



DIGITAL FASHION CONCEPT: DIGITAL FASHION HOUSES

Review scientific paper
DOI: 10.5937/CT_ITI24043Y

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ABSTRACT: *The paper presents fashion houses in the realm of digital fashion. This research considers the potential of cutting-edge digital technologies in fashion design, including the implications of digitalism in this field and the relationship between creativity and sustainability in a digital context. The focus is on the integration of digital technology and fashion design. It is importance to emphasize the positive impact that digital technologies have on sustainability. The expansion of digital technologies has facilitated the emergence of sustainable consumption alternatives.*

Keywords: *Digital fashion, digital clothing, digital fashion house, fashion industry.*

DIGITALNI MODNI KONCEPT: DIGITALNE MODNE KUĆE

APSTRAKT: *Rad predstavlja modne kuće u domenu digitalne mode. Ovo istraživanje razmatra potencijal najsavremenijih digitalnih tehnologija u modnom dizajnu, uključujući implikacije digitalizma u ovoj oblasti i odnos između kreativnosti i održivosti u digitalnom kontekstu. Fokus je na integraciji digitalne tehnologije i modnog dizajna. Važno je naglasiti pozitivan uticaj koji digitalne tehnologije imaju na održivost. Ekspanzija digitalnih tehnologija olakšala je pojavu alternativa održive potrošnje.*

Ključne reči: *Digitalna moda, digitalna odeća, digitalna modna kuća, modna industrija.*

1. INTRODUCTION

The term technology, derived from the Greek words technē ("art, craft") and logos ("word, speech"), initially referred to a discourse on the fine and applied arts. By the mid-20th century, the term 'technology' had been redefined by such phrases as "the means or activity by which human seeks to change or manipulate his environment" [10].



If the social conditions and circumstances are conducive, technology develops over time in a progressive manner, whereby each generation is able to utilize the accumulated technical expertise of its predecessor in order to innovate. An important feature of the moving technology forward was the advance in power technology. During the first Industrial Revolution between 1760 and 1830, the introduction of the steam engine enabled the general mechanization of production, replacing the artisanal methods of individual 'know-how' with the high and rapid production of consumer goods [2]. 2nd and 3rd Industrial Revolutions between in the late 19th-20th centuries use of electric power led to the development of computer and automation systems. Current information technology and digital transformation is based on electric power and the process of changing from analog signal to digital data.

The term 'information technology' was first defined in the article named "Management in the 1980's" published in the Harvard Business Review in 1958. According to writers Harold J. Leavitt and Thomas L., [1]. "information technology is summarized by techniques for processing large amounts of information quickly and high-speed computers".

Technological developments continue to change and shape our way to live throughout human history. The 21st century has seen a digital transformation revolution of information and communication technologies (ICTs) have reshaping our world as industrial revolutions had a major impact on the development of the textile and fashion industry. In recent years, digital transformation has emerged as a significant phenomenon in the field of fashion. The integration of 2D and 3D CAD (computer-aided design) software, mobile devices, VR (Virtual Reality), AR (Augmented Reality), ICTs, and social media has led to the emergence of the phenomenon known as 'digital fashion'. The term 'digital fashion' is used to describe clothing that is not physically manufactured, but instead produced digitally [11].

The global COVID-19 pandemic has precipitated that digital transformation in the fashion industry, particularly in the context of the industry's response to the lockdown. In 2021, fashion week live streams, metaverse fashion shows, digital activations, and AR/VR runways were presented online. It became increasingly evident that there is a growing trend of collaboration between technology companies and global fashion brands. Luxury fashion brands have created digital clothing for gaming platforms (Roblox X Gucci Town, Zepeto & Ralph Lauren) or video games player skins (Fortnite X Balenciaga, The Gran Turismo X Dior, Minecraft X Burberry, Need for Speed X Balmain) as well as digital fashion items and fashion NFTs. The growing engagement with the internet, social media, video gaming, and virtual universes is also stimulating interest in digital fashion. Conversely, some forward-thinking fashion designers have established digital fashion houses, which are thought to have a more profound impact on the fashion industry. The advent of VR and AR technologies has enabled designers to create virtual garments and users wear them through virtual reality.

