

WEAVING FASHION WITH A.I.

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Abstract

Artificial Intelligence (AI) has revolutionized the fashion industry, impacting various stages of the fashion lifecycle and offering promises of enhanced operational efficiency, personalized consumer experiences, and contributions to sustainability and innovation. This paper outlines the main trends, implications, constraints, and potential risks associated with AI in fashion design and production. In particular, the paper delves into biases in AI-powered systems, emphasizing data, algorithmic, and transparency gaps that can perpetuate discrimination.

Bringing ethics and pluralism into AI-powered design, the paper introduces intersectional feminism and feminist design principles, which can help envisioning a more inclusive, equitable, and unbiased fashion discourse.

In conclusion, the paper contends that feminist design principles can inspire the development of more inclusive and ethical AI-powered fashion. By challenging norms, promoting diverse representations, and incorporating user perspectives, feminist design can contribute to a socially responsible and equitable future for fashion technology.

Keywords: *AI-Powered Fashion, Biases, Intersectional Feminism, Feminist design, Ethics*

Introduction

In the realm of fashion, Artificial Intelligence (AI) has been transformative, impacting various aspects of the fashion lifecycle. Several applications have entered the market and the manufacturing process with the promise that the integration of AI in fashion cannot only enhance operational efficiency but also offer a more personalized and engaging experience for consumers while contributing to the industry's evolution towards sustainability and innovation.

In what follows, we first briefly portray the main trends in the use of AI in fashion, and later discuss implications, constraints and potential risks associated with design and production of AI-powered fashion.

Personalised shopping experience

In the age of data-driven insights, personalization acts as the entry point to numerous opportunities, fostering deeper connections between retailers and their customers. One of the most popular applications of AI in fashion is the creation of a personalized shopping experience with a variety of modes and contexts of use. Through sophisticated AI algorithms, customer preferences, purchase history, and browsing behavior are analysed to provide tailored product recommendations. This not only can enhance the overall shopping experience but also ensure that customers are presented with items that resonate with their individual tastes.

AI-powered styling tools offer personalized style and outfit recommendations. These tools analyze individual preferences, body types, and fashion trends to suggest complete outfits. Whether integrated into online shopping platforms or utilized by fashion influencers and bloggers, these tools aim to enhance the overall fashion experience for consumers.

Personalised shopping does not limit to receiving suggestions of purchasing. The development of virtual try-on solutions powered by AI enables users to visualize how clothing items will look on them without physically trying them on. For example, Walmart has launched the “Be Your Own Model” feature, enabling users to virtually try on clothing by utilizing their own photos and augmented reality (AR) technology. Amazon Fashion collaborated with Snap, offering Snapchat users the capability to virtually showcase branded glasses and sunglasses through AR filters. Leveraging AR, these virtual fitting rooms create realistic representations, revolutionizing the way consumers interact with fashion in the digital space. The virtual try-on App Auglio (2023) offers an easy to integrate plug-in to quickly try eyewear, cosmetics and accessories. The company advertises a 20% average increase in sales from the use of AR. The shopping experience can also be enhanced using AI-driven chatbots which provide instant and personalized support, assisting customers with product inquiries, sizing questions, and order tracking. This serves the purpose to not only improve efficiency in customer service but also present prospects for brands to explore hyper-personalization and refine their offerings to align with the preferences of their customers.

Supply chain optimization and quality control

AI also plays a pivotal role in optimizing the fashion supply chain. By predicting demand, automating inventory management, and refining production planning, AI mitigates overstock and understock situations, leading to more streamlined and efficient operations within the industry. In the dynamic and fast-paced world of fashion, predictive trend analysis is crucial. AI algorithms sift through vast amounts of data from social media, fashion blogs, and historical sales to forecast emerging trends. This can empower designers to stay ahead of the curve, responding promptly to shifting consumer preferences, but also retailers who can rely on high-quality end products whose

quality is controlled by AI-powered computer vision systems during the manufacturing process to identify defects or inconsistencies in textiles and garments. Image recognition is also used to ensure the authenticity of luxury goods, protecting brands and consumers alike.

