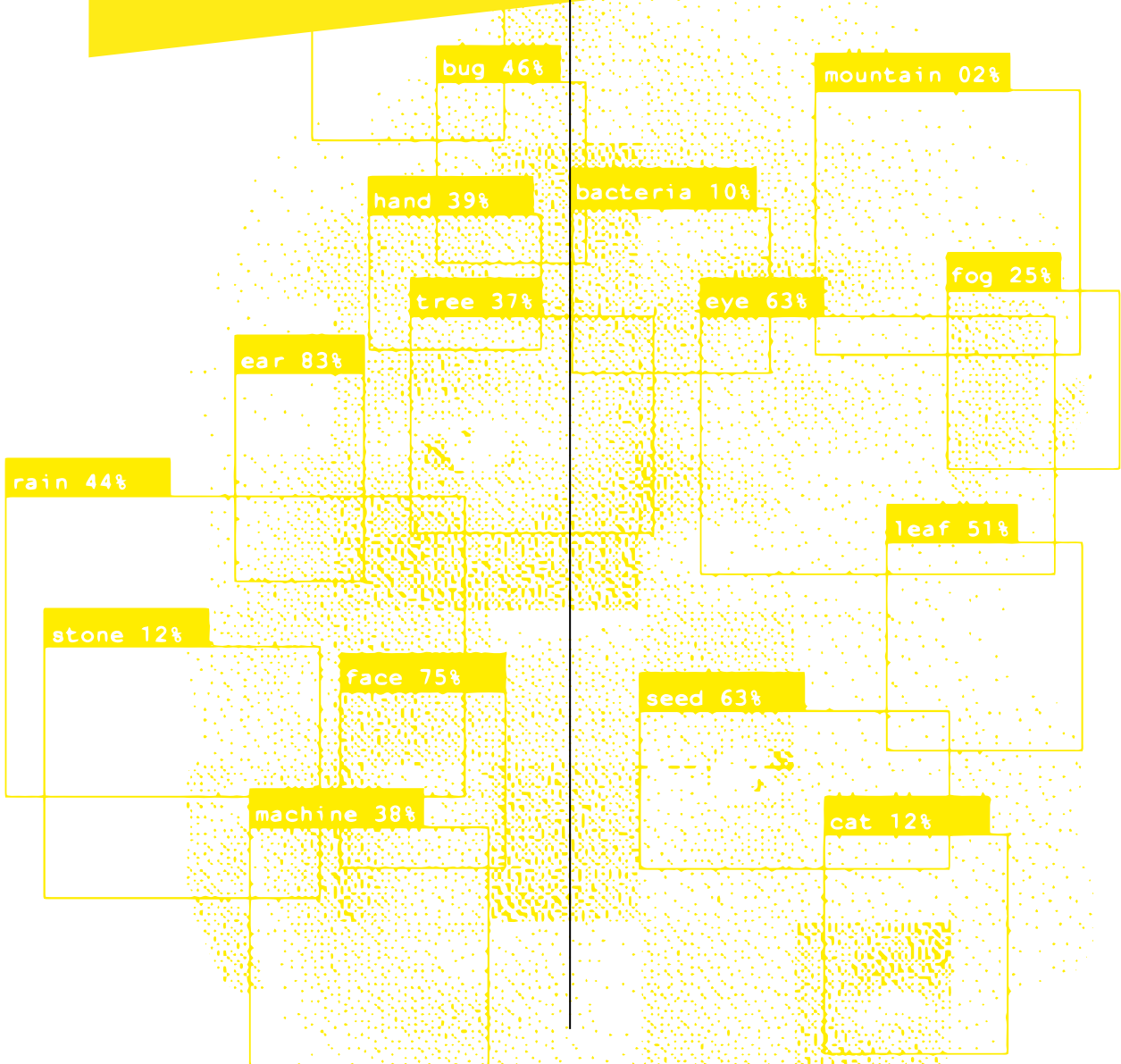


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A.I., FASHION AND RIGHTS

THE RISE OF ARTIFICIAL INTELLIGENCE IN REDEFINING FASHION PARADIGMS

ELISABETTA CIANFANELLI

Editorial

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Fashion Design, both in its theoretical foundation and practical application, is experiencing a significant cognitive transformation. This evolution is best interpreted not simply as a mere transition but as a continuous process of adaptation that affects professions, processes, and cultures (Anantrasirichai & Bull, 2022). This ongoing change necessitates a critical re-evaluation and recalibration of current ontological and epistemological frameworks (Dufva & Dufva, 2019; Kraus et al., 2021), emphasizing the need to redefine and reconsider the principles and methodologies in the Fashion Design field.

In this context, the emergence of artificial intelligence (AI) signifies the onset of an era of evolutions and revolutions in Fashion design thinking and practice, characterized by shifts, advancements, and radical changes (Ozmen Garibay et al., 2023). Fashion, traditionally reflective of societal, cultural, and economic dynamics, is now at a pivotal point due to the integration of AI into its processes. This transformation, both rapid and extensive, is reshaping the entire spectrum of the fashion industry, influencing various aspects such as design, production, customer purchasing experiences, and communication strategies (Särmäkari & Vänskä, 2022; Särmäkari, 2021).

This leads to a significant paradigmatic shift in the field of design: the evolution in the generation of images and forms, especially through the use of generative algorithms, facilitates the creation of high-quality and realistic content. This evolution expands creative possibilities (Wingström et al., 2023; Miller, 2020), while simultaneously introducing new ethical and methodological challenges (Siau, K., & Wang, W.; Luce, 2019). The arrival of these new tools is redefining the relationship between design and mathematics, between project and computational geometry, paving the way for an unprecedented interaction between different disciplines.

