and prompt-based design generation were further optimized with the introduction of diffusion models like Stable Diffusion and DALL-E.

In summary, the LLM applications showcased here have revolutionized the fashion industry by driving innovation, enhancing customer engagement, and revolutionizing the way stories and content are created. In conclusion, the introduction of these LLMs in the fashion industry

has been truly revolutionary because they have brought innovation, improved customer experiences, and even more exciting forms of storytelling. In today's digital world, combining different multimedia aspects such as text, photography, and designs within a multimodal AI system has allowed for an entirely new fashion experience.

Table 1. Evolution of AI Technologies in Fashion

Era	Technology	Major Contribution in Fashion
1990s	CAD Systems	Digital sketching and pattern design
2000s	Machine Learning	Trend forecasting and recommendations
2010s	Deep Learning and CNNs	Visual recognition and style classification
2014 onwards	GANs	AI-generated garments and textile designs
2020 onwards	Diffusion Models and LLMs	Prompt-based fashion generation and virtual fashion

The fashion industry is entering into an era where the use of artificial intelligence is not going to be just for technical purposes but also as a partner for creativity. This evolution has influenced the whole process of designing, learning, and even the business side of fashion.

3. UNDERSTANDING GENERATIVE AI TECHNOLOGIES

The workings of Generative AI lie in learning from the data set patterns and creating new outputs that mirror the training data but remain original. A number of key technologies drive Generative AI for fashion design.

3.1 Generative Adversarial Networks (GANs)

GANs are among the most influential generative models in fashion design applications. They consist of two competing neural networks: the generator and the discriminator. The generator creates synthetic outputs while the discriminator determines whether the outputs are real or fake.

The learning process can be mathematically represented as:

$$\min_{G} \max_{D} V\,(D,G) = E_{x\sim p_{\mathrm{dt}}(x)}[\log D\,(x)] + E_{z\sim p_z(z)}\left[\log\left(1 - D\big(G(z)\big)\right)\right]$$

This adversarial learning mechanism enables GANs to generate realistic fashion images, garment silhouettes, textile textures, and style variations.

3.2 Diffusion Models

Images produced by the diffusion models are constructed from random data distributions by iteratively subtracting noise. Such models have shown enhanced visual quality and fast response time over the earlier GAN-based systems.

Fashion image generation has widely adopted diffusion models for platforms like Mi journey, Stable Diffusion and DALL-E. Designers can even give the words in their search and get good visuals in seconds.

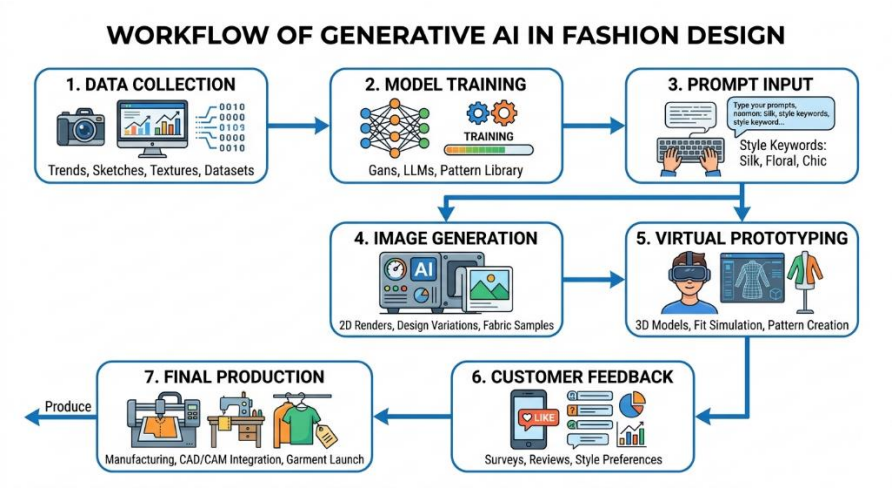

Figure 1. Workflow of Generative AI in Fashion Design

3.3 Transformer Models and Large Language Models

In cases of sequential data, AI systems can use attention mechanisms to process the data in a transformer architecture. Transformer systems are used in fashion for trend analysis, design storytelling, customer interaction, and optimizing prompts.