The purpose of this paper is to provide a definition of digital fashion created through digital technologies and to introduce the concept of digital fashion houses.

2. DIGITAL FASHION

The scope of the concept of digital fashion is not yet fully described, and the manner in which it should be defined in the literature is an actual topic that is attracting the interest of academic researchers. Nobile, Noris, Kalbaska, and Cantoni [3]. defined the term as “*Digital fashion involves all those processes that include (i) marketing and communicating tangible and intangible products; (ii) the development and implementation of processes that support the advancement of the industry; (iii) the effects of digital advances on society*”. Sayem [6] stated that: The innovations in digital fashion can be grouped into four main categories: “*Digital design and e-prototyping, digital business and promotion, digital human and metaverse, digital apparel and smart e-technology*”. The term is summarized by Baek et al. [4] as “Digital fashion is the virtual creation, production, and representation of one’s identity via computer-generated design”. According to Särämäkari [5]. the term 'digital fashion' is used in various contexts by the media and practitioners to refer to different types of digital products and processes. It encompasses tools for virtual product development and visualization, marketing and educational materials for online stores and virtual museums, and digital end products intended for virtual use. The 3D file serves as a repository for all the garment and material data that can be utilized across various platforms.

The technologies that we had developed over the past centuries have enabled the efficient utilisation of energy resources and increased product capacity. Nevertheless, the advanced technologies generated carbon-intensive industries also resulted in environmental pollution. The environmentally polluting production and consumption cycle of the fashion and textile industry has been leading to the search for alternative solutions in the field of fashion. Although there is a growing emphasis on sustainable products and circular fashion system, the advanced of digitalisation has led to suggestions that it might offer an alternative model to traditional production and consumption behaviors. According to Black [9] there is a widespread opinion that the current state of fashion is undergoing a profound transformation. Development of novel business models for the fashion industry with the dual objective of reducing consumption and increasing delight, while leveraging the advantages of digital technologies, could prove to be a pivotal contributor to a sustainable future. In this context, Särämäkari's definition of 'digital end-products for virtual use' can be interpreted as a reference to digital clothing in the evaluation of digital fashion within the scope of sustainable fashion products.

b. Digital Clothing

Computer-aided design (CAD) programmes has enabled the creation of two-dimensional (2D) designs within the fashion industry since the 1980s. The advent of three-dimensional (3D) virtual reality technology has led to the widespread use of digital clothing as a tool for the design and virtual prototyping of garments and textiles in the field of product design. Some virtual try-on software, such as CLO 3D, MarvelousDesigner, TUKA 3D, Browswear, OptiTex, Lectra 3D Prototype has been in use for several years. Three-dimensional softwares offer a number of advantages such as effective design process, visual fidelity including lower cost, time saving, improved efficiency, ease of access and higher accuracy [7].



According to Chan et al. [8], there is no research that explores digital fashion exclusively as a virtual end-product, with the exception of Särmäkari's (2021) study, which describes it as both a tool and a digital end product.

ICT that have developed with the Internet have enabled social media to emerge as a new form of self-expression. The advent of digital platforms has enabled individuals to disseminate their own comments, images and videos online, thereby facilitating the sharing of their personal lives and experiences. Social media and gaming platforms has transformed the landscape of social interaction. Explained by Särmäkari [5] “Digital-only fashion tackles the expression function, already virtualized by the social media.”

The concept of digital fashion may appear to be a relatively novel phenomenon, but in fact, digital gamers have spent a considerable sum of money purchasing virtual clothing for their avatars for years [12]. Beside gamers, social media users have access to a plethora of digital filter and application that allow them to modify their appearance in pursuit of aesthetic enhancement. The interaction of users with new media results in the creation of alternative digital identities, whereby they manipulated their physical appearance in their posts. The widespread of digital socialisation has also helped give rise to digital fashion, including digital clothing.

Forbes magazine reported in May 2019 [13] that a panel on the topic of sustainability, organised by the London-based enterprise *Favourup* and attended by Instagram-based influencers, discussed the threat of ‘fast-fashion’ and the challenges of conscious consumption. In the question-and-answer session that followed the panel questions were asked “why not wear digital clothing? If your platform of communication is digital, why can’t your clothes be?”

