Indonesian Journal of Education and Psychological Science (IJEPS)
Vol 3 No. 6, 2025: 605-622

The Rise of Digital Fashion: Virtual Clothing and Its Market Potentials

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A R T I C L E I N F O
Keywords: Digital Fashion, Sustainability, Metaverse, AI and 3D Modelling, Phygital Fashion

Received : 22, September
Revised : 24, October
Accepted: 30, November

A B S T R A C T
The rise of digital fashion marks a revolutionary shift in the global fashion landscape, redefining how creativity, technology, and commerce intersect. Emerging from the convergence of 3D modelling, artificial intelligence (AI), blockchain, and augmented reality (AR), digital fashion transforms garments into purely virtual artefacts that exist beyond physical materiality. This article explores how digital fashion reconfigures traditional production systems, consumer experiences, and sustainability narratives. By examining virtual clothing's evolution, market dynamics, and integration into metaverse platforms, it highlights how dematerialized design processes reduce waste, enable circular business models, and democratize access to fashion innovation. The paper also evaluates key technologies such as NFTs for digital ownership and AI-driven personalization, that drive value creation and cultural expression in virtual ecosystems. While emphasizing the ecological and economic advantages of digital fashion, the study equally acknowledges emerging challenges related to intellectual property, digital labour, and market legitimacy. Ultimately, the research argues that digital fashion represents not a fleeting trend but a transformative paradigm shaping the future of identity, creativity, and sustainability in the 21st century, where physical and virtual fashion coexist symbiotically within a connected, data-driven world.

DOI: https://doi.org/10.59890/ijeps.v3i6.205
ISSN-E: 3030-8410
https://dmimultitechpublisher.my.id/index.php/ijeps

INTRODUCTION

Background and Motivation

Fashion is deeply embedded in global economies and cultural life, and it is currently undergoing a significant transformation as digital technologies influence design, production, and consumption. Scholars have identified this transformation as a result of the convergence of digital media, 3D modelling, virtual environments, and platform economies, collectively giving rise to "digital fashion" as a unique phenomenon rather than a mere extension of physical apparel (Boughlala & Smelik, 2024; Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024). Digital fashion, garments designed, modelled, and rendered entirely in digital form, challenges traditional categories such as materiality, wardrobe, and display by separating sartorial value from physical textiles and supply chains. This shift allows for the introduction of innovative creative expressions, dematerialized retail formats, and design-led sustainable interventions across the industry (Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024; Hardabkhadze et al., 2023). The concept of virtual clothing extends beyond visual representation to include practical applications: digitally native garments can be embodied by avatars in gaming and metaverse platforms, integrated into social media identity practices, or presented through immersive experiences and XR-enabled exhibitions. This development challenges pre-existing boundaries between play, identity, and commercial exchange in fashion (Boughlala & Smelik, 2024; Park et al., 2023; Nwamekwe et al., 2025).

This evolving landscape has opened various cultural and commercial avenues, attracting interest from startups, platform intermediaries, and established luxury brands. It has also prompted empirical research into consumer preferences for digitally mediated fashion expression and environmentally conscious purchasing behaviours (Joy et al., 2022; Nwamekwe & Okpala., 2025; U-Dominic et al., 2025).

LITERATURE REVIEW

Emerging evidence suggests that immersive presentation formats and the experiential value of digital garments positively influence purchase intentions and perceived value, indicating substantial market potential for digital collections, NFTs, and metaverse-ready launches, which can serve both as creative statements and revenue streams for brands (Park et al., 2023; Zhang et al., 2023; Nwamekwe et al., 2025). However, researchers note that the promise of digital fashion is intertwined with sustainability narratives and platform practices. While it offers opportunities for dematerialization and circular business models, it also raises concerns about digital labour, intellectual property rights, and platform governance as the sector expands (Rosato & Calleo, 2024; Spagnoli & Cardoso, 2023; Deng et al., 2024; Joy et al., 2022; Kim et al., 2025).