Retailers can also benefit from AI algorithms for dynamic pricing which optimise pricing strategies based on market conditions, competitor pricing, and customer behavior allowing them to stay competitive and enhance overall profitability. At a more systemic level, AI can also be actively employed to address the sustainability challenge, which is a growing concern in the fashion industry, by sourcing materials and monitoring the environmental impact of production processes.

AI-generated fashion

In the creative processes of fashion design, the use of AI is controversial due to contrasting viewpoints on its impact. Some designers consider generative AI as a threat, some others as a valuable ally. These divergent views stem from a complex interplay of technological advancements, industry dynamics, and individual perspectives within the fashion design community.

Risks are associated to potential job displacement, loss of human touch, and a shift away from traditional craftsmanship. A main concern is related to the lack of creativity since generative AI relies on patterns and data from existing designs, which may lead to the generation of designs that lack true originality producing designs that closely mimic existing trends without introducing novel concepts.

From an opposite viewpoint, some designers consider AI as a valuable ally, appreciating its ability to enhance efficiency, provide innovative design suggestions, and contribute to a faster and more data-informed creative process. By providing inspiration, generating design concepts, and even assisting in the creation of patterns, AI has the potential to accelerate the design process and encourage creativity.

Whatever the personal opinions, there is no doubt that the integration of AI into the fashion industry has ushered in a new era of innovation, efficiency, and personalization, fundamentally reshaping the way fashion is designed, produced, and consumed. However, beside some benefits, AI-generated fashion design poses challenges and ethical considerations. Questions related to intellectual

property, cultural sensitivity, and the potential loss of human craftsmanship need to be addressed as this technology becomes more prevalent. Furthermore, AI-based technologies may harbor biases, arising from incorrect assumptions in the machine learning process. If the training data is generated by a stochastic process or an ill-defined problem, or if it poorly represents discriminating features, creating an effective prediction model becomes challenging. For instance, training a model to predict a specific trend in fashion using only gender information limits its predictive power due to the absence of other significant factors like height, age, geographic area, social and cultural background.

While an algorithm representing every point in the input distribution would minimize errors on training data, it may also capture random variations and noise, leading to poor predictive ability and high generalization error. Therefore, selecting the right dataset and training model is crucial for generating reliable predictions, as it ensures the inclusion of relevant factors and minimizes biases introduced by inadequate or skewed data.

Biases in AI-powered systems

Jamnik and Cheng (2021) posit that biases in AI-based systems can stem from three distinct sources:

Data Bias: Biases may emerge from datasets that lack representation, especially concerning minority groups. This deficiency can arise when minority groups lack internet access, hindering the generation of suitable data for processing. The term “Missing Data” (D’Ignazio & Klein, 2020) is coined for data not intentionally created or used for training, influenced by factors like prejudice and a lack of societal will to include them. The absence of representation perpetuates existing prejudices against minority groups and further contributes to their exclusion from society.

Algorithmic Bias: Professionals (developers, designers, and engineers) shaping AI-based systems may not encompass the diversity present in the wider world. This lack of diversity in the design process results from the natural tendency to work and reason within one’s worldview, shaped by personal beliefs and ideas that get transmitted to machines. The absence of diverse perspectives may inadvertently lead to biased services favoring a specific user group, while neglecting the needs and viewpoints of others. For instance, a t-shirt

crafted by a team entirely composed of cisgender designers might overlook the needs of non-binary individuals. The lack of diversity in design teams can also create blind spots, hindering the identification of potential issues or opportunities. Without varied perspectives, important details may be overlooked, leading to services that are inefficient, ineffective, or even harmful.

Transparency Gap: The lack of transparency is a critical factor contributing to discrimination in AI-based systems. As algorithms become more complex and autonomous, understanding the inference mechanisms adopted by the machine can become challenging. This opacity in the decision-making process can result in biased outcomes that are difficult to scrutinize or rectify.