Conversational AI systems are being programmed by fashion brands to make custom product recommendations, assist customers, and create marketing material.

3.4 Multimodal AI Systems

Multimodal systems bring together unification of text, image, audio, and video processing functions under one roof and in one AI system. Such systems enable designers to integrate the sketches, text descriptions, and reference images for creating integrated fashion designs.

For instance, a designer can upload a brief sketch of a garment and prompts to any details or things they feel like they want to incorporate with regard to colour, fabric, and inspiration. The AI system then creates design variations that are realistic and consistent with the inputs supplied.

4. APPLICATIONS OF GENERATIVE AI IN FASHION DESIGN

Generative AI is transforming nearly every stage of the fashion value chain. Its applications extend from conceptual ideation to consumer engagement and post-production analysis.

4.1 AI-Assisted Fashion Ideation

Concept generation is one of the key use cases of Generative AI. The traditional way designers work is by creating a mood board, studying fashion or fashion items from the past, travelling and gathering inspirations from other cultures. AI systems can expedite the process by creating numerous design ideas based on textual prompts and visual references.

Creative fatigue is diminished and experimentation can be quick with AI-powered ideation. This allows designers to experiment with different designs, colours and styles, without having to sketch them all.

4.2 Textile and Pattern Generation

Generative AI models can create unique textile prints, embroidery patterns, and fabric textures. A.I. systems can create new patterns using past pieces of fabric and cultural imagery, while maintaining the essence of the art.

The manufacture of sustainable fashion comes with many benefits from AI-powered textile systems, particularly in reducing trial-and-error sampling processes and optimizing digital printing workflows.

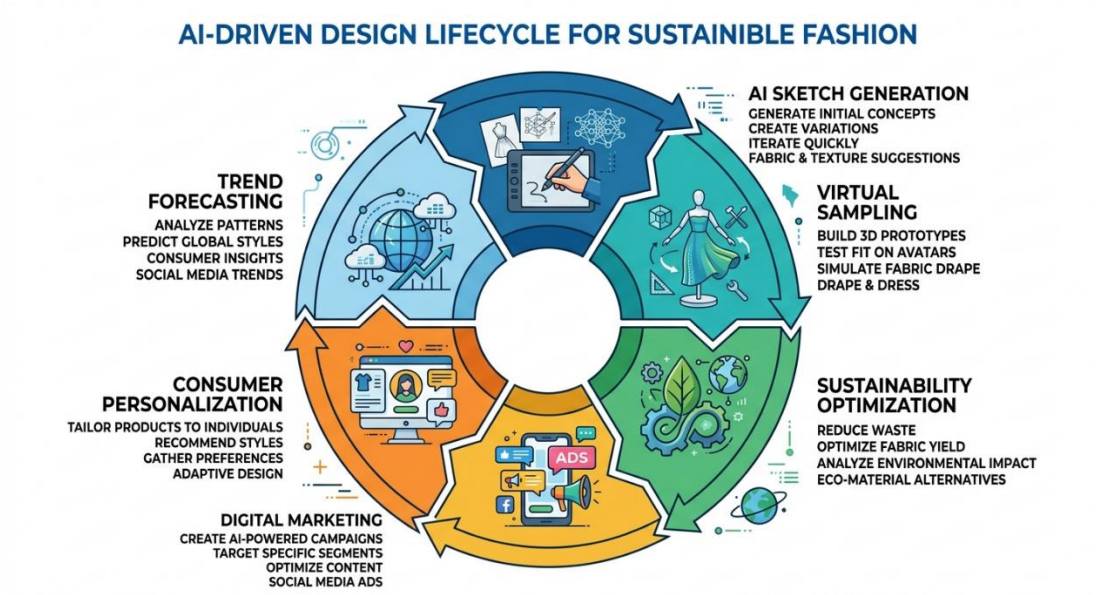

Figure 2. AI-Generated Fashion Design Lifecycle

4.3 Virtual Fashion and Digital Avatars

The advent of the metaverse and digital fashion systems has led to the need for virtual clothes and AI avatars. Today, fashion houses design digital clothing for gamers, virtual influencers, and augmented reality platforms.