New directions in knowledge and methodology are fostering the development of innovative research paradigms, as AI stands as one of the most significant technological innovations of our time, deeply rooted in the data revolution (Tedeschi & Lombardi, 2017) and fundamentally based on mathematical and logical structures. These structures form the core of AI's ability to process, analyze, and interpret large volumes of data efficiently. Mathematics underpins the algorithms at the heart of AI, while machine learning and neural networks employ advanced calculations for continuous learning and improvement.

The shift fostered by AI includes data-centric decision making (Verganti et al., 2020), where AI's analysis of large datasets can inform and sometimes even influence design choices. AI can also intervene in creative abilities, enhancing them through generation tools and machine learning (Thompson et al., 2016). It simplifies problem solving with efficient computing and simulation capabilities and facilitates large-scale customization, allowing designs tailored to individual user preferences.

In the fashion design field, AI extends beyond personal consumer interactions, profoundly impacting the actual design processes (Särmäkari & Vänskä, 2022; Särmäkari, 2021; Luce, 2019). Designers, adapting to this AI-driven landscape, find their creative processes and problem-solving approaches being reshaped. The technology introduces a new paradigm in which design decisions are increasingly informed by data-driven insights. Consequently, the role of designers is evolving, requiring a harmonious blend of traditional creativity with AI's analytical capabilities, marking a significant evolution in both personal and professional realms influenced by AI.

On the one hand, the pervasive and nuanced integration of AI in daily activities marks a significant shift in how technology permeates everyday life. For individuals, this integration is evident in simple tasks, such as online shopping, where AI algorithms operate behind the scenes. By analyzing purchasing behaviors and personal preferences, these algorithms tailor experiences to individual needs, subtly guiding choices and shaping experiences (Andronie et al., 2021; Wong et al., 2013). This personalization raises significant questions about privacy and data management, highlighting the need to balance the benefits of customization with respect for individual privacy (Harrison et al., 2019; Xiong et al., 2019). On the other hand, the influence of AI in fashion exemplifies a broader paradigm shift where traditional processes are redefined by data-driven insights and innovative technological approaches. This shift in the fashion industry underscores how AI is not just a tool for efficiency but also a catalyst for reinventing creative and operational processes. In the fields of industry and manufacturing, the advancement of AI represents a critical transformation, marking its comprehensive integration into fundamental design and production processes (Gmenier et al., 2023). This development is a key aspect of the transition towards Industry 4.0 (Xiong et al., 2019), characterized by the integration of digital and intelligent technologies in manufactur-

ing. This evolution has led to the creation of advanced design software that interfaces with modern manufacturing technologies, such as additive manufacturing and the industrial Internet of Things (IoT). AI's role in these sectors extends beyond mere process automation, introducing new models of operational efficiency and multi-faceted collaboration that combine human creativity with algorithmic intelligence. Through predictive analysis and supply chain optimization, AI can contribute to reducing waste, promoting a more conscious and responsible consumption model (Van Wynsberghe, 2021). AI can anticipate trends and modulate production (Luce, 2019), thus encouraging more environmentally respectful practices.

AI tools today are equipped with predictive capabilities, enhancing forecasting and strategic planning. They provide deep analytical insights and tailor solutions to meet the specific requirements and contexts of design challenges. As a result, the field of design is experiencing an exploration of new areas, driven by data and AI's analytical power. The emerging synergy between human creativity and AI's computational power is reshaping the traditional limits of design, enabling designers to overcome previous constraints. This changing scenario presents a series of challenges and opportunities, requiring designers to navigate an ever-evolving environment and find a balance between creative intuition and the technical capabilities of AI.

A particularly complex area is that of intellectual property rights related to AI-generated designs (Lubart, 2005). Defining the ownership and authorship of a design created by an algorithm poses new legal challenges, necessitating updated and specific regulatory frameworks for the sector.

AI-driven automation in the fashion sector also raises important questions about social impact, particularly regarding the future of work (Wingström et al., 2023) and the role AI plays in the evolution of professional skills. It is crucial to consider how AI can both replace and enhance human labor, requiring careful consideration of the social and economic implications.

Another critical aspect is the risk of inherent bias in AI algorithms (Fujita, 2018; Ntoutsis et al., 2020), which could influence design and marketing choices in the fashion sector. Addressing these biases is essential to ensure that AI promotes inclusivity and diversity, rather than perpetuating existing stereotypes. Consequently, ethics in the use of AI becomes a central topic, requiring ongoing

reflection and careful regulation.

Looking to the future, the integration of emerging technologies like augmented and virtual reality, along with AI, promises to further transform the fashion industry, creating immersive and innovative shopping experiences. These developments open up a world of possibilities but also require a deep understanding of their potential ethical, social, and design implications.

Furthermore, as AI ingrains itself more profoundly in day-to-day activities, its influence permeates into the design sphere. Designers are progressively reconceptualizing AI as a "new design material" (Holmquist, 2017; Yildirim, 2022), perceiving it not merely as an auxiliary tool or technological adjunct but as an integral component of the creative process (Davis, 2013; Daniele & Song, 2019). This paradigm shift, while replete with intricacies and subtleties, demands a reevaluation of traditional design methodologies, beckoning designers to embrace AI as a collaborative partner in creativity. This novel approach unfurls a spectrum of unique possibilities and challenges, compelling designers to navigate an evolving landscape where the potential of AI is harmonized with human-centric design ethos.

