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Genesis, Features and Prospects for the Development of Digital Fashion

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Abstract: In the modern world, the fashion industry is constantly evolving, and digital technologies are having an increasingly significant impact on its development. Therefore, the research relevance is determined by the need to explore the features of modern digital fashion concerning the commercial aspect, ethical issues and concept of sustainable fashion. This research aims to predict the prospects for the development of digital fashion in the fashion and design industry, and is based on the following methods: analytical, comparative, generalisation and systematisation methods. The study results showed that digital fashion is becoming increasingly popular among well-known brands, designers and fashion houses, while the commercial use of digital fashion is expanding thanks to the non-fungible token (NFT) platform and other digital tools. At the same time, the research also identifies ethical issues related to the protection of intellectual property in digital reality. Furthermore, the research analyses the segmentation of the digital fashion market and forecasts the development of this industry until 2030 and beyond. In terms of the relationship with the concept of sustainable fashion, it is found that digital fashion can contribute to sustainable development by reducing the use of physical resources and preserving the environment.

Keywords: digital fashion; brand; design; fashion industry; technology; intellectual property; sustainable development

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1 Introduction

Digital fashion is a term that describes a cultural phenomenon associated with changes in society due to the spread of information technology. It emerged in the 1990s when the Internet became more accessible to the general public. The concept combines traditional elements of fashion with the use of virtual reality, computer graphics, artificial intelligence and other digital tools to create, present and consume fashion products. Today, digital fashion is a complex and changing category that continues to evolve along with changes in technology and society. The phenomenon of digital fashion has undeniably generated significant hype and attention in recent years, driven by the intersection of technology, social media and the desire for unique online identities. However, whether it will sustain its momentum and evolve into a full-fledged industry depends on various factors. While digital fashion offers novel avenues for self-expression and sustainability, its long-term success hinges on overcoming challenges such as creating tangible value for consumers, addressing environmental concerns and navigating the complexities of intellectual property rights. As technology continues to advance and virtual experiences become more integrated into our lives, digital fashion has the potential to evolve into a substantial and innovative industry, but its longevity will be determined by its ability to adapt to changing consumer preferences and the evolving digital landscape (Ding et al. 2023).

The emergence of digital fashion is due to several key factors, with the most important being information technology. With the advent of personal computers, the Internet, mobile devices and other communication and information processing technologies, it has become possible to create, store and distribute large amounts of data and content at low costs (Miethlich 2022). Another reason is the rapid development of social media and content-sharing platforms such as Facebook, Twitter, YouTube and Instagram. People have become active participants in the media space, creating, commenting and retweeting content, which has led to an increase in the influence of public opinion and a change in the way sellers and consumers interact. In

addition, the proliferation of smartphones has enabled people to be online all the time, regardless of where they are, which has also changed the way people shop and use services (Fishman 2023).

According to Chakraborty et al. (2021), the topic of digital fashion is of great importance in today's world, as technology is changing the way fashion is perceived. Digital fashion is reshaping traditional design, production and marketing processes, providing new opportunities for creativity, interactivity and customisation. Chakraborty et al. offer the following key aspects of digital fashion:

- digital design: software for creating and designing clothes allows designers to create products in a digital environment. This can include a variety of technologies, from 3D modelling software to artificial intelligence;
- digital clothing sales: online clothing stores have become the norm in today's world. Many globally renowned brands and stores are now using digital technologies to enhance this experience, such as virtual fittings where customers can "try on" clothes digitally;
- digital clothing is clothing that exists only in digital format. This can be clothing for virtual avatars in video games or virtual reality, or things that can be "worn" on images of real people. Such digital products can be sold in the same way as real ones;
- digital engagement: brands are actively using social media to engage the community in design and marketing strategies. Some are using augmented reality technology to create interactive advertising campaigns.

Digital fashion as a new trend in the industry plays a significant role in solving various key tasks (Minh and Ngan 2021). First, it helps to promote innovation in the industry. A variety of technologies allow designers and brands to experiment with new shapes, technologies and materials, pushing the traditional boundaries of design and opening up new opportunities for creativity. Secondly, digital fashion can serve as a mechanism for implementing personalisation in fashion. It can use advanced data and machine learning algorithms to create individually tailored products that meet the unique needs of each consumer (Brych 2022). Thirdly, digital fashion has the potential to ensure accessibility. In particular, virtual fittings can provide wider access to fashion products, regardless of physical limitations or geographical distances. It also facilitates greater mutual engagement between consumers and retailers, for example through virtual fashion shows and virtual fitting rooms. Finally, given the relevance of environmental concerns, digital fashion can be part of a strategy to reduce the industry's environmental footprint by minimising the use of physical resources required to produce and transport real clothes.