In fact, the concept of digital clothing as a virtual end-product was first presented in 2018 with the Scandinavian retail brand Carlings 19-piece digital-only capsule collection, named 'Neo-Ex' [14]. In the following year, Fabricant sold the inaugural digital-only couture dress, entitled 'Iridescence', on the blockchain [15]. Digital clothing that does not utilise fabric or any tangible material in its creation is based entirely on electrical energy and utilises only computer-aided design software data.

The functionality of garments remains a significant factor in consumer usage. It is unlikely that digital fashion will ever fully replace physical clothing [16]. Digital clothing may be an alternative that could help to reduce the carbon footprint of the fashion industry by eliminating physical production, transport and material waste and disposal processes. The digital fashion concept offers more sustainability than the current fashion industry. The 2023 Digital Fashion Annual Sustainability Report [17] by the American digital fashion company DRESSX indicates that the production of a digital garment emits 97% less CO₂ than the production of a physical garment, while on average saving 3300 liters of water per item.

As the virtual economy grows and 3D technologies improving, digital clothing evolving from prototypes to end products. Digital clothing is blurring the line between 'real' and 'virtual'.

3. DIGITAL FASHION HOUSES

The advent of internet, blockchain technology, Metaverse, VR, AR, 3D modelling, and immersive environments is transforming the way we interact and conduct business in a rapidly evolving digital landscape. These cutting-edge technologies are leading to a restructuring of industries, including the fashion industry, and a redefinition of the value of design. The digital transformation of the fashion business is creating new value and markets. One of the digitalised business models is that of digital fashion houses, which design, 3D model and market digital clothes to consumers as a means of enhancing immersive experiences and end-products.

c. The Fabricant

The Fabricant is a digital fashion house based in Amsterdam that was established in 2018. The first digital couture dress created by the company attracted considerable interest at an auction in 2019. The piece, entitled 'Iridescence' [27] was unveiled at the Ethereum Summit in New York as part of a cryptocurrency conference. This was the first digital-only garment to be sold at auction on the Ethereum blockchain for 54 ETH - \$9,500 at the time [13].

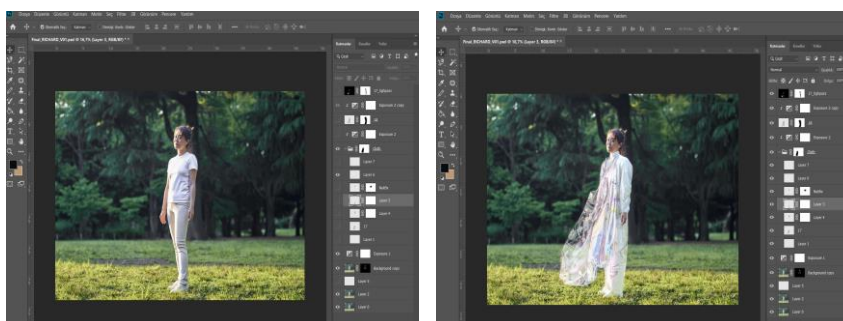


Figure 1: 'Iridescence', The Fabricant, 2019.

The team comprising Kerry Murphy (Founder), Amber Jae Slooten (Co-founder and Creative Director), Adriana Hoppenbrouwer-Pereira (Co-founder), Marco Marchesi (CTO), and Eoin Whelan (CFO). The manifest of the digital fashion house is to construct the wardrobe of the Metaverse and to facilitate the growth of the decentralised fashion industry in collaboration with users. The Fabricant founders describe their business as fashion's tech RenaiXance. The company's founder identifies the Fabricant as a digital fashion house that is pioneering the development of a new sector of digital-only clothing. They specialised in photo-realistic 3D fashion design and animation. Their business model is based on the convergence of fashion and technology, with the objective of creating digital couture and fashion experiences that are entirely digital and do not involve any physical products. The brand's philosophy is to demonstrate that clothing does not require a physical form to exist. The domain of digital fashion represents a vast and largely untapped creative terrain, where previously physically impossible concepts become possible. Furthermore, they posit that the digital-only fashion sector will facilitate the

creation of new creative avenues that extend beyond the limitations of the physical world. They promote sustainability and aim to significantly reduce the negative environmental impact of the current fashion paradigm [18].