The intersection between fashion and artificial intelligence is thus opening new creative and technological frontiers. It configures a scenario where fashion design increasingly characterizes itself in the design of rules, algorithms, and structures, even before the creation of imaginaries and forms, in search of convergence – or divergence – between artificial intelligence and human intelligence. However, these developments are not without challenges, opening up ethical and legal questions that must be addressed critically and reflectively to tackle central issues such as rights, ethics, and social responsibility.

The second issue of Fashion Highlight Journal situates itself within this evolving landscape, endeavoring to unravel and comprehend the multifaceted implications of integrating artificial intelligence in the realm of fashion design. Through the diverse perspectives and insights offered by its contributors, this issue aims to delve into the intricate ways AI is reshaping fashion design's traditional methodologies and creative processes. This issue particularly aims to encourage scholarly discussion regarding the interplay between fashion, artificial intelligence, and rights. It examines how the fashion sector, within a rapidly changing environment, is addressing key concerns related to pri-

vacy, intellectual property, inclusivity, skills development, and responsibility. A significant area of focus is exploring AI's potential to maintain diversity, function inclusively, and protect individual identities, highlighting its critical role in the context of contemporary fashion.

Greta Rizzi and Daria Casciani open the discourse with an article providing a comprehensive understanding of AI's evolution and its integration into fashion processes. Their work navigates through the stages of research, design, development, and manufacturing, tackling the ambiguity of AI terminology and highlighting the need for technological transformation toward sustainable fashion evolution.

Benedetta Giovanola, Simona Tiribelli, Emanuele Frontoni, and Marina Paolanti then take us through the complex data webs of the fashion domain. Their paper explores the powerful efficiency of AI in data interpretation, juxtaposing this technological breakthrough with the ethical challenges emerging in this digital evolution, emphasizing the need for robust frameworks for responsible AI use.

Barbara Pasa offers a three-dimensional exploration of AI in fashion design, considering complexity, education, training, and the 'Made in Italy' concept. Her essay is a reflective journey addressing socio-economic and cultural aspects, emphasizing the role of designers as co-regulators and rule-makers in the AI era, beyond the creation of mere forms and imaginaries.

Monica Titton critically examines contemporary fashion design through the lens of generative AI, using Demna Gvasalia's work at Balenciaga as a case study. She discusses the accelerated design process driven by market demands and proposes strategies to break the cycle of self-reference and copying prevalent in fashion design.

Patrizia Marti explores the impact of AI across the fashion lifecycle, addressing operational efficiency and personalization, while highlighting biases in AI systems. Her paper introduces feminist design principles as a means to envision more inclusive, equitable, and unbiased fashion discourse, advocating for AI-powered fashion that aligns with these principles.

Chiara Scarpitti, Arrarita Bianco, and Raffaele La

Marca reflect on the transformation of data mining into life mining, fed by the proliferation of electronic devices and wearables. They present fashion and jewelry design projects that subvert the surveillance system, charting new spaces of design thinking that challenge the prevailing logic in AI.

Victoria Rodriguez Schon and Chiara Colombi critically review AI's role in trend research within fashion. They scrutinize AI's ethical and nuanced analysis capabilities amid industry reliance on its speed and neutrality, urging for a responsible AI utilization that respects cultural nuances and social equities.

Moreover, Arrigo Bertacchini and Pietro Salvatore Pantano's study navigates the intersection of AI with the fashion industry. They emphasize the need for structured approaches to deploy AI in fashion, exploring its capacity to enhance and expand human creativity. The study also confronts the ethical quandaries posed by AI, particularly when trained on culturally specific data, potentially embedding biases, and the necessity for explainability in AI's decision-making processes.

Complementing this, Niccolò Musmeci and Pietro Salvatore Pantano's work delves into the intricate issues surrounding AI, such as originality, intellectual property, and the inherent biases in machine learning models. Their analysis pivots around the dual aspects of AI: the risks associated with its unchecked expansion, notably the undermining of human cognitive supremacy, and the prospects of creating a harmonious relationship between human intelligence and AI.

In the intricate system of fashion, scientific research is often the product of interrelationships and connections between different disciplinary areas, and Fashion Highlight aspires to serve as a space for open, transdisciplinary and intersectoral dialogue. The study of the interaction between fashion and Artificial Intelligence (AI) fits perfectly with the Fashion Highlight journal's scope: a sector deeply intertwined with social, cultural and economic dynamics, requires understanding from various perspectives including technological complexity, creative implications, marketing strategies, ethical concerns, legal and regulatory challenges, sustainability issues and human-computer interaction. As AI reshapes everything from design and

manufacturing to consumer experiences and communication strategies in fashion, it's clear that navigating this space requires a synthesis of different skills and points of view. This confluence of disciplines highlights the importance of collaborative and interdisciplinary discourse to fully grasp and exploit the transformative power of artificial intelligence in fashion and beyond.

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ESSAYS

A.I. INTO FASHION PROCESSES

LAYING THE GROUNDWORK

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Abstract

The article aims to provide a comprehensive understanding of Artificial Intelligence (AI) and its integration into fashion processes, focusing on the research, design, development, and manufacturing stages. First, it offers an overview of AI evolution, from its early developments to the contemporary advanced Machine and Deep learning models, attempting to tackle the challenge of ambiguous terminology and aiming to deal with the different interpretations of AI capabilities. Subsequently, a review of the perspectives on the integration of AI tools within fashion processes will be presented. This overview will underscore the growing need for industries to undergo a conscious technological transformation, adopting AI toward a more sustainable and responsible fashion evolution.