Given the aforementioned, the research aims to analyse the peculiarities and prospects of digital fashion development by 2030 and beyond.

2 Literature Review

The topic of the peculiarities of virtual fashion development has already been the subject of research by many scholars. Ahn et al. (2023) investigated the user experience of a digital fashion show using virtual reality. The authors evaluated various aspects of the user experience: usability, satisfaction, engagement and emotional response. According to the authors, interactivity can be an important factor that influences the effectiveness of a digital fashion show. This article can help in understanding how virtual reality can change the way people interact with fashion and what the potential advantages and disadvantages of using virtual reality technology in the context of fashion shows could be.

Chong (2023) analysed how digital fashion is changing fashion as a whole and creating new opportunities for designers, consumers and businesses, covering topics such as digital design and production, virtual reality and augmented reality in fashion, the use of NFTs and blockchain, digital fashion shows and other innovations in this area. In addition, the author considered potential trends, challenges and opportunities for the development of artists in this field. Elsewhere, Kalhor (2021) provided an overview of various ways artificial intelligence can be used in the fashion and apparel industry, such as design automation, trend forecasting and personalised marketing. The researcher defines digital fashion as an industry that mainly uses artificial intelligence to develop clothing and accessories.

Han et al. (2021) focused on the role of virtual prototyping in fashion design education, especially with the use of electronic textiles (E-textiles). E-textiles are textile materials that contain digital components or electronics: sensors, LEDs, batteries and microprocessors. Clothing made from such materials can interact with the environment, adapt to the needs of the wearer or provide new functions such as health monitoring. Kolisnichenko et al. (2023) explored the stages of digitalisation in the fashion industry, its innovative potential and the prospects for transforming it into an environmentally sustainable system. In particular, the authors examine how digital technologies and innovations are impacting the fashion

industry, from design and production to marketing and distribution. They also provided an assessment of how digitalisation can contribute to the sustainability of fashion by reducing its detrimental impact on the environment.

Strategies aimed at reducing material waste during the mass production of clothing were described by Ramkalaon and Sayem (2021). In particular, they refer to zero-waste pattern cutting (ZWPC) technology, a design technique that minimises or eliminates waste. Traditionally, when creating a product, designers cut pieces of fabric using patterns, which leads to waste – pieces of fabric that are not used in the final product. According to scientists, depending on the complexity of the design, this waste can account for 10–30 % of the original fabric. In response to this, ZWPC technology requires designers to create patterns in such a way that every piece of fabric is used efficiently. ZWPC is part of a wider movement in sustainable fashion that aims to reduce the waste and environmental impact of the textile industry (Sarybaeva et al. 2015). This approach, however, requires significant effort on the part of designers, as not only the aesthetics of the product but also the efficiency of the use of materials must be considered and calculated.

Meng (2022) explored the relationship between digital fashion and so-called sustainable fashion, a concept that encompasses a range of practices in the fashion and design industry that aim to reduce its negative impact on the environment and society. These two areas are united by a common goal – finding new ways to live a more environmentally sustainable and socially responsible lifestyle. Sustainable fashion focuses on reducing the environmental impact of fashion and increasing social justice in the fashion and design industry (Hardabkhadze et al. 2023; Sabyrhanova and Bajzhanova 2011. It includes a wide range of practices: using more durable materials, minimising waste in production, reducing water and carbon footprints, supporting fair trade and ethical production and supporting the reuse of raw materials (Bayzhanova, Kudabaeva and Dzhanahmetov 2013; Teymurova, Huseynli and Miethlich 2023). Digital fashion, in turn, uses technology to create, sell and distribute products in a virtual environment, which reduces the use of resources and the environmental impact caused by the production of clothing.