Rationale and Objectives of the Review

The rise of digital fashion marks a major shift in how creativity, identity, and commerce intersect in the modern fashion world. This review explores how virtual garments, NFTs, and metaverse experiences are transforming traditional fashion practices. It aims to connect fragmented research by examining the

evolution, market potential, and challenges of digital fashion. Specifically, the review clarifies how digital clothing developed, evaluates its growing economic value, and discusses key issues such as sustainability, ethics, and technology. By synthesizing insights from design, technology, and consumer behaviour, the review provides a holistic understanding of digital fashion's role in reshaping value creation, cultural expression, and innovation across the industry, while highlighting opportunities for future research and creative exploration.

METODOLOGY

Definition and Evolution

Digital fashion denotes garments that exist solely as digital artefacts, typically created with 3D modelling and simulation tools and visualized through augmented reality (AR) or virtual reality (VR) for avatars or as overlays on photographs, rather than being fabricated from physical textiles, a distinction that reframes materiality and consumption in fashion (Hakeem et al., 2024). Its lineage is traceable to gaming cultures and avatar economies, where in game "skins" and virtual dress functioned as aspirational markers; these practices seeded contemporary workflows and aesthetics now formalized as digital only apparel and virtual wearables (Boughlala & Smelik, 2024).

Over time, this practice matured into interoperable ecosystems: marketplaces and platform environments enable purchase, customization, exhibition, and even tokenization of virtual garments (NFTs, metaverse collections), fostering new commercial and identity economies while promising dematerialization benefits and novel sustainability narratives (Emeka et al., 2025; Chidiebube et al., 2025; Huggard & Särmäkari, 2023). Empirical analyses highlight how presentation formats and immersive platforms shape perceived value and adoption, underscoring the rapid evolution from niche play to market opportunity (Park et al., 2023).

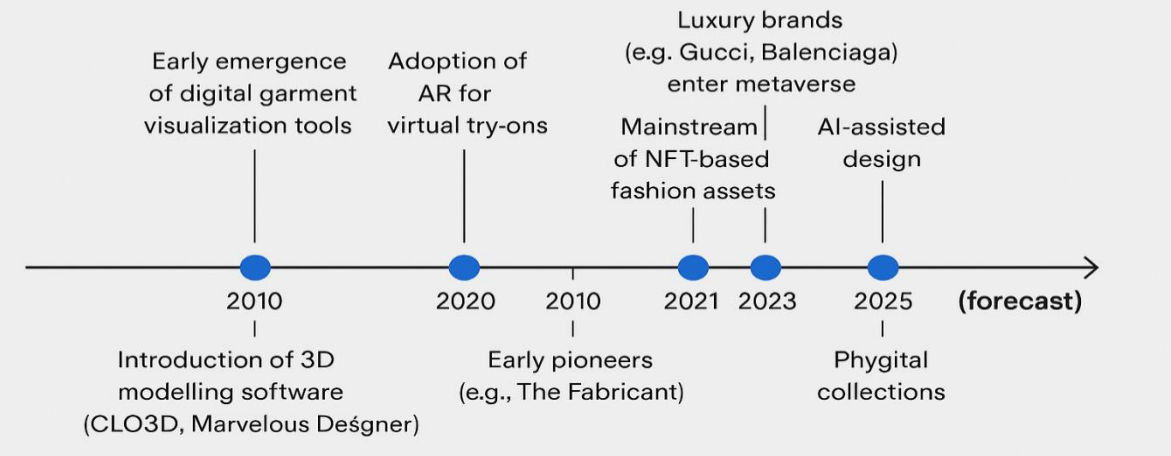

Figure 1. Evolution of Digital Fashion (2010-2025)

Figure 1 presents a timeline illustrating the progressive evolution of digital fashion from 2010 to 2025. The timeline captures the early emergence of digital garment visualization tools, the introduction of 3D modelling software such as CLO3D and Marvelous Designer, and the rise of early pioneers like The

Fabricant in 2018. It also highlights key milestones such as the adoption of augmented reality (AR) for virtual try-ons, the entrance of luxury brands like Gucci and Balenciaga into the metaverse, and the mainstreaming of NFT-based fashion assets by 2021. The final segment (2023–2025) forecasts increased adoption of AI-assisted design, phygital collections, and cross-platform virtual wardrobes, illustrating how technology continues to redefine the boundaries of fashion creativity and consumption.