Keywords: *Artificial Intelligence; Technological Innovation; Sustainable Fashion; Fashion Processes Transformation*

Introduction

The fashion sector is undergoing the transformations of the 4th Industrial Revolution, in which several technological innovations are unfolding to positively reshape the current ecosystem towards a more sustainable and customer-oriented business (Bertola & Teunissen, 2018). Within this framework, the recent developments in Artificial Intelligence (AI) started to impact the fashion industry, proving the ability to change the creative, industrial and business processes. In recent years, AI has demonstrated its application potential in many areas, thus becoming more than just a domain of technical interest but involving interdisciplinary research for further

progress (European Commission, 2022b). Indeed, the transversal performances of AI intelligent systems, namely systems capable of learning from increasingly complex data, analysing situations and assisting in decision-making processes (Herm et al., 2022), demonstrated their great applicability across the entire complex fashion value and supply chain over the last 30 years. Despite this, fashion industries are still sceptical about its proper integration into their processes due to a lack of knowledge and skills to manage the technology into traditional processes toward a broader paradigmatic shift (Giri et al., 2019) for a positive and responsible change in the sector. The limited knowledge about AI is partially reflected by the terminological ambiguity surrounding the AI domain, characterised

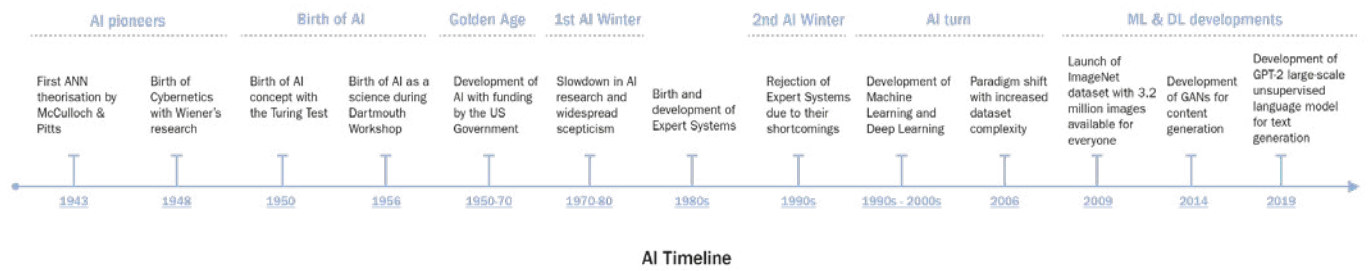


Fig. 1

by intertwining disciplinary backgrounds and interrelated branches, models and algorithms (European Commission, 2022b). The complexity derives one-sidedly from the connection of AI with the concept of *intelligence*, which, by its very essence, encompasses different perspectives on the nature of its meaning, studied at length by psychologists, biologists and neuroscientists (AI HLEG, 2019). Besides this, several terms revolve around AI, making it necessary to clarify their correct definitions and their relationship to the AI interdisciplinary field of research. Given this context, the paper firstly aims to provide terminological definitions and a glossary about AI, and secondly to position AI within the fashion practices and processes, clarifying adopted models and reviewing the state of the art of AI's widespread applications within the fashion Textile and Clothing (T&C) industry.

The History of AI

The conceptual origins of AI trace back to the 1940s, when the pioneers of AI, McCulloch and Pitts, scholars of philosophy, psychology and mathematics, published '*A Logical Calculus of the Ideas Immanent in Nervous Activity*' (1943), in which they first hypothesised that brain functions could be explained according to mathematical logic. The structure of the first embryonic Artificial Neural Network (ANN) capable of learning and reasoning has thus been suggested on a theoretical level, albeit with little success in application. A few years later, Cybernetics arose as a result of '*Cybernetics: Or Control and Communication in the Animal and the Machine*' (1948) by the mathematician and philosopher Wiener. Within the book, the human brain was first compared to a computer, speculating on how human intelli-

gent behaviour could be simulated by machines using feedback mechanisms (Tauli, 2019). These early research directions paved the way for what is recognised as the actual birth of AI, signed by the publication of '*Computing Machinery and Intelligence*' by the mathematician and cryptanalyst Turing in 1950. The article exposed the philosophical question of whether machines can think, inspiring the structure of the well-known Turing test, in which the machine's ability to simulate human responses is assessed.

The term AI, however, originated in the research project '*Study of Artificial Intelligence*' organised in 1956 at Dartmouth University by McCarthy, from which a new scientific discipline called *Artificial Intelligence* was described for the first time. (European Commission, 2020).