Digital fashion is eco-friendly since clothes are only available digitally without any material creation process. Digital fashion clothes can be used within virtual social environments and commerce systems by consumers.

4.4 Personalized Fashion Recommendation Systems

Generative AI systems analyse consumer preferences, social media activity, body measurements, and purchasing behaviour to provide personalized styling recommendations.

Recommendation accuracy can be represented using predictive learning functions:

$$P(y|x) = \frac{e^{w^T x + b_j}}{\sum_{i=1}^{n} e^{w_i^T x + b_i}}$$

These systems improve customer satisfaction and increase online retail engagement.

4.5 Virtual Try-On Technologies

AI-based virtual try-on tools rely on computer vision technology and generative algorithms to virtually fit the clothes onto an avatar or a live user's image. The applications facilitate more efficient and enjoyable online shopping processes by minimizing returns.

The emergence of virtual fitting tools was especially crucial after the globalization of e-commerce.

Table 2. Major Applications of Generative AI in Fashion

Application Area	AI Contribution	Benefits
Fashion Ideation	AI-generated concepts	Faster creativity
Textile Design	Automated pattern creation	Unique designs
Virtual Fashion	Digital garments and avatars	Sustainability
Recommendation Systems	Personalized suggestions	Consumer satisfaction
Virtual Try-On	AI fitting simulations	Reduced return rates
Trend Forecasting	Predictive analytics	Better inventory planning

4.6 Trend Forecasting and Market Analysis

Fashion trend setting is highly dependent on social media, celebrity influence, world affairs, and consumer behaviour. AI applications rely on data sets gathered from social networking sites like Instagram, Tik Tok, fashion blogs, and retail websites to detect trends.

AI's predictive analysis allows fashion brands to forecast their market needs. They can plan production accordingly without having excess inventory.

5. PROPOSED AI-DRIVEN FASHION DESIGN FRAMEWORK

This chapter proposes an AI-driven collaborative fashion design framework integrating human creativity, Generative AI systems, sustainability principles, and consumer interaction.

The framework consists of five interconnected layers:

1. Data Collection Layer
2. AI Processing Layer
3. Creative Collaboration Layer
4. Sustainability Optimization Layer
5. Consumer Experience Layer

Phase 1 refers to collecting data from different sources, including fashion libraries, social media, consumer feedback, runway looks, and textile libraries.

Phase 2 is a result of processing through AI technologies, and it includes GANs, diffusion models, and transformers.

Phase 3 is focused on designers collaborating with AI technology and evaluating and refining all the ideas proposed by AI.

Phase 4 brings sustainability into the picture, a strategy that seeks to limit wastage, reuse materials, and enable digital prototypes.

The final layer adds a new dimension to the user experience by focusing on personalized fashion suggestions, virtual fitting rooms, and virtual shopping experience.