Technological Foundations

Digital fashion relies on technologies such as:

1. 3D Modelling Software (CLO3D, Marvelous Designer, Blender): 3D modelling and cloth-simulation tools are fundamental to digital fashion creation as they allow designers to construct, drape, and animate garments with a realistic appearance before any physical prototypes are made. Studies of fashion digitization highlight that 3D visualization and rapid modelling have become integral to modern workflows, helping to bridge the gap between physical and virtual garments (Igbokwe et al., 2025; Kim et al., 2025). Research comparing dynamic design workflows confirms that innovations in body scanning, pattern simulation, and scene integration enable testing of complex pattern-cutting and fit concerns virtually, thus expediting iteration cycles and supporting both digital-only collections and hybrid design-to-production pipelines (Igbokwe et al., 2025; Kim et al., 2025).
2. Augmented Reality (AR): AR platforms facilitate experiential try-on solutions by projecting 3D clothing onto live video or avatars. Comparative studies show that AR and VR try-on systems, particularly those utilizing personalized avatars, significantly increase user engagement and perceived value in online contexts (Liu et al., 2020; Nwamekwe et al., 2024). Technical evaluations of markerless mobile AR also identify practical limitations (such as spatial stability and device variability) while validating that smartphone-based virtual try-on experiences can serve as a mainstream retail interface, linking social media dressing with e-commerce (Scargill et al., 2022; Liu et al., 2020; Nwamekwe et al., 2024).
3. Blockchain and NFTs (Non-Fungible Tokens): Blockchain technology and NFT standards have emerged as key solutions for establishing provenance, scarcity, and ownership of purely digital garments, offering verifiable records that brands and consumers can use to authenticate digital fashion assets and establish secondary markets (Joy et al., 2022; Nwamekwe et al., 2025). Legal and intellectual property discourse suggests that while NFTs open new commercial avenues in the metaverse, they also introduce challenges regarding counterfeiting, brand protection, and trademark law, highlighting the need for interoperable standards and governance in virtual fashion markets ((Nwamekwe & Nwabunwanne, 2025; Joy et al., 2022; Nwamekwe et al., 2025).
4. Artificial Intelligence (AI): AI applications including generative models and predictive analytics, are increasingly woven into the fabric of digital

fashion. Generative networks and diffusion models can generate new silhouettes or texture variations, while computer vision and big data analytics assist in trend forecasting and personalized recommendations. Additionally, automated avatar fitting and virtual try-on technologies utilize machine learning to enhance realism and fit (Ezeanyim et al., 2025; Okpala et al., 2025; Zhao et al., 2021; Kohli, 2024). Concurrent research discusses the ethical and educational implications of these technologies, including concerns about bias, labour displacement, and the demand for new skills in fashion education as AI advances design automation and personalization in virtual clothing (Giovanola et al., 2024; Kohli, 2024; Ezeanyim et al., 2025).

These technologies collectively underpin a new digital ecosystem were creativity and commerce merge seamlessly.