The 1950s-1970s marked flourishing developments in AI research; this positive attitude was attributable to the substantial funding from the US Government and the *Defence Advanced Research Projects Agency* (DARPA) for technological advancements supporting Cold War strategies and the Apollo space programme. At the end of the 1970s, however, a sceptical attitude towards AI began to spread due to the economic shortcomings and the technological limitations of that period, clearly expressed by the shortage of computing power, memory and processing speed (Tauli, 2019). This period, named *1st AI Winter*, was overtaken by a phase of flourishing development that began in the 1980s due to the emergence of *Expert Systems* (ES) or *Knowledge-based systems*, which were able to provide assistive knowledge through programming logic within specific domains, achieving excellent results in medical diagnostics, chemistry, electronics, engineering, geology, management, process control and military science (Negnevitsky, 2002). Even though these

systems found broad applicability within the Industry, after the 1990s, they underwent a phase of rejection that introduced the *2nd AI Winter* (European Commission, 2020). The main reasons behind their decline can be recognised in their limited and extremely sectoral applicability, the inability to manage large amounts of knowledge, the inaccuracy of the results, and the lack of funds to update the systems' models (Taulli, 2019). Between the 1990s and the 2000s, AI research led to the development of increasingly complex mathematical models and algorithms for *Machine Learning* (ML) and *Deep Learning* (DL), which extended their capabilities to various fields. The year 2006 marked a significant turning point in AI development, thanks to the contribution of Fei-Fei Li, a computer science professor at Stanford University, who argued that AI's main limitation could be attributed to the scarcity of datasets, which failed to represent real-world complexity. According to her vision, more data could lead to better models. This insight catalysed a fundamental paradigm shift, shaping the current applications of AI prevalent in diverse domains, including computer vision, speech recognition, natural language understanding, social network filtering,

machine translation, bioinformatics, drug design, medical image analysis, material inspection, and games (European Commission, 2020).
Toward a comprehensive definition of AI

The identification of a common vocabulary in AI is a highly complex issue. Historical grounds can be identified behind the terminological misuse and mixup mystification. Indeed, the evaluation of AI has traditionally been divided between two different perspectives that have led to divergent methods of assessing its results. On the one hand, its cognitive drive, associated with empirical science, has been interested in reproducing human intelligence. This approach involves observations and hypotheses about human behaviours, assessing the success of the machine according to its fidelity to thinking and acting like human beings. On the other hand, the engineering nature of AI is aimed at reproducing intelligent behaviour; in this case, the achievement of the goal is evaluated according to the ideal performance of AI systems (Russell & Norvig, 2010; Floridi, 2022). Therefore, two different scientific scopes led to this dichotomy: (i) to determine the connections between AI knowledge representation, learning