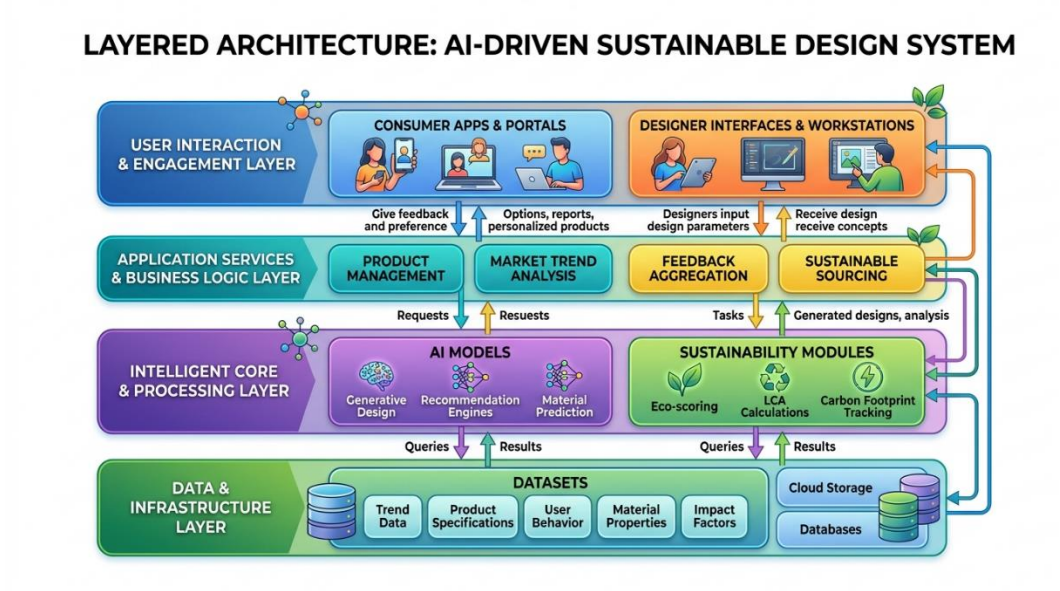

Figure 3. Proposed AI-Driven Collaborative Fashion Framework

Table 3. Proposed Framework Components

Framework Layer	**Functions**	**Outcomes**
Data Collection	Gather fashion datasets	Accurate training
AI Processing	Generate designs and predictions	Creative outputs
Collaboration Layer	Human-AI interaction	Refined aesthetics
Sustainability Layer	Waste reduction optimization	Eco-friendly production
Consumer Layer	Personalization and virtual try-on	Enhanced experience

The proposed framework demonstrates how AI can function as a collaborative ecosystem rather than an isolated automation tool.

6. IMPACT ON CREATIVITY AND INNOVATION

Creativity was viewed as a capacity of a person alone. It was considered a unique attribute of humanity, which included imagination, intuition, emotional and artistic elements. Nevertheless, Generative AI challenges this idea as it allows designing fashion items, aesthetically pleasing and contextualized.

There are obvious differences between creations produced by people and those developed by computers. Inspirations of human designers arise from emotions, their social status, histories, and culture. Contrary to AI models, the decisions made by humans rely on experience gained before. In contrast to humans, the decisions made by AI rely on the identification of certain statistical patterns discovered through the training data set.

Generative AI should be understood as a supplementary means of enhancing creativity rather than its substitution. A designer could easily explore different combinations that would require a substantial amount of work, try futuristic designs, imagine certain concepts and many other things.

Generative AI encourages collaboration in creativity process. As technologies evolve, human creators start functioning more and more like curators and editors of AI processes, directing its activity towards artistic output.

One more key innovation is hyper-personalization. While traditional fashion production methods are based on mass manufacturing principles, AI-driven solutions offer the capability of creating personalized fashion experiences that align with consumer preferences and body measurements.

Beyond that, Generative AI is helping to spearhead interdisciplinary innovation in merging fashion with game development, AR, VR, and blockchain. Now, through the digitization of fashion assets, digital objects can inhabit physical as well as virtual space at the same time.

7. SUSTAINABILITY AND ETHICAL CONSIDERATIONS

The fashion industry sits among the big contributors to the pollution of the environment. Waste, carbon dioxide, over-watered and unsold products are still issues. The application of Generative AI can offer multiple ways to advance sustainability.

AI-based demand forecasting minimizes overproduction by forecasting consumer preferences. Digital prototyping reduces the number of samples and fabric waste. Virtual fashion collections also are an effective method to save the surroundings, as they don't require any physical manufacturing.

What cannot be overlooked, however, are these ethical issues. Generative AI algorithms are fed vast amounts of data that includes copyrighted artwork, fashion styles, and cultural patterns. Issues of ownership and intellectual property rights are raised.

The second significant issue concerns bias. An AI system that uses all the information about fashion in the western society may not reflect the aesthetics of various cultures and body types.