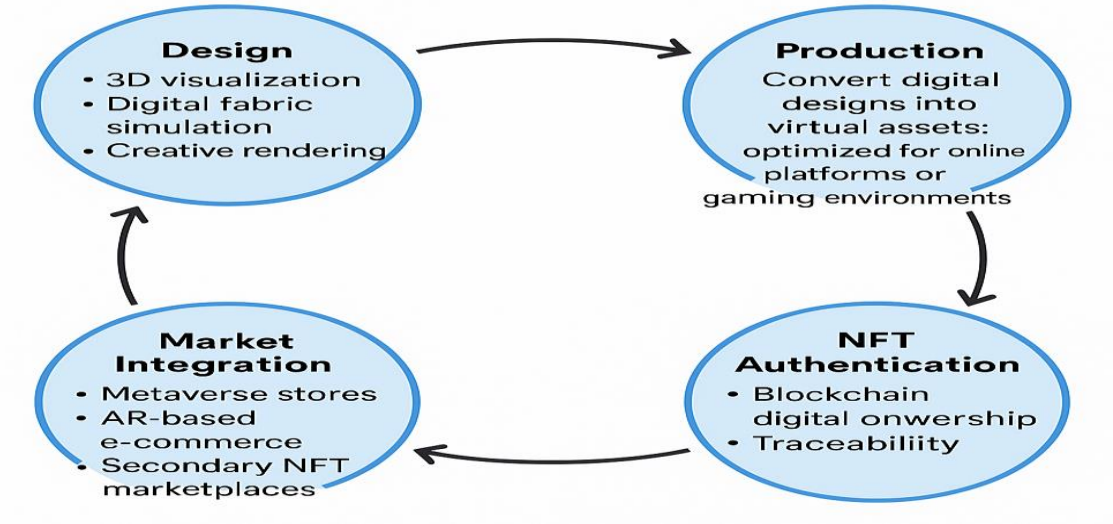

Figure 2. Conceptual Model of the Digital Fashion Ecosystem

Figure 2 depicts the digital fashion ecosystem as an interconnected model comprising four primary stages: Design, Production, NFT Authentication, and Market Integration. The Design phase incorporates 3D visualization, digital fabric simulation, and creative rendering through software platforms. The Production phase involves converting digital designs into virtual assets optimized for online platforms or gaming environments. The NFT Authentication stage ensures digital ownership and traceability using blockchain technology, which legitimizes each virtual garment as a unique collectible asset. Finally, the Market Integration phase connects these assets with consumers through metaverse stores, AR-based e-commerce platforms, and secondary NFT marketplaces. The model emphasizes a circular, technology-driven system that merges creativity, authenticity, and commerce within a sustainable digital framework.

RESULT AND DISCUSSION

Market Potentials of Virtual Clothing

1. Economic Growth and Consumer Adoption

Digital fashion's market potential is underpinned by converging commercial drivers: blockchain-certified NFTs and virtual assets enable provenance and new revenue streams, while gaming and metaverse integrations create large, transactionable audiences, mechanisms shown to influence consumer behaviour and brand strategy in metaverse contexts (Sung et al., 2023; Okpala et al., 2024). Concurrently, empirical analyses link platform characteristics and presentation formats to perceived value and purchase intent for digital garments, evidencing viable commercial pathways for brands entering virtual markets (Park et al., 2023). Studies framing digital-only models as dematerialized, low-marginal-cost propositions further explain why both luxury houses and independent designers pursue digital collections as scalable business opportunities (Emeka et al., 2025).

Adoption is concentrated among younger cohorts: Gen Z and Millennials demonstrate stronger intentions to acquire virtual clothing for online identity and social display across Instagram, TikTok, and metaverse spaces, with influencers and social platforms catalysing diffusion (Nwamekwe & Nwabunwanne, 2025; Sun et al., 2021). Research also indicates that experiential and economic values rather than solely traditional self-expression motives, often drive purchase intentions in virtual settings, supporting business models that leverage affordable virtual SKUs and limitless creative variation (Park et al., 2023; U-Dominic et al., 2025; Zhang et al., 2023).

2. Sustainability and Environmental Impact

Digital fashion is increasingly framed as a potentially less-polluting alternative to conventional apparel production, especially as the clothing sector is identified as one of the most environmentally damaging industries due to resource-intensive supply chains and wasteful sampling practices (Rosato & Calleo, 2024; Hardabkhadze et al., 2023). By "dematerializing" garments creating 3D-rendered pieces that exist only digitally brands and designers can avoid physical sampling, cut textile waste, and minimize stages of the production chain that generate emissions.

This benefit is underscored in research on digital twins, virtual prototyping, and digital-first workflows (Nwamekwe & Igbokwe, 2024).
Beyond waste avoidance, virtual clothing can enhance resource efficiency as collections may be iterated and market-tested in silico before any fabric is cut, thus lowering the risk of overproduction and shortening development cycles. Empirical work demonstrates that sustainability features increase consumer receptivity to virtual fashion, aligning digital offerings with eco-conscious demand (Deng et al., 2024). These findings support the view that digital fashion represents a pragmatic approach for brands to pursue lower-impact product strategies while addressing environmentally driven consumer preferences (Emeka et al., 2025; Rosato & Calleo, 2024).