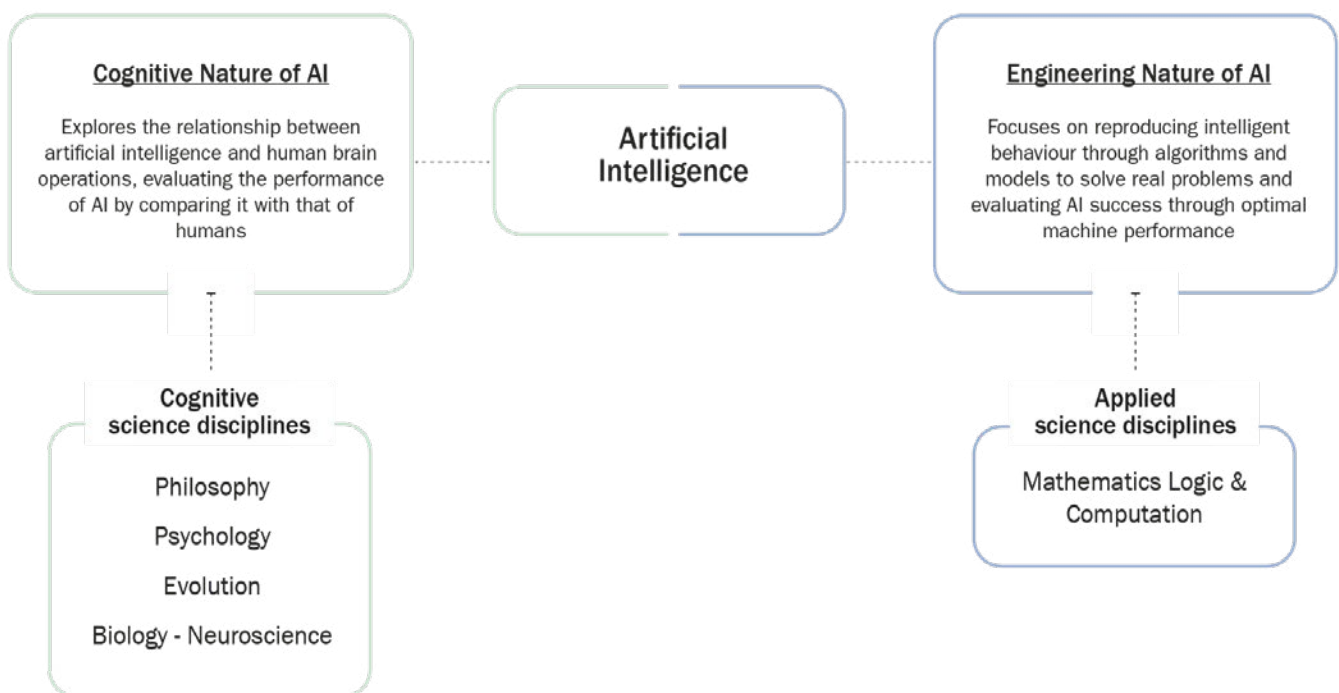


Fig. 2

rules and human intelligence, pursued mainly by psychologists, philosophers and cognitive scientists, and (ii) to employ knowledge representation and learning rules in solving real-world problems, pursued by computer scientists and engineers. In acknowledgement of the diverse interpretations of AI, the attempt is to remain as impartial as possible, drawing on the definition proposed by the AI HLEG and used by the *European Commission* in the 'AI Watch' document (Samoili et al. et al. 2020): "Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal." (AI HLEG, 2019, p. 6). From this description, three primary capabilities of AI emerge (i) 'perception' understood as the collection of data from the environment; (ii) 'reasoning' interpreted as the set of techniques and symbolic rules transforming data into numerical knowledge, moving from *knowledge representation* to *knowledge reasoning*; and (iii) 'actuation' meant as the execution of the best-identified solution in response to the problem (AI HLEG, 2019, p. 3). In its present-day applications, AI intersects with ML when focusing on systems that can learn autonomously from data without being programmed explicitly for the purpose (European Commission, 2022b). ML is based on a statistical method in which the system preprocesses large amounts of information to predict a phenomenon (Yüksel et al., 2023). Its training is mainly based on the following learning models: *Supervised Learning*, focusing on the determination of the relationship between input and labelled values; *Unsupervised Learning*, relying on a process of identifying data with common characteristics from an unlabelled database, which does not require supervision for training but lacks an objective evaluation of its performance and *Reinforcement Learning*, grounded on the classic trial-and-error method, in which machine-generated results are approved or rejected until the system develops the ability to create own solutions (Taulli, 2019; Yüksel et al., 2023). The fourth category of *Semi-supervised Learning* can also be added to the proposed classification, which, as the name suggests, combines *Supervised* and *Unsupervised Learning*

using labelled and unlabelled data (European Commission, 2020; Taulli, 2019).

In general, the predictive power of ML systems improves with the increase of the dataset, up to achieving a superperformance. In contrast to traditional programming, the absence of linear correlations between input and output data makes the model difficult to interpret, seldom preventing an understanding of how the algorithm achieved the final result, thus leading to the *Black Box AI* effect (Saranya & Subhashini, 2023; Yüksel et al., 2023).

Within the ML domain lies the subfield of DL, which is used for processing large amounts of data relying on ANNs. The very concept of depth is reflected in the DL structure, based on multiple hidden layers. This type of architecture is currently being exploited in various branches, such as computer vision, speech recognition, natural language processing, and machine translation, where the computational power has reached, if not exceeded, human performances (European Commission, 2022b).

Methodology

A literature review was performed between May and November 2023, drawing on the *Google Scholar* database, selecting the following keywords for the scientific articles' research: 'fashion industry', 'fashion design', 'apparel industry', 'textile sector', 'fashion supply chain', 'fashion design creative process', and 'sustainability', paired with 'Artificial Intelligence'. Only results published after 2018 were selected to limit AI's applications to its most recent developments. Furthermore, the authors' prior knowledge filtered the paper screening process to cross-explore the intersection between AI and fashion and report a general overview of the topic by presenting a comprehensive schematisation of AI clustering models within the T&C industry processes.

The review of the state-of-the-art of AI applied to the Fashion Industry

Recently, AI has been integrated across various aspects of the fashion industry, a trend confirmed by the prevailing scientific literature. Indeed, most of the research exploring the application of AI in the textile and clothing (T&C) sectors has emerged in the last decade (Giri et al., 2019). The most widespread applications of AI in the