Additionally, it is necessary to ensure transparency in the utilization of AI technology. In particular, there should be a code of ethics for fashion companies.

Ethical Challenges Associated with Generative AI

- Copyright infringement and ownership disputes
- Algorithmic bias in design outputs
- Loss of traditional craftsmanship
- Cultural appropriation risks
- Employment displacement concerns
- Deepfake fashion advertising and misinformation

Responsible AI governance frameworks are therefore necessary for sustainable and ethical innovation.

8. CHALLENGES AND LIMITATIONS

However, despite all the advantages of Generative AI, there are also certain problems that need to be addressed.

The issue of data quality needs to be raised first. Effective operation of AI depends on the amount of training data used in the process. Replications, errors, or biases might be caused by inaccurate or incorrect information.

The lack of originality may be yet another limitation. The restriction due to the limitations imposed by current trends in the training data has been viewed by many experts as hindrances in creating anything new and innovative through AI-created designs.

The large-scale diffusion models that involve heavy computing may also pose challenges. They are highly resource-demanding and require massive amounts of computing power.

Another problem associated with using AI in generating art is connected to fears and worries about future job security. Designers might be afraid that AI will replace them or at least devalue their contribution in terms of creativity and emotional intelligence. Specialists claim that machines cannot feel what humans feel.

In addition to that, there are many regions where regulation on AI-generated art still needs to be elaborated. Mechanisms for defining ownership and responsibility should be created.

Lastly, relying too heavily on AI-driven fashion trends can limit the variety of styles in the fashion landscape by favouring those that are programmed.

9. FUTURE TRENDS IN AI-POWERED FASHION

AI systems will collaborate with humans more and more in the future of fashion design. There are a number of trends in the development of fashion that can be predicted for the coming generation.

First, multimodal AI systems will evolve into more sophisticated systems that will allow for the real-time generation of fashion based on text, voice, sketches, and motion-based inputs.

Second, smart textiles, biometric sensors, and adaptive design systems will merge on wearable technologies made up of Artificial Intelligence. Fabrics can react to the physical surroundings, temperature and mental states in a dynamic way.

Thirdly, metaverse fashion ecosystems will grow enormously. Digital clothing collections, blockchain authenticated fashion assets, and virtual influencers will transform the concept of ownership and consumer experiences.

Fourthly, AI systems for sustainable fashion will prioritize circular design patterns, such as reuse, optimisation of materials and sustainability in production.

Last but not least, AI literacy will be part of curriculum in educational institutes for fashion design courses. A higher level of multi-disciplinary expertise is needed for designers of the future, encompassing aesthetics, technology, ethics and data science.

10. CONCLUSION

Generative AI is changing the game when it comes to fashion ideation, innovation, sustainability, and interaction with consumers. Improvements in GANs, diffusion models, transformers, multimodal systems, and more will revolutionize fashion ideation, fabric production, personalization, virtual prototyping, and e-commerce.

In this chapter, the fashion evolution of AI technology was examined, as well as an overview of Generative AI, some applications of this technology in industry, and the collaboration between fashion designers and AI. According to the results, the use of AI does not substitute fashion designers but improves their creative output via fast experiments, intelligent automation, and informed decisions made thanks to data.

Moreover, generative AI can reduce waste, create prototypes, and optimize operations in the supply chain. Nevertheless, there are other ethical issues that should be governed in terms of copyright rights, bias, representation of cultures, and employment.

Fashion design in the future will become collaborative and will involve interactions between people and machines. Fashion designers will become culture interpreters and storytellers, whereas AI technologies will be seen as intelligent creative assistants.

The line between physical fashion and digital fashion is becoming increasingly indistinct, and Generative AI will increasingly be found in the ecommerce system, marketing, and retail fields, as well as in fashion education. Companies able to embrace technological innovation and ensure ethical responsibility, whilst also maintaining a human-centred approach to creativity, will shape the next generation of global fashion change.

REFERENCES

[1] R. Bick, E. Halsey, and C. C. Ekenga, "The global environmental injustice of fast fashion," *Environmental Health*, vol. 17, no. 1, pp. 92–101, 2018, doi: 10.1186/s12940-018-0433-7.