Sharma et al. (2021) investigated the development of an intelligence system designed to provide personalised design recommendations. Such a system would use machine learning to analyse data on consumer tastes, trends, body sizes and shapes and make design recommendations that best suit a particular consumer. This will include, for example, identifying colours, fabrics, prints, silhouettes or other design elements that are most suitable for a particular person or people with certain characteristics or preferences. According to the authors, personalisation is becoming increasingly important in retail, and consumers expect products and services that meet their individual needs. Technologies based on data analytics and artificial intelligence can help fashion designers and brands create more relevant products and services (Berestetska et al. 2023; Ivanova 2019).

Another key issue arising from the introduction of digital technologies in the fashion industry is the protection of intellectual property. Øverjordet (2021) believes that digital fashion, like any other format of creativity, is subject to copyright law. An original digital clothing design created by a designer or brand is a work of authorship, and its use without permission may be considered copyright infringement. However, the evolution of technologies such as blockchain and non-fungible tokens (NFTs) is creating new challenges. For example, one of the features of NFTs is that they allow digital assets to be "frozen" on the blockchain, which guarantees their uniqueness and authenticity. Thus, in the future, NFTs may become a powerful tool for protecting design copyrights, allowing authors to control their distribution and use. However, the protection of intellectual property in digital fashion is not limited to this, and also requires adequate regulation at the legislative level. Given the global nature of digital fashion, international copyright standards and agreements need to be developed, as well as the specifics of regulation in different countries.

Kolisnichenko et al. (2021) explored the use of digital technologies in the process of vocational education and training (VET) in the field of design and technology in Ukraine. The authors looked at technologies such as design software, 3D modelling, virtual and augmented reality. They also analysed specific programmes or courses available in Ukraine and their effectiveness in preparing students for work in the digital economy, including fashion.

Derman (2020b) examined the impact of globalisation and digitalisation on global fashion markets. The author explored how global trends related to the development of the Internet, social media and other digital technologies affect the production, distribution and consumption of fashion goods. The study analysed in detail how these processes affect the business models of fashion brands, consumers, jobs in the fashion industry and the impact of fashion on the environment. In addition, the researcher provided specific examples of how individual brands have adapted to these trends and drew conclusions about what changes can be expected in the future as these trends continue to develop. Derman (2020a) also analysed the use of digital technologies in the design and presentation of clothing collections. The author described the software used for fashion design, digital platforms for presenting new collections and examples of brand interaction with consumers, and also discussed

how digital technologies can affect the aesthetics of fashion, the roles of different stakeholders (designers, models, consumers) and the strategies for the development of the fashion industry.

Overall, the literature review has shown that the topic of digital fashion is relevant, and the introduction of technology into the fashion industry is taking place at different levels – from design and production to sales. Scholars agree that over the next decade, it will continue to evolve in line with technological advances and changes in consumer demand.

3 Materials and Methods

The study uses a set of methods that allows for a comprehensive analysis of digital fashion, its evolution, current state and prospects. These include the analytical method, the method of comparison, methods of generalisation and systematisation. In particular, the analytical method was used to study various sources of information about digital fashion: statistical data and market trends. It was also used to study the role of the latest technologies, including the NFT platform and the Metaverse, in the commercial use of digital fashion. Integration methods of digital technologies into the production of fashion products, the use of digital platforms for the presentation of new collections, customer interaction and commercial exploitation of virtual goods were reviewed. The experience of well-known brands such as Adidas, Tommy Hilfiger and Zara was assessed in terms of their strategies for using technology. In addition, the ethical issues arising in the context of intellectual property protection in this area were considered. At the same time, the environmental aspects of digital fashion were highlighted and its potential to support sustainable development by reducing the use of physical resources and preserving the environment was identified.

The comparative method was used to draw parallels between digital and traditional fashion, identify their key differences and track the impact of digital fashion on the fashion industry as a whole. This approach included comparing the processes of creating, distributing and consuming digital fashion products with traditional methods of producing and selling clothing, as well as assessing the efficiency, cost and environmental impact of both approaches. This, in turn, was used to formulate recommendations for the optimal use of digital technologies in fashion, as well as to identify key areas for further research and innovation in the industry.