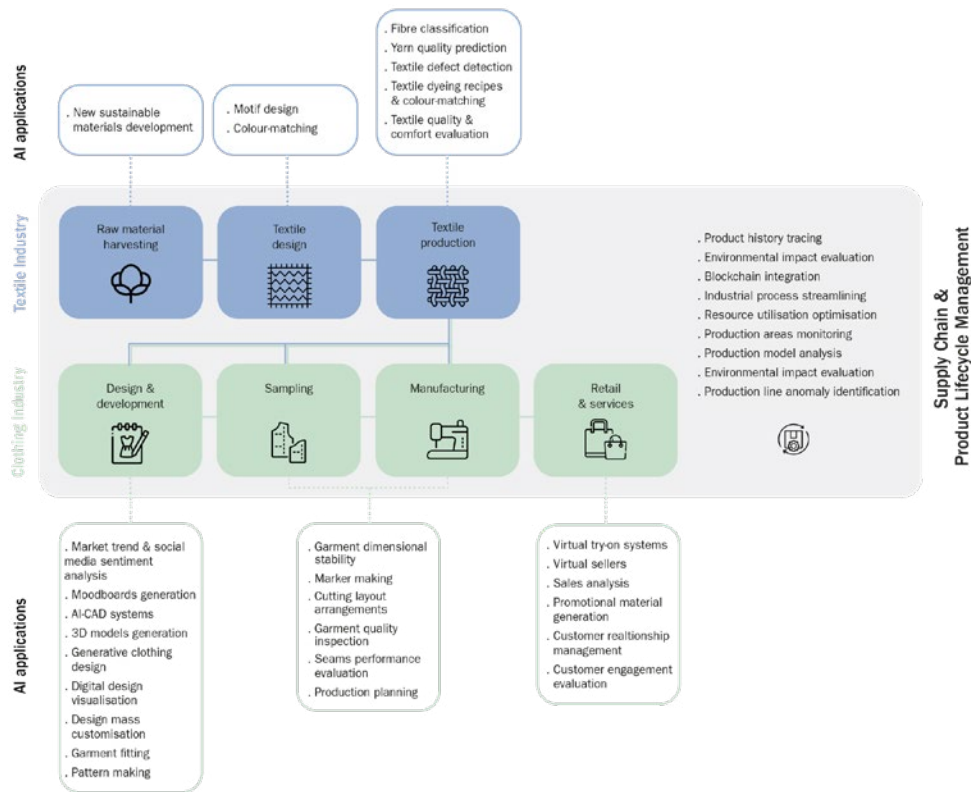


Fig. 3

fashion industry can be classified into several macro-categories, each contributing to different stages of the fashion supply chain. At the *raw material harvesting* stage, AI is used for experimental research in the biomolecular field, paving the way for developing new sustainable materials, such as synthetic spider micro-silk (Sareen, 2022). Within the *textile design* phase, ML tools play a crucial role in enhancing creativity by suggesting attractive patterns and colours in the design of textiles (Varshney, 2021). In the *textile production* process, AI is used for various tasks, including fibre classification, yarn quality prediction, textile defect detection, the creation of textile dyeing recipes with colour-matching predictions (Sikka et al., 2022), and as well as contributing to the evaluation of textile quality and comfort (Sareen, 2022). In clothing *design and development*, AI is being exploited for market trend analysis and social media sentiment analysis for the guidance of new designs, for assisting design using computer-aided design (CAD) systems (Noor et al., 2022), and for generative clothing design and digital fashion design (Särmäkari & Vänskä, 2022). During clothing *sampling and production* phases, AI finds application in marker creation, prediction

of garment dimensional stability (Noor et al., 2022), pattern recognition and garment quality control. Furthermore, AI helps in the arrangement of cuts, production planning and optimisation of material used. Finally, at the *retail and service* stage, AI is exploited for virtual try-on systems, personalised shopping experiences through AI-powered chatbots and sales analysis (Sareen, 2022).

In addition to these applications listed above, the refinement of AI systems has thus reached the manufacturing sector, which has grasped the opportunity to achieve the goals of Industry 4.0 (I4.0) through AI's application in the Fashion Product Lifecycle Management (PLM) toward cost reduction, optimised resource management, increased productivity and higher product quality. Indeed, thanks to the implementation of intelligent systems, it is possible to streamline industrial processes by simultaneously monitoring multiple production areas, anticipating and identifying errors before they occur, simulating potential scenarios and analysing models to predict future results (Alenizi et al., 2023). Hence, in the case of the pilot collaboration carried out in 2019 between Google and Stella McCartney, ML

technology achieved a comprehensive analysis of environmental impact along the entire supply chain by examining raw materials, resources and production processes, facilitating more informed decision-making (Candeloro, 2020). Moreover, recent studies on the application of ChatGPT have shown how it can support the sustainable management of the fashion supply chain, providing suggestions to textile companies on how to optimise water management, recommending more sustainable production processes, identifying anomalies in the production line and providing insights into the environmental impact of companies (Rathore, 2023; Xu et al., 2023).

In addition to the proposed overview of the functions of AI in T&C, the performed literature review identified several criteria for clustering AI in fashion. As proposed by the European Commission, AI can be categorised into *creation*, including both customisation for mass production as well as novel design creation through generative AI; *production*, where AI efforts are exploited in favour of circular economy objectives; and *user engagement*, in which the computational power is used for analysing emerging trends through extensive data analysis and for increasing the engagement of shopping experiences through digital AI-based assistants (European Commission, 2022a). The literature review by Giri et al. (2019) drew up a different classification of AI applied to fashion divided into *apparel design, manufacturing, retailing, and supply chain management*, thus considering primarily the application of ML and ES to different industrial phases and processes. Nayak and Padhye (2018) highlighted a more comprehensive range of AI performances in the fashion production stages. These applications range from *mechanical property prediction, classification and selection, defect identification and analysis, process control and online monitoring to supply chain management and retail*. Specific areas of interest include the categorisation of fibres and yarns, fabric performance and aesthetic properties prediction, defect recognition, seams performance evaluation, pattern making and garment fitting, production planning optimisation, final garment quality inspection, supply chain optimisation, and retail functions such as forecasting and customer relationship management (Nayak & Padhye, 2018). A similar clusterisation of AI applicability was also proposed in the research by Mohiuddin Babu et al. (2022): “AI can be applied in all the stages (*pre-production, production, and post-produc-*

tion) of textile manufacturing. It involves processes such as conceptualization, design development, production planning and control (PPC), spreading, cutting, bundling, sewing, pressing, and packaging” (Mohiuddin Babu et al., 2022, p. 5). Differently, the classification proposed by Zou & Wong (2021) focused less on an interpretation from an industrial perspective, offering instead a reading channeling the viewpoints of manufacturers, stylists, designers and fashion enthusiasts alike. The resulting overview of AI applications is clustered into seven categories: *overview*, containing general information on technologies applied to fashion and AI; *evaluation*, summarising research that deals with the drafting of evaluation protocols for fashion research to achieve data collection that meets a scientific criterion; *basic tech*, including the application of AI from the perspective of computer vision based on image processing; *selling* in which the domains of sales, *styling*, design and shopping are brought together, converging in the area of virtual sellers to provide better shopping experiences to online shoppers; *styling* focusing on the provision of online styling services, including the topics of *recommendation* and *classification*; *design* addressing 3D garment generation, garment design detail modification, virtual try-on, promotional material generation via Generative Adversarial Network (GAN); and *buying* which analyses trend forecasting prediction, and selling. More recent literature highlights how research interests have shifted from the AI applied to data analysis to its generative capabilities (Choi et al., 2023), allowing the enhancement of the design phase through the implementation of Deep Generative Models (Croitoru et al., 2023), paving the way for the redefinition of the creative development phase (Rizzi & Vandi, 2023). The turning point in AI’s creative agency recognition came in 2019 when fashion designer DeepVogue received an award during an international design competition in Shanghai (Särmäkari & Vänskä, 2022). Indeed, in recent years, a transformation has taken place in the *design and development* phase through the application of GANs for the creation of original images and 3D models (Yüksel et al., 2023), as well as for the generation of mood boards, design visualisations, and merging and modifying specific features of the design item. This allowed designers to explore new solutions beyond the possibilities of currently known design processes (Lee, 2022). However, the effective integration of generative AI tools into design and development

processes still requires their alignment with fashion industry standards and learning industry-specific knowledge, which is still difficult to achieve (Choi et al., 2023).