Figure 2: 'RenaiXance', RTFKT x The Fabricant, 2021.

The digital fashion house has been engaged in the production of digital clothing collections since 2021, through a series of creative partnerships [28]. Collections in chronological order: Genesis, RTFKT x The Fabricant (2021), The Dawn of Co-Creation, Zodiac Wardrop, World of Woman & The Fabricant (2022), Wholeland-XXories, Wholeland-Kapers, Not in Paris-Highsnobiety, Artifact 001-Weekday, Wholeland-Primal Rave, Deep (2023), Guild-Master Peace, Maison Margiela x The Fabricant (2024). Additionally, the Fabricant engages in collaborative endeavors with global brands and retailers such as *Maison Margiela*, *Tommy Hilfiger*, *Adidas*, *Puma*, *Under Armour*, *Off-White*, *H&M*, and *World of Women*, applying its expertise to the digital realm of fashion. The platform enables users to engage with creative designs that may not be realised in physical products.

d. Auroboros

Auroboros, a digital fashion house pushing the boundaries of clothing through the fusion of haute couture, technology, sustainability and science [20]. The digital fashion house derives its name from the alchemical symbol of infinity, the 'ouroboros', the image of a serpent or dragon devouring its own tail, representing a perpetual cycle of rebirth and reinvention. Reflecting the metaphorical driving force behind Auroboros, the addition of 'AU' (the element of gold) to the brand name reflects the ultimate goal of alchemists to transform any material into gold. Alissa Aulbekova and Paula Sello, co-founders of the digital fashion house, have been working together as creative directors of the brand since 2018 [21]. The avant-garde duo focuses on designing products that are presented in digital formats that can be worn on both physical and virtual body images. They create digital-only couture products that can be worn and purchased through digital platforms, social media, film, avatars, and video games. Brand identity is described as a Metaverse native luxury fashion house that creates for both the physical and digital worlds.

For the first time in fashion history, Auroboros launched a purely digital ready-to-wear line, entitled 'Biomimicry' [29] at London Fashion Week 2021. Designers draw inspiration not only from the realities of science, but also from the fantasy of science fiction films which inspire their 'unreal' materials and utopian fantasy aesthetic [22]. The collection was informed by a number of influences: the cyclical forces of nature, technology and Alex Garland's science fiction films, to Hayao Miyazaki's anime.



Figure 3: 'Biomimicry', Auroboros, 2021.

Aulbekova and Sello aim to expand the boundaries of the luxury industry, reimagining the ways in which they conceptualize, design, and influence consumer behavior with regard to clothing. This approach also encourages the shaping of new discussions around the idea of a utopian future and its relationship to the human body.

Auroboros' digital collections offers an alternative solution to the pollution of the fast fashion industry, allowing creation without physical constraints and producing 97% less material waste than physical production. Additionally, digital clothing is genuinely body and gender inclusive, as each item is digitally tailored to the individual wearing it [21].

Auroboros, which has been featured in the Business of Fashion 500 list, Forbes 30 under 30 in 2022 under Art & Culture and the Netflix series "The Future of Fashion," is a company that mentors the next generation and is dedicated to the pursuit of sustainability. However, it also has a forward-thinking approach to fashion and the digital realm, with a particular emphasis on the potential of Web3 innovation in the domain of digital fashion.

e. Republiq

The name "Republiq" is a reference to the French roots of the founders of the brand and to the activist mentality that pervades the fashion house. Singapore-based label Republiq, led by fashion designer James Gaubert – a designer with over 22 years of experience in luxury fashion – is defined as the metaverse-ready virtual fashion house. As a founder and creative director, Gaubert aimed to identify a creative counterpart to physical clothing that would also help to address the waste and ethical crisis currently facing the fashion industry. The republiq is a fully digital/virtual fashion house that produces unique creations, which challenge the norms of the industry by interpreting and creating an extraordinary lifestyle.