The methods of generalisation and systematisation were used to process the vast amount of information collected, identify the main themes and trends, formulate generalised conclusions and determine the main directions of digital fashion development. In particular, the generalisation included the identification of general trends, problems and prospects based on data on various aspects of digital fashion, such as design, production and consumption. The systematisation was used to structure this information into logically organised categories or thematic blocks, which allowed for a better understanding of the complexity and diversity of digital fashion, as well as the formulation of sound recommendations for further study of this industry.

4 Results and Discussion

4.1 The Concept of Digital Fashion, its Main Areas of Focus and its Use by Modern Brands

4.1.1 The Concept of Digital Fashion

Digital fashion is a new form of design industry that has emerged in the context of the expansion of digital technologies and the introduction of innovative solutions into the fashion industry. One of its most popular areas is the 3D modelling of clothing (Shen 2021). To create high-quality 3D models of clothing that can be used to produce real products, present designs, or manufacture products in virtual reality, the following programs are most often used:

- CLO 3D is one of the most popular software programs in the fashion industry. It allows users to design clothes in 3D space to imagine how the product will look and behave when worn. CLO 3D can export designs to a variety of formats and supports a large number of materials and fabrics;
- Browzwear also specialises in fashion modelling. The app provides tools for 3D design, printed products and virtual fittings;
- Optitex is another popular choice among fashion designers. The software offers numerous solutions for 3D modelling of clothing, footwear, accessories and automated fabric cutting;
- Marvelous Designer is known for its realistic fabric simulations and is used in the fashion industry as well as in graphics and animation.

Many well-known fashion brands use 3D modelling software in their design process. Among them, for example, is Adidas, who used 3D printing in 2017 to create a new line of shoes.

Nike has also used 3D modelling and printing to design and manufacture footwear, in particular, to create personalised products for athletes. The well-known retailer H&M has also recently started using 3D modelling for virtual models and clothing on its website, which has allowed the company to quickly and efficiently display new products for shoppers. Tommy Hilfiger has announced that they will switch to 100 % digital design by 2022, using 3D design and AI for all their products. This follows on from Balenciaga, who used 3D modelling to create the first digital show collection that was presented in virtual reality.

It is important to note that while some brands are already actively implementing 3D modelling, others are only just starting to explore this technology. The use of 3D technologies in fashion is slow, but it is an area that has all the prerequisites for further development. Among other strategies that are transforming the traditional mechanisms of selling and presenting clothing is virtual reality. For example, some brands and retailers are integrating augmented reality (AR) technologies and other digital tools into the sales process to allow customers to visually "try on" clothes before buying. Various brands such as ASOS, Zara and Adidas are already incorporating these technologies into their mobile apps. Several companies are even experimenting with the use of virtual reality to model full-fledged virtual stores, which allow customers to "walk around" and select products in a digital environment. For example, Tommy Hilfiger has developed a virtual reality (VR) experience that allows customers to virtually view fashion shows in 3D (Feng 2020).

Another popular technology which, however, raises much controversy in terms of convenience, is digital clothing. In its most radical form, it is clothing that is never physically produced; instead, it is created in a virtual space and can be "worn" on virtual models. This is still a new and experimental aspect of selling clothing, but some companies, such as The Fabricant, are already creating and selling digital clothing. There are centres for the promotion and commercial use of digital fashion – places (physical or virtual) where digital clothing and accessories are actively distributed and sold. The Metaverse, a large shared virtual space, is one of the key places for the promotion of digital fashion. This space is created by merging physical and virtual reality and usually includes many virtual worlds or environments. The Metaverse can appear in very different forms, from real-world simulations to fantasy worlds. It can include virtual cities, countries and planets, as well as a variety of gaming or non-gaming environments, and users can interact with each other in real-time using their virtual characters or avatars. They can attend virtual events, meet friends, study, work, play games, engage in creativity and more.

4.1.2 The Use of Digital Fashion by Various Brands

Digital fashion in the Metaverse includes the creation, sale and use of virtual clothing, from simple costumes to complex and unique fashion products. Products are made by professional designers, amateur users, or generated by artificial intelligence. It should be noted that some digital clothing products can have significant value potential, especially if they are unique or limited. Decentraland is the largest virtual world where users can buy, collect and sell virtual property and items. Elsewhere, *Fortnite* is a well-known video game where players can purchase "skins" (virtual clothes) for their characters. Some skins are rare or only available for a short time, which contributes to their value (Huang and Li 2021). Furthermore, the Metaverse can provide opportunities for fashion brands to promote their products by creating virtual versions of their real-world clothing collections or by creating special products for the virtual world.

