# Future of Artificial Intelligence in Fashion Products

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**Abstract:** In today's context, artificial intelligence (AI) refers to systems that exhibit intelligent behaviour through analyzing their surroundings and achieving specific objectives. The concept of artificial intelligence has gained significant popularity in recent years. As AI continues to rise, it is reshaping various industries, not only in the fashion sector but also in music, art, textiles, and more. The ongoing digital transformation is revolutionizing the world by incorporating new technologies that alter how different industries approach their operations. For instance, fashion companies are now collaborating with tech providers, acquiring startups, and developing their own technological solutions to create additional revenue streams and minimize resource waste. This paper investigates technologies that forecast fashion trends and simulate virtual clothing. A range of innovations demonstrates how technology is automating, customizing, and accelerating developments in the fashion realm. In conclusion, technology has significantly transformed the textile and Fashion Design Industry by enhancing efficiency, sustainability, and product innovation. While challenges still exist, the transformative potential of technology in the fashion sector underscores its role in meeting the demands of a rapidly evolving world while addressing environmental and social concerns.

**Key words:** Artificial Intelligence, Digital transformation, Fashion Design Industry, Technologies, Innovations in Fashion Products

## 1. INTRODUCTION

Fashion is a term used interchangeably to describe the creation of clothing, footwear, accessories, cosmetics, and Jewellery, each representing different cultural aesthetics. These elements are combined creatively to form outfits that represent unique styles of dressing, serving as symbols of one's social status, personal expression, and group affiliation. The journey of fashion has evolved from the barter system to become a billion-dollar industry, establishing itself as one of the most valuable sectors, with an anticipated growth of $106 billion by 2026. In order to adapt to the ever-changing needs of consumers, the contemporary Fashion Design Industry is swiftly integrating post-modern technologies across its three main segments: design, production, and retail.

For enthusiasts of artificial intelligence (AI), it is evident that AI is rapidly becoming a game-changer within the Fashion Design Industry. AI is influencing every aspect, from design and marketing to sales, presenting businesses with novel opportunities to streamline their operations and achieve new levels of success. Artificial Intelligence (AI) is the field focused on creating machines that can mimic human-like thinking and execute tasks that are often associated with human intelligence. The rise of AI has prompted the undertaking of research to understand its adaptation, transformation of processes, and its impact on the Fashion Design Industry. An array of innovations is showing how technology is accelerating the Fashion Products; including predictive technologies that can anticipate style trends and virtual reality clothing.AI-driven predictive analytics is being employed to optimize inventory management. Excessive production and inventory levels have adverse environmental consequences in the Fashion Design Industry. Predictive analytics, driven by AI, enables brands to accurately foresee demand, optimize production quantities, and reduce surplus stock. AI-based solutions offer real-time data and analytics, enabling brands to monitor their entire production process. This empowers them to identify inefficiencies and make data-driven decisions to enhance resource conservation, particularly in terms of energy and water consumption. This represents how AI is contributing to greater sustainability in the Fashion Design Industry.

## 2. LITERATURE REVIEW

### 2.1 Establishment of technology and AI in the Fashion Design Industry

Fashion and technology have a dynamic and continuously evolving relationship.
Today, the term "techno-fashion" is used to describe a phenomenon primarily of the 21st century, but the influence of technology on fashion design and production dates back to as early as the mid-18th century.

As fashion writer Bradley Quinn points out, technology has always been at the core of fashion. The rapid advancements in technology complement the ever-changing aesthetics of fashion, providing each other with broader frames of reference and new horizons to explore. The exhibition "Fashion and Technology" examined the impact of emerging technologies on the nature of fashion design and production spanning the last two and a half centuries. It focused on innovations that have shaped the production processes, materials, aesthetics, and functionality of fashion. The journey began with items from the Industrial Revolution of the 18th and 19th centuries when innovations in textile manufacturing brought about a revolution in the Fashion Design Industry. These innovations included the introduction of the Spinning Jenny, the Jacquard loom, and the sewing machine. The exhibition then progressed chronologically to the contemporary era. In the early 20th century, technology brought about rapid transformations in the urban landscape, symbolised by the rise of skyscrapers. The Art Deco movement emerged as an expression of these technological changes, introducing a highly geometric aesthetic that transcended into fashion through decorative motifs. Innovations in rubber and plastic materials also found their way into various fashionable items, including sports and evening wear.