3. Branding and Customer Engagement

Brands leverage virtual clothing to craft immersive narratives and experiential campaigns that extend storytelling into AR/VR and metaverse spaces, enabling richer brand worlds and deeper consumer engagement (Ezeanyim et al., 2025; Petit et al., 2019). Interactive virtual try-ons and curated phygital showcases increase attention and decision confidence while supplying real-time behavioural data for personalization and retargeting, strengthening customer relationships across touchpoints. Simultaneously, limited-edition NFTs and blockchain-backed drops create artificial scarcity and provenance that amplify exclusivity and foster loyalty among digitally native collectors (Sung et al., 2023).

Collaborations between fashion houses and digital artists have blurred the lines between couture and code, producing hybrid goods that appeal to both tech-savvy communities and traditional luxury consumers, and expanding brand relevance into gaming and creator economies (Boughlala & Smelik, 2024; Gehlatia, 2023). Virtual influencers and avatar economies catalyse organic diffusion and co-creation, allowing brands that integrate narrative, scarcity, and immersive experiences to convert engagement into monetizable community value and long-term brand equity.

The Intersection of Digital Fashion and the Metaverse

1. Fashion in Virtual Worlds

In virtual worlds, the sartorial choices of avatars function as immediate social signals; users curate digital garments to express status, creativity, or group affiliation, with social and hedonic gratifications driving the acquisition of virtual clothes (Nwamekwe & Okpala., 2025). Social-identity cues embedded in avatar apparel enhance identification and group belonging in both face-to-face and mediated settings (Okeagu et al., 2024). Scholarship indicates that digital fashion is intertwined with the histories of virtual dressing and platform cultures, making avatar personalization a core locus for identity play and community formation in the metaverse (Gehlatia, 2023).

Brands are translating these dynamics into commerce by opening virtual storefronts and experiential spaces, leveraging immersive try-ons, drops, and curated events to deepen engagement and convert play into purchase (Gehlatia, 2023). Retail studies confirm that such "phygital" experiences (AR/VR showrooms, in-platform boutiques) not only extend storytelling but also provide measurable engagement data that firms can monetize and optimize.

2. NFTs and Digital Ownership

NFT-based garments have instituted provable digital ownership by pairing unique token identifiers and smart contracts with virtual designs, allowing each digital garment to be authenticated, traced, and transferred on a tamper-evident ledger. This process converts fashion pieces into collectible digital assets and enables secure peer-to-peer transactions in virtual worlds (Augustin et al., 2023; Nwamekwe et al., 2025; Sung et al., 2023). Research indicates that blockchain provenance supports consumer confidence in digital luxury items and promotes interoperable ownership models that bridge various marketplaces and metaverse platforms (Sung et al., 2023; Joy et al., 2022).

This tokenized ownership fosters active secondary markets for digital apparel, such as auctions and resales, which may reshape luxury consumption through artificial scarcity and provenance narratives. However, these developments also surface trust, legal, and intellectual property challenges that brands must manage when entering these markets (Sung et al., 2023; Chidiebube et al., 2025; Nwamekwe et al., 2024). Business-model analyses indicate that NFTs create new monetizable lifecycles for garments, such as primary sales and aftermarkets, contingent on platform governance and consumer trust (Nwamekwe et al., 2024; Zarifis & Castro, 2022).

3. Case Study: The Fabricant and DressX

The Fabricant's early commercial breakthrough most famously the auctioned "Iridescence" digital dress, demonstrated that purely virtual couture can carry real market value and public legitimacy, converting experimental design into a monetizable asset while foregrounding sustainability and creative freedom in a dematerialized format (Boughlala & Smelik, 2024; Spagnoli & Cardoso, 2023). Case analyses of The Fabricant frame its practice as a deliberate intervention in fashion's material economy, promoting 100% digital garments that aim to reduce sampling waste and expand expressive possibility beyond physical constraints (Boughlala & Smelik, 2024; Rosato & Calleo, 2024).