Bringing ethics and pluralism to AI-powered design

D’Ignazio and Klein (2019) advocate for a fresh perspective on data science and data ethics, proposing the adoption of Data Feminism as a framework. This approach seeks to comprehend how factors such as race, class, sexuality, ability, age, religion, and geography profoundly influence an individual’s experiences and opportunities in the world. Data Feminism extends beyond gender considerations; it embraces pluralism and diverse voices, acknowledging that knowledge creation is inherently situated, embodied, and context-dependent.

This perspective aligns with “intersectional feminism”, a term popularized by the legal scholar and advocate Kimberlé Crenshaw (1991), which emphasizes the significance of recognizing how various social identities intersect and interact to shape an individual’s experiences of privilege and oppression. Intersectional feminism acknowledges that individuals can simultaneously embody multiple marginalized identities, such as race, gender, class, sexuality, disability, and more. This feminist approach challenges the limitations of single-issue feminism, which focuses solely on gender-related issues without acknowledging the intricate ways other factors intersect to shape individuals’ lives.

In the context of feminist design, intersectional theory and critique are considered essential components. They provide a more inclusive and comprehensive understanding of gender issues and their intersection with other social identities. Feminist design actively critiques and challenges

gender stereotypes and biases that may be perpetuated through design choices. Designers are encouraged to steer clear of reinforcing harmful gender norms and, instead, promote positive and empowering representations.

This critique has been expanded within a feminist approach aiming to encourage the integration of a norm-critical, gendered lens in the design of new technologies.

Bardzell (2010) defined qualities of feminist design which can help deepen the knowledge on how different gender identities can shape both the use of technologies and their design.

The first quality is *pluralism*. It encourages the designers to take multiple points of view prioritising the diverse experiences and perspectives of users, particularly those from marginalized communities, in the design process. This helps to ensure that technology is inclusive and accessible to all users.

The quality of *participation* refers to valuing participatory processes to facilitate the emergence of empathic relations between the designer and the target people. Feminist interaction design places the needs and experiences of people at the forefront of the design process. This helps to create technology that is responsive to the unique needs of different communities.

The quality of *advocacy* prompts the designer to behave ethically during the design process, valuing the contribution of people involved, offering progressive solutions, and trying to be open minded without imposing values which might offend or harm on users and other stakeholders. Ethical considerations such as privacy and security must be incorporated into the design process to ensure that technology serves the needs and interests of users.

The quality of *self-disclosure* refers to the possibility for people to be aware about the assumptions that a software program is taking about him/her and creates opportunities for expressing preferences through implicit or explicit behaviours.

The quality of *ecology* encourages interaction designers to adopt a comprehensive and structural approach, contemplating how design artifacts impact all stakeholders and their interrelationships within the system ecology they operate in.

In contrast, the *embodiment* quality challenges the disembodied perspective of the user associated with a mentalistic view of human information processing. Instead, embodied design places value

on gender commonalities and differences, human sexuality, pleasure and desire, experience, and emotion.

Feminist design as a way to AI-powered fashion

We believe that feminist design can significantly contribute to the development of better AI-powered fashion. Taking a feminist design orientation in fashion can challenge and avoid the reinforcement of gender stereotypes. By questioning traditional norms and biases, AI-powered fashion systems can be designed to offer a more diverse and representative range of styles that cater to a broad spectrum of gender identities.

Feminist design emphasizes inclusive representation, acknowledging the diversity of body shapes, sizes, and identities. AI-powered fashion can benefit from this approach by ensuring that recommendations, designs, and representations are inclusive and celebrate a variety of styles and expressions.

In the following we try to envision how AI-powered fashion could concretely incorporate feminist design principles toward a more inclusive, equitable and unbiased fashion discourse.

Pluralism

AI systems in fashion often involve sizing recommendations. Feminist design principles encourage the consideration of size and body diversity, ensuring that fashion AI takes into account a wide range of body types and offers personalized recommendations that empower people.