Balenciaga presented its spring-summer 2021 collection in a virtual format through the video game *Afterworld: The Age of Tomorrow* (Figure 1). Participants could view the brand's new collection in a kind of virtual fashion show where the game characters wore clothes from the new Balenciaga collection. *Afterworld: The Age of Tomorrow* was created as an adventure game where players could interact with the environment and characters, and is currently the largest game ever created for a fashion show. This move has been hailed as revolutionary for the fashion industry.

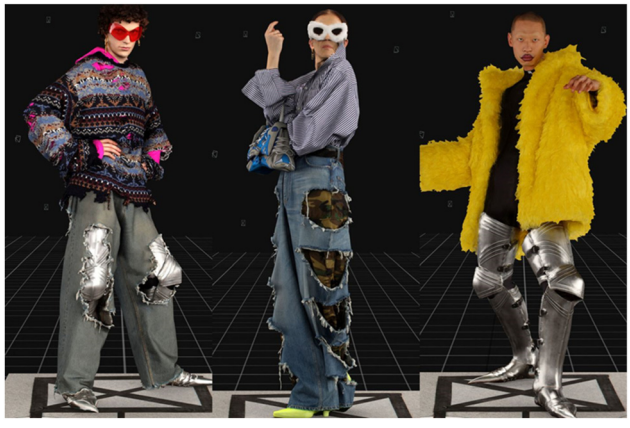

Figure 1: Virtual avatars showcase the autumn collection of the Balenciaga brand, spring-summer 2021. Source: Balenciaga Presented the Video Game Afterworld: The Age of Tomorrow (2021).

Louis Vuitton released virtual clothes for the characters of the video game *League of Legends* (Figure 2). In addition, the brand created a digital version of its physical bag collection that could be purchased and used in the mobile game *League of Legends: Wild Rift*, which allowed users to "wear" the brand's products in the digital world. These initiatives not only allowed the company to draw attention to its physical products but also to make money from digital sales.

Gucci worked with many video games, including *Tennis Clash* and *The Sims*, to create a virtual version of its designs. In the Roblox environment, the brand opened the Gucci Garden Experience, a virtual exhibition where users could view and "try on" virtual garments (Figure 3).

NFT platforms play an important role in the commercial use of digital fashion. NFTs are a special type of cryptographic token that represents an irreplaceable digital asset, based on blockchain technology that supports

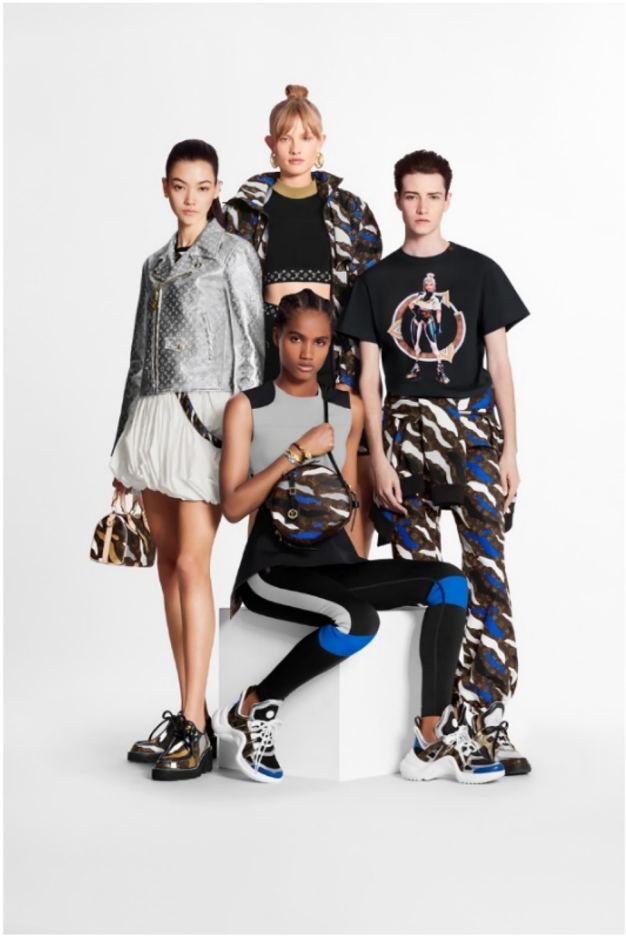

Figure 2: Virtual clothes for *League of Legends* video game characters by Louis Vuitton 2019. Source: Louis Vuitton and Cybersport: The Brand Created a Collection Based on *League of Legends* characters (2019).