After World War II, fashion's engagement with technology surged once again. Parisian couturiers like Pierre Cardin and André Courrèges drew inspiration from the Space Race, creating youthful fashions reflecting the anticipation of recreational space travel in the 1960s.

In the late 20th century, the proliferation of personal computers and the introduction of the internet had a transformative impact on culture. Fashion designers like Jean-Paul Gaultier found inspiration in cyberspace, while software programs such as Computer-Aided Design (CAD) and computer-operated Jacquard looms began to revolutionize garment production.

Digital technology continues to revolutionize fashion in areas such as promotion, fabrication, and basic design. From 3-D printing to advancements in wearable electronics, designers are crafting garments that can play music, answer calls, and even monitor the wearer's heart rate. Social media platforms like Facebook and Twitter have also redefined the boundaries of fashion branding in recent years.

**Fig.1** 3D Printed Outfits

The interplay between digital technology and fashion is still in its nascent stages, and as fashion designer Hussein Chalayan has remarked, technology will be the catalyst for fashion renewal, introducing new materials and methods of creating clothing. Without taking risks, transformative change cannot occur. Artificial intelligence (AI) is rapidly becoming a game-changer in the Fashion Design Industry, influencing various aspects from design to marketing and sales. AI has the capability to analyze vast amounts of data, extracting insights from sources like social media, fashion blogs, online retail platforms, and global fashion events. This analysis encompasses elements like colour schemes, fabric choices, styles, and regional fashion preferences, enabling AI to identify patterns and predict trends with remarkable accuracy.

For instance, the multinational technology company IBM partnered with the Fashion Institute of Technology (FIT) to leverage AI for fashion through a set of APIs specifically tailored to the industry. These APIs harness deep learning, natural language processing, and computer vision to enhance customer experiences, refine product development, optimize merchandising and planning activities, and bolster merchandise performance analysis.

Heuritech, an AI platform, utilizes machine learning to analyse millions of images from social media and the web daily, assisting brands like Louis Vuitton and Dior in anticipating trends and aligning their production accordingly. Similarly, trend-forecasting agencies like Edited and WGSN employ AI to analyse data from e-commerce platforms, fashion shows, and social media, offering actionable insights to brands worldwide. By embracing AI, the Fashion Design Industry is transitioning from a traditionally reactive field to one that is proactive and predictive, paving the way for a more sustainable and consumer-centric future.

### 3.2 Top technology trends in Fashion Design Industry

#### A. 3D Printing

Since the advent of 3D printers, many brands, both big and small, have been looking into the possibilities it holds for on-demand production. This will create new avenues for customization, sustainability, and creativity. Many fashion brands are embracing 3D in their collections in 2022, from accessories to full looks. Despite the fact it takes many hours to create, it results in less waste and proves far less labour-intensive than other types of manufacturing.

Indeed, printing garments on demand reduces fabric waste by about 35%. This minimal waste approach could provide valuable insights on how to reshape the current state of factories and align them with a more sustainable social and environmental focus. 3D printing also takes fashion to a new level of conceptual art. Anouk Wipprecht's incredible Spider Dress has mechanical arms which shift depending on the closeness of other people. This 3D-printed dress combines cutting-edge scientific technology and haute couture fashion, demonstrating the versatility of this new technology. Dutch designer Iris van Herpen has also experimented with 3D printing, and some of her looks were worn at the Met Gala red carpet last year by celebrities including Teyana Taylor and Dove Cameron. Fashion brands including Dior and Reebok have also produced 3D-print wearable designs.