Platforms such as DressX have translated this model into a marketplace logic, enabling consumers to "wear" digital outfits on social media and within metaverse spaces and thereby normalizing virtual dress as a medium of identity and exchange (Rosato & Calleo, 2024; Hardabkhadze et al., 2023). Together, these actors exemplify how technical innovation, platform distribution, and influencer and community dynamics coalesce to reframe clothing as both experiential content and ownable digital property, accelerating acceptance among tech curious and eco minded audiences (Hardabkhadze et al., 2023; Rosato & Calleo, 2024).

Challenges and Limitations

1. Technological Barriers

Despite its conceptual promise, digital fashion confronts entrenched interoperability and scalability barriers: metaverse architectures remain fragmented, producing platform-dependent assets that cannot move seamlessly between virtual worlds and marketplaces (Wang et al., 2023; Huynh-The et al., 2023). Surveys of metaverse fundamentals and blockchain reviews identify cross-chain protocols and standardization as unresolved engineering and governance tasks, meaning many digital garments are effectively locked to single ecosystems unless interoperable standards or trusted network infrastructures are adopted (Wang et al., 2023; Huynh-The et al., 2023; Li et al., 2023).

Technical costs and skills further constrain diffusion: high-fidelity 3D garment rendering, real-time physics, and body-aware simulations demand substantial computation and specialized expertise in 3D scanning, cloth simulation, and avatar integration, as documented in fashion-tech evaluations and AR/VR try-on studies (Igbokwe et al., 2025; Kim et al., 2025; Liu et al., 2020). Mobile AR experiments also reveal device variability and stability limits that hinder consistent user experiences, reinforcing the need for optimized pipelines,

edge/cloud rendering, and upskilling in fashion curricula to scale production and consumer access (Scargill et al., 2022; Kohli, 2024).

2. Market Skepticism and Cultural Resistance

Market skepticism and cultural resistance remain significant barriers to virtual clothing adoption: many consumers still regard digital garments as intangible or frivolous rather than legitimate modes of dress, a perception documented in netnographic studies that identify virtual fashion's "disconnect from reality," negative stakeholder images, and resistance to aggressive marketing as adoption inhibitors (Kim et al., 2025; . Scholars of the metaverse and platform urbanism further note that wider social ambivalence, characterized by contested public values and limited empirical data, amplifies distrust and slows mainstream diffusion of digital fashion practices (Bibri et al., 2022).

Bridging this perception gap therefore requires deliberate education, culturally resonant integration, and transparent demonstrations of value: researchers and practitioners argue for clear sustainability metrics and virtual-first workflows (to show environmental gains), authentic brand storytelling in XR, and curated experiences that foreground creative freedom and provenance to build legitimacy and trust (Vitalis et al., 2024; Igbokwe et al., 2024; Onyeka et al., 2024). Targeted communication, participatory design, and rigorous evidence of social and ecological benefits are essential to convert skepticism into sustained engagement (Kim et al., 2025; Bibri et al., 2022).

3. Ethical and Legal Issues

Ownership and intellectual-property risk are central ethical and legal concerns in digital fashion. While NFTs and blockchain technology can register provenance, they do not eliminate issues such as counterfeit tokens, ambiguous rights transfers, or trademark conflicts, these challenges are documented in empirical and legal analyses of luxury NFT drops and brand activity in the metaverse (Sung et al., 2023). Trust frictions throughout the NFT purchasing lifecycle (including wallets, marketplaces, and after-sales) exacerbate these issues, necessitating that brands adopt clear contract models, interoperable provenance standards, and robust marketplace governance to mitigate consumer harm and protect their reputations (Sung et al., 2023).

Equally pressing are the digital-labour ethics for designers and creators who operate within virtual supply chains. Scholars suggest that dematerialization can obscure labour allocation, attribution, and fair compensation while creating new precarity, unless platform rules, intellectual property attribution, and remuneration frameworks are enforced (Kim et al., 2025). Addressing these challenges will require coordinated legal clarifications, industry codes of conduct, and transparent platform governance to secure creators' rights as the sector expands (Kim et al., 2025).