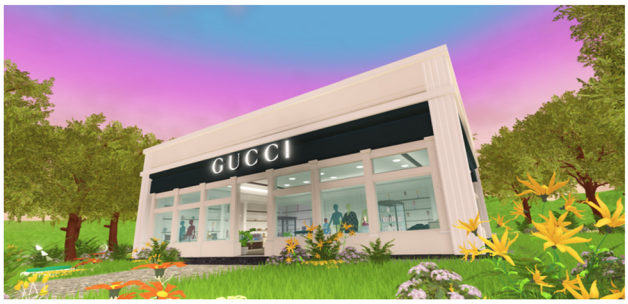

Figure 3: Virtual space of the Gucci brand on the Roblox platform, 2022. Source: Machulka (2022).

cryptocurrencies such as Bitcoin or Ethereum. The term irreplaceable means that each NFT is unique and cannot be replaced by anything else. This is different from tokens such as Bitcoin, where each token can be exchanged for another token that is similar to it (Patashkova et al. 2021). NFTs can be used to represent ownership of a variety of digital assets, such as virtual clothing, digital art, virtual real estate, music, videos, collectables and more. They can also be used to represent ownership of physical assets in the real world. One of the key aspects of NFTs is that they can prove the ownership and provenance of a digital asset, which opens up new opportunities for digital trading and collecting. That is, designers or brands can create a limited edition of virtual clothing or accessories and sell them as NFTs. These items can be used to express individuality in the digital space, or can act as an investment asset, while in the fashion world they can be a means of demonstrating status or brand recognition. However, it is important to note that while NFTs provide an opportunity to own digital assets, they also bring several challenges, including issues related to digital ownership, data storage and environmental impact (Nobile et al. 2021).

Market segmentation is an important tool in strategic marketing that allows organisations to identify and target different consumer groups based on their unique needs and preferences (Chen et al. 2022). In the context of digital fashion, market segmentation can be particularly useful as it involves a wide range of products, technologies, platforms and users. The main segments of the digital fashion market can be identified based on various criteria, such as technological capabilities, demographics, consumer behaviour and user needs and preferences (van Rijmenam 2022). Among the possible segmentation vectors, the following are relevant:

(1) Technological segmentation: this type of segmentation identifies groups of users based on their technological capabilities. For example, some users may use AR technology to view digital clothing in a real-world environment, while others may engage with digital fashion

through VR platforms or the Metaverse. Different groups of users may use different platforms and devices to interact with digital fashion, such as mobile devices, computers, VR headsets or AR technology. Each of these platforms requires a different design, interaction and functionality, and therefore each may attract different user groups.

(2) Demographic segmentation: this type covers groups of users based on their demographic characteristics, such as age, gender, education level and income.

(3) Lifestyle and interest segmentation: this type identifies groups of users based on their preferences, interests, lifestyle and values. For example, some users may be interested in eco-friendly or sustainable digital fashion, while others may be looking for exclusivity.

(4) Segmentation by consumer behaviour: groups of users based on their behaviour, purchasing habits, interaction with brands and responses to marketing activities.

Identifying and targeting these segments can help organisations develop and implement more effective marketing strategies that better meet the needs and interests of different consumer groups. However, it is important to note that market segmentation needs to be flexible and adaptive, given the rapid pace of technological development and changes in consumer behaviour. The target audience of digital fashion can be extremely diverse, as digital fashion can satisfy a wide range of needs and interests. It can include not only individual consumers but also brands, designers and game developers, as well as commercial and non-profit organisations. When defining the target audience, it is important to consider various aspects: demographic characteristics (age, gender, education), behaviour (habits, attitudes towards technology, interests) and context of use (at home, on social media or in the Metaverse) (Derman 2020a; 2020b). The target audience for digital fashion may also include user groups with different lifestyles and values. Understanding the target audience is an important step in developing and implementing effective digital fashion strategies, which allows organisations to better respond to the needs of their users, create attractive products and build deeper and longer-term relationships with their customers.