**Fig. 2** 3D printed dresses worn by Teyana Taylor & Dove Camron for the Met

### B. AI – based inventory management

Inventory management software aids in the monitoring and tracking of inventory levels, orders, sales, delivery, and receipts. Purchase orders, bills of materials, and other production-related documents can also be generated using inventory management software. Several of these technologies are available online, and they are frequently cloud-based and include artificial intelligence. By enabling data-driven production and distribution centres, automated inventory management software has dramatically enhanced enterprises. When compared to traditional human approaches, AI's ability to understand real-time inventory control dynamics that affect inventory stock levels is revolutionary. AI can anticipate problems, offer solutions, and even carry them out for you. H&M: H&M uses AI to optimize its supply chain and reduce waste. The company uses machine learning algorithms to analyze sales data and predict product demand. Based on these predictions, H&M adjusts its production levels and distribution networks to reduce waste and improve efficiency. (kochar, 2023)

### 3.3 In the era of big data: Artificial Intelligence for fashion & sales predicting

Big data is larger, more complex data sets, especially from new data sources. These data sets are so voluminous that traditional data processing software just can't manage them. But these massive volumes of data can be used to address business problems you wouldn't have been able to tackle before. By Nassim Nicolas Taleb (in a complex meaning), Intelligence consists of ignoring irrelevant things. Artificial Intelligence incorporates a set of methods that are very suitable in the field of Fashion. AI is capable of handling the "3V" of big data, namely speed, variation, quantity with uncertainty, volatility, complexity in the Fashion Design Industry, and related markets. However, AI techniques are already in use in all sectors of the Fashion Design Industry, the diversity of currently available methods, models, applications, and data types makes implementing these techniques difficult. It scares some fashion companies. The consumer movements, such as sustainable fashion movement, make fashion consumers in their shopping actions to be more increasingly driven by a sense of consciousness rather than greed. Nevertheless, it still can be stated people have never consumed as many clothes as today, and along with it, the way how they do it changed. The information has become probably the most valuable element for society and industrial progress today. The big data environment has radically transformed our daily life and the economic and business World. For the Fashion Design Industry, the Big Data Era, supported by applications of the Internet, is very challenging and poses a considerable scale of opportunities. Many types of data can be analyzed in the context of Fashion: point-of-sale (POS) data, geographic information systems (GIS) data, social media data, virtual 3D data, sensory data, and textile physical data. The management of the profitable use of these data requires advanced techniques. Data mining is an interdisciplinary subfield of computer science and statistics, the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems. The overall goal is to extract information (with intelligent methods) from a data set and transform the information into a comprehensible structure for further use. Data mining is the analysis step of the "knowledge discovery in databases" process or KDD. Before data mining algorithms can be used, a target data set must be assembled.

Application of Knowledge Discovery in Databases (KDD) – a form of data mining, roots back to the 1990s, when the term data mining appeared first in the database community; these were the years 2005-2006. The success of a collection is a crucial issue for the survival of a fashion brand. To predict the success of fashion products is difficult, as the ever-changing landscape of Fashion shows short life cycles and high volatility of the consumer trends. The foreseeing abilities of the skilled predictors refined in the digital era; the traditional techniques developed, more recently involving the Artificial Intelligence in the Big Data analysis. Several AI methods and AI-based hybrid methods have proven effective in forecasting fashion sales performance. [5] [6] with the increasing demand to be able to follow consumers' demands, the quality and type of information changed. Before companies expected to be told, through valuable reports and trend-books, what to design for their customers in detail, today, designers prefer to rely on comprehensive lifestyle, socio-cultural, and economic trend-analysis building their brand identity alone. Today, Fashion Design Industry workers and trend forecasters rely on the Internet to retrieve information; they spend a significant volume of time tracking what is being looked at online and who is doing the looking. New technologies are helping retailers to manage inventory using AI-powered tools to gauge demand.(Csanak, 2020 )