Table 1. Comparative Analysis of Physical vs. Digital Clothing

Dimension	Physical Clothing	Digital Clothing
Cost	Involves high production and logistics costs due to raw materials, manufacturing labour, and global	Once designed, digital garments have minimal reproduction costs. They can be distributed and sold

	distribution networks. Each garment incurs additional marginal costs.	globally at negligible incremental expense.
Environmental Impact	The textile industry contributes significantly to global pollution through carbon emissions, chemical waste, and high water consumption.	Digital fashion produces almost no physical waste, requires no water, and emits negligible carbon compared to traditional manufacturing.
Scalability	Limited by production capacity, material availability, and inventory constraints. Scaling up increases environmental and operational burdens.	Infinitely scalable—digital garments can be endlessly replicated, customized, and distributed globally without physical inventory or waste.

Table 1 offers a comparative evaluation of physical and digital clothing based on three key dimensions: cost, environmental impact, and scalability. Physical clothing incurs high production and logistics costs due to raw materials, manufacturing labour, and global distribution, while digital garments are relatively low-cost to reproduce once the design is completed. Environmentally, digital fashion produces negligible waste and emissions, contrasting sharply with the textile industry's significant carbon footprint and water usage. In terms of scalability, digital garments can be infinitely reproduced, customized, and sold globally without inventory constraints. This comparative analysis reinforces the economic and ecological advantages of digital fashion while acknowledging the continuing cultural value of tangible garments in certain consumer markets.

Future Directions and Emerging Trends

1. **Integration of AI and Predictive Design**

AI-driven predictive analytics are poised to sharpen trend forecasting and demand sensing in fashion by mining large-scale design, sales, and social media data to anticipate consumer preferences and shorten decision cycles (Okpala et al., 2025; Zhao et al., 2021). Research and industry reviews argue that embedding machine learning (ML) in the early design pipeline enables designers and merchandisers to move from reactive to anticipatory workflows, informing assortment, timing, and narrative choices with greater empirical precision (Okpala et al., 2025; Zhao et al., 2021).

Concurrently, machine-learning models are improving virtual prototyping: generative and diffusion networks enhance visual realism, while physics-aware simulators and body-scan-driven pipelines increase fit accuracy and predict fabric behaviour, thereby reducing physical sampling and development time (Papachristou et al., 2023; Habib et al., 2025). These advances suggest AI will not only automate repetitive tasks but also expand creative exploration by rapidly generating aesthetic variants validated against predicted consumer responses (Zhao et al., 2021).

2. The Rise of Phygital Fashion

Hybrid "phygital" garments which were designed to exist simultaneously as embodied objects and as digital wearables are emerging as a defining trajectory for fashion innovation because they reconcile tactile consumption with the social and creative affordances of virtual spaces (Boughlala & Smelik, 2024; Spagnoli & Cardoso, 2023). By linking digital twins, AR overlays and on demand physical production, phygital strategies narrow the historical gap between material and virtual apparel, enabling iterative co creation and faster market testing while preserving brand craftsmanship in the physical realm (Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024).

Consequently, fashion firms are piloting business models that pair tokenized digital assets with tangible garments, using data driven design and connected supply chains to monetize exclusivity, enhance storytelling, and reduce waste through targeted production (Rosato & Calleo, 2024; Hardabkhadze et al., 2023). These hybrid offerings promise richer customer engagement and new revenue lifecycles (primary drops, authenticated resales and experiential activations), but they require integrated technical pipelines and careful governance to realize scale and trust (Boughlala & Smelik, 2024; Hardabkhadze et al., 2023).

3. Virtual Fashion Education and Workforce Transformation

As universities integrate fashion-technology modules and 3D/AI tools into curricula, digital craftsmanship (3D simulation, AR/VR, generative design) is increasingly recognized as a core professional skill. This evolution necessitates pedagogy that combines aesthetics with technical fluency and ethical literacy (Huggard & Särmäkari, 2023; Kohli, 2024). Recent scholarship argues that curricular renewal embedding AI, virtual prototyping, and co-design methods—will democratize creation, providing independent designers with low-cost digital toolchains, collaborative platforms, and marketplace entry points previously restricted by physical production barriers (Emeka et al., 2025; Kohli, 2024).