4.2 Goals and Prospects for the Development of Digital Fashion

The tasks and functions of virtual fashion may vary depending on the context of its distribution (Table 1).

Table 1: Tasks and functions of virtual fashion.

Task	Meaning
Identity expression	Digital clothing allows users to express their identity, style and creativity in digital spaces such as social media, virtual worlds or video games
Economic value	Digital fashion can also have a real monetary value. It can be sold, bought or traded through NFT platforms or other digital marketplaces. This can provide new earning opportunities for designers and collectors
Branding and marketing	For fashion brands, digital apparel can be used as a means to draw attention to their physical products or to create a unique branded product in the digital space
Constant development	Digital fashion can be considered more environmentally sustainable than traditional fashion, as it does not require the production, transport or storage of physical goods
Innovation and experimentation	Since digital clothing is not limited by physical constraints, designers can experiment with new styles, materials, shapes and animations that would not be possible in the real world

Source: V. Patil (2023).

All of these features make digital fashion an important new direction in the fashion industry and digital culture in general. In terms of property and copyright, digital fashion, which is created in a digital format, raises complex issues. Intellectual property encompasses a variety of categories, including copyrights, patents, trademarks and design rights, which provide owners with control over the use of their creations and innovations (Yaroshenko et al. 2020). However, in the virtual environment, copyright and other forms of intellectual property are often governed by licensing agreements. When a user purchases a digital fashion item, they are effectively acquiring the right to use it, not ownership of the item per se. A variety of strategies and tools are used to protect intellectual property in the digital fashion industry (copyright and trademark rights to protect designs and brands, patents to protect technological innovations or unique creation processes, encryption, digital signatures and blockchain technologies) (Wu and Devendorf 2020).

Digital fashion is currently experiencing a significant period of growth and innovation, and this trend is expected to continue over the next decade. Although there are many uncertainties about the specific nature of this development, several key trends can be identified that are likely to impact the digital fashion landscape by 2030. One of the leading trends in digital fashion is the continued use of AR and VR to enable interaction with fashion pieces and brands. With AR and VR, users can try on digital clothing, accessories and

shoes in real-time without having to visit a physical store. Another interesting trend is the deepening of interactivity and collaboration with consumers. Some brands are already launching virtual exhibitions or games that allow consumers to actively interact with digital fashion, contribute their ideas and participate in the creation of unique collections. Technological innovations are also having a significant impact on the production process and sustainability of digital fashion (Torybaeva 2013). The use of on-demand production can reduce the environmental impact by creating garments only when there is an order. Elsewhere, adding smart technologies to digital clothing can increase its functionality and convenience for consumers. Finally, by 2030, digital fashion is likely to be deeply integrated into our daily lives. It will be used not only as a means of expressing individuality and style but also as a tool for communication, learning and work, as well as for entertainment and social interaction (Heim 2022).

Overall, these trends are making the fashion industry more accessible, personalised and sustainable, opening up new horizons for creativity. While the traditional fashion industry is often criticised for its environmental impact, digital fashion offers new ways to address these issues. For example, digital fashion can significantly reduce physical waste and resource consumption, as it does not require traditional materials, production and transportation for its sale. The production of digital fashion takes place in a digital space, which eliminates the need for water, energy, chemicals and other resources traditionally used in the textile industry. The absence of a physical product also reduces the impact of post-consumer waste and avoids disposal issues. Digital fashion can also contribute to environmental sustainability through its personalisation options. Instead of producing large batches of clothing that may go unsold, digital fashion allows for the creation of personalised products on demand (Prokopenko et al. 2023). This can reduce wastage of materials, increase efficiency and make fashion more relevant to consumer needs. It is also worth mentioning the opportunities for recycling and reuse in the digital space. In digital fashion, clothes and accessories can be reused endlessly without wearing out, tearing, or losing their original quality. In this context, digital fashion can contribute to the transition to a more circular economy (Derman 2020a).