### 3.4 Virtual style assistants and fitting applications

Forecasting is one example of using Artificial Intelligence in the Fashion Design Industry. According to an article recently published by the Forbes Magazine: "…despite the established nature of the Fashion Design Industry, AI is fundamentally transforming the industry from the way that fashion companies manufacture their products to the way they are marketed and sold. AI technologies are transforming the Fashion Design Industry in every element of its value chains such as designing, manufacturing, logistics, marketing, and sales." change is coming. Article of the WWD (Women's wear daily) magazine highlights that the world-leading Fashion Design Industry sees AI empowering designers, brands, and retailers to make better products and create more compelling shopping experiences. AI has reached the Fashion Design Industry making the shopping experience of the customers ever more comfortable. For example, a virtual Dressing Room app of the clothing giant Gap, introduced in 2018, created to help clients to try on the desired clothing virtually. Another application example is the Nike Fit, a scanning app that collects data on 13 points on a person's foot to measure the full shape of a user's feet within a matter of seconds, fitting each Nike shoe style using a combination of computer vision, data science, machine learning, Artificial Intelligence, and recommendation algorithms. (Kochar, 2023 )

**Fig. 3** Virtual fitting applications

### 3.5 AI as a fashion designer

Fashion experts are skeptical about if an industry built on creativity can be ever computerized completely. Fashion, as a materialization of human fantasy concerning the human body, shaping of the silhouette of the outfit, and creation of custom beauty, is eternally an art, an activity addressed to designers and artists. If AI, as augmented Intelligence, can help the human thinking process to focus on higher-value decision-making, arises a logical question: Can AI become a fashion designer? The answer is, unfortunately: Yes. The San Francisco based research center of the giant merchandising Amazon was launched the year 2004. Lab126 has developed an algorithm able to recognize particular fashion styles tracing on images; later, the tool can generate similar style new items. A simple, however competitive AI fashion designer.

AI-enabled improvements are already found in the fashion sector; several forward-thinking retailers are already using social networks (Instagram, Pinterest) to track the latest fashion trends and respond quickly. Processes of the leading companies are powered with smart technologies, enabling higher speed, lower cost, and improved flexibility at each stage of the supply chain, and it has further capacities in production automation and delivery of the goods. It has further capabilities in areas including forecasting, analyzing of new trends choosing and making right and sustainable fabric and color combinations, designing the desired cut with zero waste, organization of the production process in the most flexible, and sustainable way. When discussing prospects of application of Artificial Intelligence in Fashion Designing, firstly, we must highlight: Design is a form of reasoning-argumentation of a solution, a kind of a proposal.

The arguments can also be typed according to what logical way we reach the conclusion we formulated in the theorem. Fields and features that receive the most attention in AI research are processes of planning, reasoning, and problem-solving, which also constitute the most complex problems in the design. Design is a form of problem-solving. In a psychological approach, we call a problem any question or task for which we cannot find the exact or immediate answer or the solution. The best example of the same is CLO 3D, a powerful software that allows fashion designers to create realistic 3D garments and simulate how they fit and move on different body shapes and poses. It can help you save time and resources, improve your design quality and accuracy, and showcase your creativity and style. Countless global fashion brands and film/game production companies such as Hugo Boss, Mango, Adidas, Weta Digital, and Ubisoft use CLO Virtual Fashion solutions, making CLO the unrivaled leader of the virtual garment industry.