[2] H. Caselles-Dupré, "Generative AI and the reimagining of fashion design," *International Journal of Fashion Technology*, vol. 11, no. 2, pp. 45–62, 2025.

[3] I. Goodfellow, J. Pouget-Abadie, M. Mirza, B. Xu, D. Warde-Farley, S. Ozair, A. Courville, and Y. Bengio, "Generative adversarial networks," in *Advances in Neural Information Processing Systems*, vol. 27, 2014, pp. 2672–2680.

[4] Y. Guo and J. Li, "Garment pattern generation method based on diffusion models," *Textile Research Journal*, vol. 95, no. 4, pp. 315–329, 2025.

[5] K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016, pp. 770–778, doi: 10.1109/CVPR.2016.90.

[6] Y. Jin and J. Rha, "Understanding fashion designers' behavior using generative AI," *Archives of Design Research*, vol. 37, no. 2, pp. 55–72, 2024.

[7] H. F. Karagoz and K. Oguz, "Textile pattern generation using diffusion models," *arXiv preprint arXiv:2304.00520*, 2023.

[8] D. P. Kingma and M. Welling, "Auto-encoding variational Bayes," in *International Conference on Learning Representations (ICLR)*, 2014.

[9] A. Kumar and I. Patras, "FashionSD-X: Multimodal fashion garment synthesis using latent diffusion," *arXiv preprint arXiv:2404.18591*, 2024.

[10] J. Lee and H. Kim, "Diffusedesigner: Sketch-based controllable clothing image generation," *Human-centric Computing and Information Sciences*, vol. 15, no. 1, pp. 1–18, 2025.

[11] H. Liang, "Generative AI in fashion design process," *Aalto University Publication Series*, pp. 1–88, 2025.

[12] McKinsey & Company, *The State of Fashion 2024*. McKinsey Global Institute, 2023.

[13] OpenAI, *Generative AI Systems and Creative Applications*. OpenAI Research Reports, 2024.

[14] A. Radford, J. W. Kim, C. Hallacy, A. Ramesh, G. Goh, S. Agarwal, and I. Sutskever, "Learning transferable visual models from natural language supervision," in *Proceedings of the International Conference on Machine Learning (ICML)*, 2021, pp. 8748–8763.

[15] G. Rizzi and P. Bertola, "Exploring the generative AI potential in the fashion design process," *European Journal of Cultural Management and Policy*, vol. 15, no. 1, pp. 1–18, 2025.

[16] S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Pearson, 2021.

[17] A. K. Singh and I. Patras, "Latent diffusion models for fashion synthesis," in *Proceedings of Computer Vision in Fashion Technology*, 2024, pp. 55–71.

[18] E. Stone, *The Dynamics of Fashion*, 5th ed. Fairchild Books, 2022.

[19] R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 2nd ed. MIT Press, 2018.

[20] M. Tegmark, *Life 3.0: Being Human in the Age of Artificial Intelligence*. Knopf, 2017.

[21] X. Wu and T. Rissanen, "An application of generative AI for knitted textile design in fashion," *The Design Journal*, vol. 27, no. 4, pp. 511–528, 2024.

[22] Y. Xu, W. Wang, F. Feng, Y. Ma, J. Zhang, and X. He, "Diffusion models for generative outfit recommendation," *arXiv preprint arXiv:2402.17279*, 2024.

[23] C. Yuan and M. Moghaddam, "Garment design with generative adversarial networks," *arXiv preprint arXiv:2007.10947*, 2020.

[24] Y. Zhang and S. Kim, "Unlocking the potential of artificial intelligence in fashion," *Journal of Theoretical and Applied Electronic Commerce Research*, vol. 19, no. 1, pp. 35–52, 2024.

[25] X. Zheng and P. Zhao, "AI clothing pattern generation using improved diffusion frameworks," *Electronics*, vol. 15, no. 8, pp. 1751–1769, 2026.