DressX is an innovative and pioneering platform that operates at the forefront of the digital fashion industry. It offers a unique and ground-breaking concept by combining technology, fashion and sustainability. DressX enables users to explore and experiment with digital clothing, allowing them to purchase and wear virtual garments in various digital spaces such as social media, gaming environments and virtual reality platforms. The platform collaborates with a diverse range of talented digital fashion designers who create stunning, avant-garde virtual clothing collections that challenge traditional notions of fashion. DressX promotes sustainability by reducing the demand for physical clothing production and addressing the environmental impact of the fashion industry. This emerging platform has garnered attention for its potential to revolutionise the way we consume and interact with fashion, blurring the lines between physical and digital worlds. As the digital fashion industry continues to evolve, DressX stands as a trailblazer, sparking discussions about the future of fashion, self-expression and sustainability in the digital age (Joy et al. 2022).

However, virtual fashion also has its sustainability challenges. For example, it requires energy to create and store digital files. This means that the carbon footprint of digital fashion is highly dependent on the energy source used. In terms of acceptability, digital fashion can offer unique opportunities for consumers to express their identity and creativity, and for brands to increase their visibility and market presence. It can also open up new channels of interaction and collaboration between consumers, designers, brands and technologists. However, it is also important to consider that in many places, access to the technology required to participate in the digital fashion experience may be limited. This can create new forms of inequality and exclusion that should be focused on when considering the acceptability of digital fashion for the future. Therefore, while digital fashion has significant potential to improve the sustainability of the fashion industry, its full adoption and implementation requires consideration of a wide range of environmental, technological and social challenges. In this context, further research and strategy development is needed to ensure the sustainable development of digital fashion in the future.

5 Conclusions

In the context of the dynamic development of the modern world, the fashion industry is under the influence of constant innovation, with transformations becoming particularly noticeable due to the penetration of digital technologies in all spheres of life. In recent years, the concept of digital fashion has become popular, with many well-known brands, designers and fashion houses already actively using the digital format to manufacture, distribute and sell their goods, such as clothing, footwear and accessories. At the same time, the role of the NFT platform, Metaverse and other virtual fashion distribution centres is growing, opening up

new opportunities for the commercial use of digital fashion, such as virtual exhibitions. The key aspects of digital fashion include digital design, online clothing sales, virtual fitting rooms, digital interaction between brands and consumers and the use of augmented reality. Many well-known brands, including Adidas, Tommy Hilfiger and Zara, are already using these technologies, employing a variety of software for this purpose, including CLO 3D, Browzwear, Optitex, Marvelous Designer.

However, with the rapid development of digital fashion, the issue of ethics, especially about the protection of intellectual property, is becoming more relevant. With digital goods being easily copied and distributed, designers' copyrights may be at risk. In addition, the boundaries between ownership and use in the digital space are becoming ambiguous, which raises additional challenges in defining and protecting intellectual property. This calls for the development of effective regulatory mechanisms that would ensure the legal protection of intellectual property in digital fashion, considering its specifics and features. Today, digital fashion is in a phase of intense development and innovation, with this process predicted to continue until at least the end of this decade. It is also expected that the breadth and depth of digital technologies in fashion will continue to expand, which may include increasing integration with other digital technologies such as artificial intelligence and augmented reality, as well as expanded influence on all stages of the fashion process, from design and production to consumption. Digital fashion is likely to continue to influence the interaction between brands and consumers, offering new opportunities for personalisation, interaction and engagement. The role of the consumer in the fashion process may also be redefined, for example, through opportunities for co-creation or self-design. Elsewhere, digital fashion is expected to continue to address the environmental challenges of the fashion industry, providing new opportunities for sustainable fashion production and consumption.

In the context of sustainable development and environmental protection, digital fashion is proving to be a potentially environmentally attractive trend. Since it does not involve the use of material resources for the production of clothing, it can reduce the environmental impact of the fashion industry. However, it is important to approach it with an understanding of its unique challenges. In particular, the production and maintenance of infrastructure for digital technologies also have an environmental impact. Additionally, the proliferation of digital fashion has a major impact on socio-cultural aspects of society, such as consumption, identity and the virtualisation of life. Thus, despite its potential to reduce the environmental impact of fashion, the development of digital fashion requires a cautious and balanced approach that reconciles its benefits with the need to maintain social justice and care for the planet's resources. Further research could analyse the impact of digital fashion on the economy and business models of design companies in the context of their adaptation to digital technologies.

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