This workforce transformation also reconfigures supply-chain dependence: virtual prototyping and digital-first workflows reduce sampling and iteration costs, allowing designers to validate demand digitally before committing physical resources. Education that encompasses cloud/edge rendering, avatar engineering, and intellectual property practices prepares graduates for emerging hybrid roles in the fashion industry (Nwamekwe & Igbokwe, 2024; Giovanola et al., 2024). Collectively, these changes promise broadened participation in fashion entrepreneurship but require targeted training, interdisciplinary curricula, and governance frameworks to ensure equitable and ethical adoption (Kohli, 2024; Giovanola et al., 2024).

4. **Future Insight: AI-Driven Personal Stylists and the Next Frontier of Fashion**

AI-driven personal stylists will synthesize heterogeneous data sources, user preference histories, body measurements from scans, social-media signals, and inventories of both physical and digital wardrobes to produce context-aware outfit recommendations that operate across virtual and real-world contexts (Boughlala & Smelik, 2024; Spagnoli & Cardoso, 2023; Nwamekwe et al., 2025).

Advances in big data analytics and fashion forecasting methods demonstrate that mining design, sales and social streams can surface latent preferences and trend trajectories that feed personalized styling engines, enabling them to propose ensembles that suit an individual's silhouette, occasion and avatar persona while adapting to emergent social cues (Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024; Nwamekwe et al., 2025). Practical components of these systems realistic virtual try on, parametric fit models and generative aesthetic variants have matured through work in virtual prototyping and image/3D synthesis, meaning AI stylists can visualize how a digital garment drapes on a specific body or avatar and present side by side physical/digital pairings for more confident decision making (Hardabkhadze et al., 2023; Park et al., 2023; Joy et al., 2022).

Beyond one-to-one recommendations, predictive AI will become an operational backbone for designers and brands: trend forecasting models and demand sensing algorithms can shorten design to market cycles, suggest optimal assortments, and recommend fit or construction changes before physical sampling, thereby reducing waste and accelerating time to sale (Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024; Park et al., 2023). Generative networks and physics aware simulators will enable rapid production of aesthetic variations and fit tested prototypes that AI stylists can surface to consumers in real time, transforming fashion into an adaptive, data informed and immersive experience that augments human creativity with computational scale and personalization (Boughlala & Smelik, 2024; Hardabkhadze et al., 2023; Nwamekwe et al., 2025). This convergence promises novel consumer experiences seamless styling across avatars and bodies, dynamic wardrobes that evolve with tastes and new operational efficiencies for the industry as predictive intelligence is embedded into both creative and commercial workflows (Spagnoli & Cardoso, 2023; Rosato & Calleo, 2024; Nwamekwe et al., 2025).

CONCLUSION AND RECOMMENDATION

The study of digital fashion underscores a transformative era in which creativity, technology, and sustainability converge to redefine the meaning of clothing and consumption. Unlike traditional apparel, which is bound by material production and environmental cost, digital garments exist as dematerialized design artefacts, enabling new forms of expression, identity, and value creation. Through technologies such as 3D modelling, blockchain, AI, and AR/VR, the fashion industry is moving beyond its conventional production constraints toward a more inclusive, scalable, and eco-conscious paradigm.

Digital fashion demonstrates not only the feasibility of low-carbon, zero-waste design processes but also the potential to democratize access to fashion creativity and ownership. Consumers can now curate their identities in virtual spaces while brands leverage these technologies to experiment, co-create, and monetize immersive experiences. However, this transformation also raises critical questions around intellectual property, digital labour, and market legitimacy, emphasizing the need for transparent governance and ethical frameworks.

As physical and virtual boundaries continue to blur, the future of fashion will likely lie in phygital ecosystems, hybrid environments that unite tangible craftsmanship with digital innovation. In this emerging landscape, AI-driven personalization, virtual try-ons, and NFT-based ownership models will foster deeper engagement and data-informed design cycles. Ultimately, digital fashion is not merely a trend but a cultural and technological evolution that redefines sustainability, creativity, and consumption in the 21st century. It invites designers, researchers, and consumers to imagine fashion as an ever-evolving dialogue between technology and identity, one that values imagination as much as materiality and positions virtuality as a central component of future-ready fashion economies

FURTHER STUDY

This research still has limitations so further research on this topic is still needed "The Rise of Digital Fashion: Virtual Clothing and Its Market Potentials"

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