Levi's recently announced its initiative to explore computer-generated models designed to represent individuals from marginalized communities in the digital realm. Developed in collaboration with LaLaLand.ai, these digital renderings are not intended to replace human models entirely but rather serve as a complementary tool. The goal is to enhance the company's representation of diverse sizes, skin tones, and ages. Embracing AI in this manner opens up possibilities for brands to combat biases by contributing data to program algorithms with inclusivity at the forefront. Moreover, it offers an opportunity for models, especially those from underrepresented backgrounds, to be compensated for the use of their digital likenesses.

The intention of Levi's in using the AI clothing models resulting from their partnership with LaLaLand.ai is to foster greater body inclusivi-

ty allowing consumers to visualize how a garment would appear on a variety of models, encompassing diverse body types, ages, sizes, and skin tones. The concept holds the potential to assist individuals who struggle with the common issue of not seeing items modeled on a body that aligns with their own. However, Levi's application has also not been free from criticism as some have highlighted the fact that the use of digital models reduces that of real models, and this can generate the undesirable result of job loss.

Participation

Feminist design values participatory processes, ensuring that the voices of diverse users are heard in the design of AI-powered fashion systems. Involving users in the design process helps create technologies that better meet their needs and preferences.

For example, Quietude is a project funded within the H2020 EU Research Programme, WEAR Sustain (2023), which focuses on raising awareness of ethical considerations related to the collection of users' personal (physiological) data by wearable technologies. The project developed a jewellery system addressing a complex entanglement of needs of deaf people from being aware of environmental sounds to personalisation to express an individual sense of style and identity (Marti, 2021). The jewels can detect, recognize and filter sounds of interest like an alarm, a car horn, the doorbell etc. and notify the wearer through lights patterns, vibrations and shape change of the jewels.

The jewellery system was developed by a team comprising deaf women with diverse professional backgrounds and varying degrees of deafness, along with ethicists, makers, designers, and technology experts. This diverse group has been intentionally assembled to create aesthetically sophisticated and desirable objects—iconic pieces inspired by the personal experiences of deaf women, the inherent sensuality of the body, and the capacity of accessories to embody desires. Recognizing the intricate connection between personal expression, visibility, and discretion, Quietude aims to bring these products to market, acknowledging the profound and complex meaning they hold. Importantly, the project values the expertise of deaf contributors alongside other team members, viewing them as equal contributors shaping the final outcome.

Advocacy and self-disclosure

Feminist design places a premium on user empowerment and agency. In the realm of AI-powered fashion, this translates to systems that allow users to control and customize their fashion experiences, making choices that align with their preferences and values.

For example, in 2019, Carlings, a Scandinavian fashion brand, collaborated with creative agency Virtue to launch a digital collection called "Neo-Ex." This collection involved customers submitting a photo, and designers used AI technology to create a unique digital outfit that appeared in the photo. The initiative aimed to reduce the environmental impact of fast fashion and offer a new, digital approach to personal style.

Ecology

Feminist design often incorporates considerations of environmental and social sustainability. AI-powered fashion systems can be designed to prioritize sustainable practices, ethical sourcing, and responsible manufacturing, aligning with feminist values of social and environmental justice. For example, Adidas' Speedfactory initiative marks a groundbreaking move by the brand to incorporate artificial intelligence into the realms of sustainable fashion marketing and production. As a pioneering approach to reduce its carbon footprint, Adidas utilized these Speedfactories not only for manufacturing but also for direct product distribution from a single location. This strategy led to a substantial decrease in long-distance freight and associated emissions, making a notable contribution to a more sustainable supply chain (Rathore, 2017).

In conclusion, we believe that feminist design principles can inspire the creation of more inclusive, ethical, and empowering AI-powered fashion. By challenging traditional norms, promoting diverse representations, and incorporating people's perspectives, feminist design can imbue fashion technology with values to contribute to a more equitable and socially responsible future.

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