The audience for Republic comprises individuals who are motivated by a desire to effect meaningful change and make a difference. The Republic collections are characterised by their provocative nature, raw aesthetic, and unparalleled luxury. They exhibit a meticulous attention to detail and digital craftsmanship, which sets them apart from other digital fashion houses in terms of quality [30]. Furthermore, the cutting-edge fashion garments are entirely digital, fully sustainable, ethically produced and, as they are ‘one size fits all,’ they eliminate any form of discrimination based on body size or shape [23].

In his own words, Gaubert explains the purpose of establishing the digital fashion house as follows: “We are living in times of buying fashion only to share on social media. ‘Disposable outfits’ are the new norm. In response, I founded republic as the perfect solution to the global fast fashion problem” [24]. “Rather than spending money on a garment you only wear once, for social media, why not spend less money on a digital version of it? And have less impact on the environment” Gaubert explains [25].



Figure 4: 'Happy New Year', Republic, 2020.

The creation process begins with the drafting of a pattern, which is subsequently used as a basis for the production of a digital garment. Following completion of this stage, the garment is then converted into either a technical pack on 2D CAD programs. These are then passed on for production in CLO 3D. Using CLO 3D fashion design programme, digital tailors fit digital garments on avatars and rotate them to effectively see how their fabrics fall and flow from every angle. The same level of attention to detail is required for digital design as for physical design. This encompasses hardware components such as buttons and metals, as well as the stitching on garments and accessories. Republic exclusively utilizes high-quality digital fabrics, such as silk or cashmere, sourced from CLO 3D. A textile composed of high-quality fibres will flow and drape in a markedly different manner to a polyester textile of a comparable composition. The quality of digital garments closely resembles that of luxury physical garments. In a matter of hours, the purchaser will receive a fully fitted digital garment, which is ready for sharing on social media. The capacity of digital fashion is that it can generate virtual digital wardrobes, which may be populated with garments that could be easily integrated into different images or videos [26].

Table 1: The purchase of digital clothing via the Internet.

Choose a garment	Upload a photo	Place an order	Digital tailoring	Product delivery
Search the online collection on the Republiqe website to find a digital clothing.	Upload a high-resolution photo, ensuring that the image clearly depicts the body.	Follow the instructions online to place an order for your digital garment	The digital tailoring process involves the virtual fitting of garments to photographs uploaded by customers.	The finalised digital image was transmitted to the customer in the JPEG format.

5. CONCLUSION

"Data is the new oil" declared British mathematician Clive Humby in 2006. After nearly two decades, data is become the most valuable commercial resource of our time. However, data is not a finite resource, such as oil, which can be depleted or cause pollution. Digital clothing is comprised entirely of data and represents an advancement of the near-future products that will be shaped by information and communication technologies.

The production of digital clothing as an end-product offers several advantages, including zero-waste, cost-effectiveness and limitless creative freedom. The advent of digital clothing represents a new stage in the evolution of fashion, one that does not require the use of any traditional textile raw materials. Nevertheless, it is unlikely to be capable of fulfilling the need for daily wear in reshaping the future of the fashion industry.

The digitalization of the fashion industry is a transformative force that is opening new avenues for designers and consumers to interact with fashion in innovative ways. It also eliminates the challenging constraints associated with fabric and garment production techniques, thereby freeing the designer's original and artistic creativity. The digital realm of fashion offers consumers the opportunity for self-expression. The advent of digital fashion products may provide an alternative to the fast fashion industry's consumption-driven culture. The Fabricant, Auroboros and Republiqe have inspired a passionate digital fashion community to create their own Metaverse wardrobes. The Fabricant represents a more futuristic and fantastical digital fashion style. Conversely, the Republic appears to offer a more realistic style. The three digital fashion houses utilize comparable design processes to serve their users, particularly through their own websites. This research of digital fashion houses represents that the designs proposed in the field of digital fashion offer a sustainable alternative to the environmental problems created by the fashion industry.

Consequently, it has been demonstrated that by examining the realm of digital fashion houses, a new type of garment has been created that transcends the traditional concepts of materials and manufacturing methods.

The phenomenon of digital fashion is a novel and evolving concept currently under research. It is therefore necessary to allow for a period of maturation before any definitive conclusions can be drawn.



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