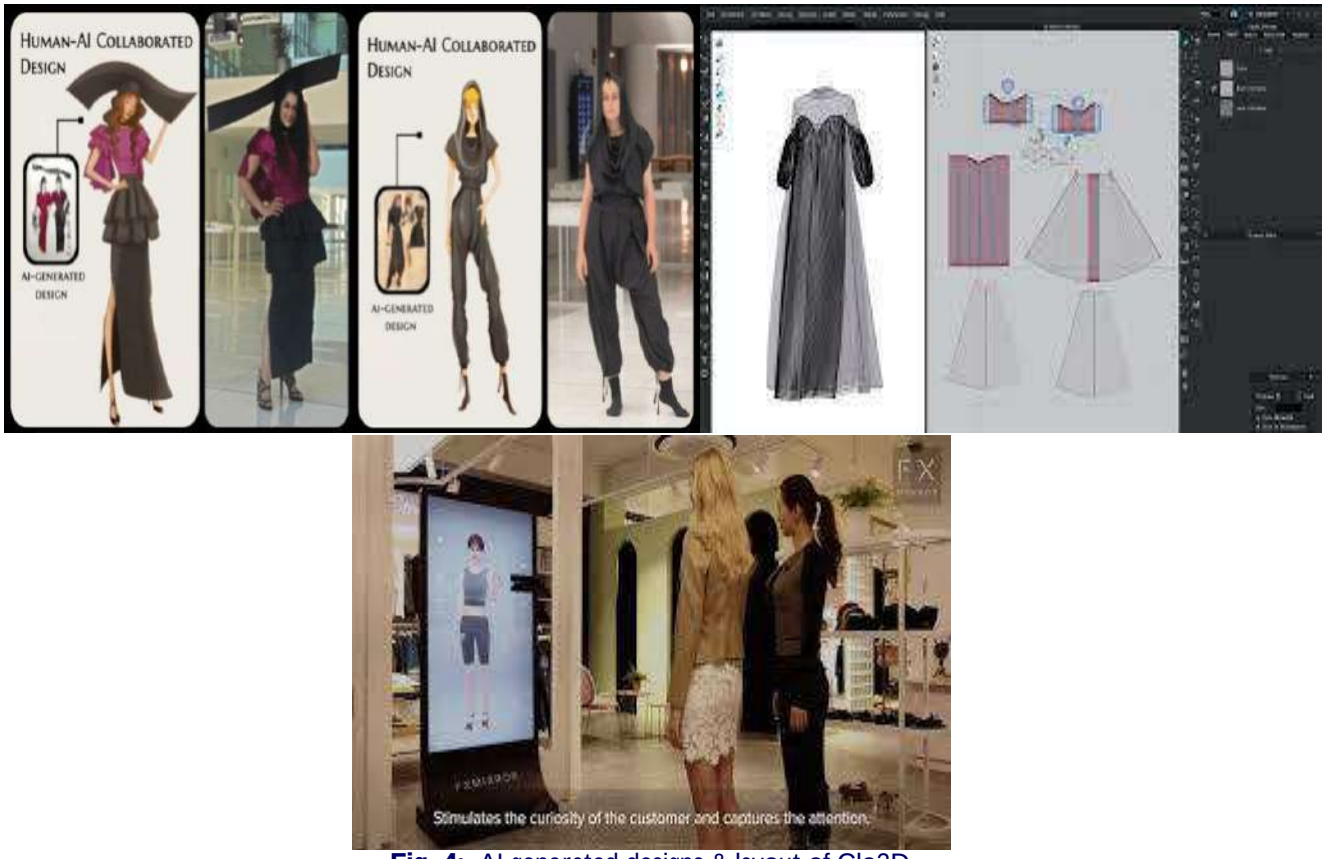


**Fig. 4:** AI generated designs & layout of Clo3D

### 3.6 AI-Powered Startups Revolutionizing Fashion Design Industry

#### a. Stylumia

Stylumia, the AI-led fashion intelligence start-up founded by former Myntra COO, was also included by Gartner in the Market Guide (June 2022) for Retail Assortment Optimization Applications in Merchandizing, analyzes and derives actionable intelligence from unstructured data sources by using advances in NLP and Computer Vision. Stylumia has the potential to change the face of the Fashion Design Industry by optimizing inventory levels for retailers around the world. It provides AI-driven solutions that address critical questions for any fashion or lifestyle brand: Which trends should be adopted? How much and what should be produced? When and where should the product be sold? It offers several solutions like Stylumia Customer Intelligence, Stylumia Fashion Intelligence, Stylumia Apollo, StylumiaStore.Y, and StylumiaImagGenie. The proposed solutions derive their intelligence from photos, user behaviour data, social media textual descriptions, and implicit signals gathered from retail sites. As a result, fashion and lifestyle specialists worldwide can make informed decisions about current course corrections and future directions and hence also help reduce waste.

#### b. ZMO.ai

Traditionally, the whole cycle of garment manufacturing usually takes two to three months – from design, fabric selection, pattern making, and modelling to hitting the shelves. But, considering the trend's rate changes, the process needs to be shortened. ZMO.ai founded by a group of Chinese entrepreneurs, can create unique-looking fashion models ten times faster and at a fraction of the cost of regular studio model pictures. It reduces the hassle of booking photographers, models, studios, and post-production. Plus, it aids in unparalleled speed to market. One can test different looks by simply putting the product's image on the model, getting the preferred on-model photos, and starting selling as soon as your first sample is ready. One can also customize the style of the models from the ample options available at the fingertips.

#### c. Lalaland

Lalaland, a dutch startup, provides a self-service platform where one can create their own hyper-realistic AI-driven virtual fashion avatars in a matter of minutes. Moreover, size, body type, body shape, identity, hairstyle, and even the level of happiness of the virtual fashion model can be customized based on the need.

This solution indeed helps in reducing the time to market. It also aspires to promote inclusivity by helping e-commerce enterprises capture humankind's incredible diversity by generating artificial, full-body fashion models. With digital avatars, e-commerce companies can showcase and validate 3D garment designs on avatars that match buyers' demographic areas before a physical sample is produced. Moreover, Lalaland not only promises to help the retailers but also the consumers while shopping online. One can choose a model that matches their size, age, and skin color and then views how clothing looks on that model. Adopting this AI-based technology is a practical benefit; if clients see how garments look on a model that looks like them, they can make a better decision. But, this may further lead to a long-term, more important psychological effect. Users who see relatable models are likely to feel heard, recognized, and respected, resulting in increased confidence. While it is too early to conclude if such an effect will be accomplished with this technology, there is no reason to doubt it. Lalaland's technology contributes to a higher first-time right hit rate and reduces the need to order several sizes. While the long-term effect has yet to be shown, and return rates vary widely between types of garments, Lalaland's experience with its first clients has demonstrated that return rates in women's wear can reduce from around 40% to about 30%. The decrease in returns means that fewer garments are discarded. It also indicates fewer shipments both to the customer and the retailer saving on carbon emissions from transportation and positively influencing profitability. (Sharma, 2024)

### 3.7 The future of Artificial intelligence in fashion

"We're all living in a world where technology moves in tandem with fashion. AI is an open space that allows you to construct, de-construct ideas and create something new altogether. This space is encouraging creativity and is aiding the Fashion Design Industry in a huge way," AI opens out a lot of ideas as to what technology can do and how can you incorporate it in your work. It is of great help if a brand knows how to utilise it," say Shane and Falguni. But what about the brands started by the gen X? Would they ever fully accept the most rapid and powerful transformation in the whole wide world for the brands that they grew like a child of their own? The answer to this question is an emotional plus a very sentimental journey of our parents, people from the gen X and it is a big NO, the struggles they went through back then still makes them choose to work harder and not smarter which thus tells us the only future of AI is us, the genZ. The generation that I represent is and always will be dependent on the latest technologies or in particular, AI that makes their work less hard and smarter. Hence, I and hundreds youngsters are the future of AI. (mohapatra, 2024)

**Fig.5:** Ultramodern use of AI

## 4. CONCLUSION

This research highlights the enduring significance of technology in the Fashion Design Industry. However, the advent of digital technologies and the immense volume of data generated by them, known as the digital transformation, has ushered in a more profound and rapid transformation in the fashion sector. This transformation is altering the way customers shop and engage with products and brands. Concurrently, companies are embracing these technologies to enhance their supply chain management and harness real-time data and analytics for more accurate demand forecasting and pricing optimization. It is evident that AI technologies have the potential to provide value across all aspects of the Fashion Design Industry, encompassing design, manufacturing, and the sales and marketing of final products. The future of fashion is undoubtedly becoming increasingly intelligent with the integration of Artificial Intelligence.

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