Discussion and conclusions

This study revealed multiple ways of evaluating AI applications in the different phases of the fashion industry. Such a fragmented scenario can be traced to (i) the complex hierarchies and non-linear decision-making processes characterising the fashion industry (Bertola et al., 2018); (ii) the ambiguity in a common-shared vocabulary for defining AI models and applications (European Commission, 2022b), and (iii) the vast set of constantly evolving AI capabilities. Indeed, the computational accuracy achieved by ML and DL in recent years has significantly impacted the design field, integrating into processes both *analytical* and *generative* AI (Choi et al., 2023). Despite these shortcomings, a crucial benefit emerging from the analysis concerns using AI in the T&C industry to increase efficiency, sustainability and circularity, from design to production, involving the supply chain management and the value chain through the customer experience (Sareen, 2022).

This article aims to contribute to the knowledge about AI applications in the T&C processes by presenting a comprehensive overview based on literature review and proposing an AI clustering model adapted to the authors' interpretation and prior knowledge. The proposed model considers AI associated with the two industries of T&C and within the following specific processes: *raw material harvesting, textile design, textile production, clothing design and development, clothing sampling, clothing manufacturing, and retail and services*. In addition, the following categorisation encompasses the contribution of AI to the T&C sector within interconnected processes of PLM and Supply Chain Management.

The literature review and the subsequent proposed model of this paper position the groundwork for the hierarchy definition, and clusterization of AI applications in the T&C fashion processes. Thanks to this model on, by vertically studying each specific process and the interconnection between the various processes, it is possible to identify AI trajectories with a view on sustainabili-

ty and circularity in the fashion industry. From this preliminary overview, it emerges that, in the case of generative AI, the main focus lies on (i) social sustainability toward the definition of a better collaboration and interaction between human operators and AI-based technologies. In addition, the incorporation of AI systems enables resource management optimisation throughout the supply chain and greater control of production cycles, leading toward (ii) economic and (iii) environmental sustainability. Indeed, AI applications to industrial processes can help companies save costs by simultaneously suggesting strategies for reducing their environmental impact.

However, despite the great potential shown by AI, technological and strategic implementation is required to achieve the full performance of AI predictions and gain a true competitive advantage. To this end, fashion companies are called to invest in tangible sources, such as hardware and infrastructure, and intangible sources, i.e., qualified personnel, to effectively manage industrial-technological innovation processes (Mohiuddin Babu et al., 2022). Therefore, the presented research can be read as a foundation for further studies, focusing on the state of fashion companies, the opportunities and challenges they face to harness the full transformative potential of the AI technological revolution toward a more responsible industry definition.

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Captions

[fig. 01] Timeline of the evolution of AI from the early stages to recent developments

[fig. 02] AI schematisation according to its dual Cognitive and Engineering nature and corresponding discipline based on the studies by Bullinaria (2005), Floridi (2022), Russell & Norvig (2010)

[fig. 03] Visualisation of AI applications to support T&C industry processes

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ETHICAL IMPLICATIONS OF ARTIFICIAL INTELLIGENCE IN THE FASHION INDUSTRY

A COMPREHENSIVE ANALYSIS

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Abstract

In fashion domain, companies increasingly navigate a complex web of data involving intricate correlations, dependencies, and the unpredictability of human behavior. Managing these diverse data flows is critical to improving decision-making in an industry that depends on both creativity and precision. In this context, artificial intelligence (AI) techniques have emerged as powerful tools that offer unparalleled efficiency in interpreting and using these huge datasets. However, as the industry moves deeper and deeper into this digital frontier, it is encountering a wide range of ethical concerns. This paper examines this intersection, exploring both the technological breakthroughs that AI is bringing to fashion and the ethical implications that accompany this digital evolution. We discuss the need for robust frameworks and guidelines to ensure the responsible use of AI, noting its potential to both increase and mitigate the fashion industry's environmental impact.

Keywords: *Fashion; artificial intelligence; AI ethics, sustainability; fairness; creativity*

Introduction

The fashion and apparel (F&A) industry is one of the largest economic sectors. According to Statista, it contributes 38% to Asia Pacific, 26% to Europe and 22% to North America. In recent years, the intersection of artificial intelligence (AI) and fashion has become a frontier of innovation and transformative potential. From design and manufacturing to marketing and retail, AI's use in fashion promises efficiency, personalization and new levels of consumer engagement (Zou et al., 2019). Long recognized as a mirror of social, cultural and economic dynamics, the fashion industry is increasingly intertwined with AI, offering unprecedented opportunities for innovation and insight. However, this

technological integration raises complex ethical considerations that require careful examination. As AI becomes more and more embedded in the fashion process, it poses a unique set of ethical challenges. These include concerns about privacy, impacting employment, perpetuating bias, and the sustainability of AI-driven practices (Hacheme & Sayouti, 2021). The fashion industry, a sector historically marked by ethical controversies ranging from labor rights to environmental impact, now faces a new set of ethical issues in the age of digital transformation. At the heart of this exploration are key questions: *How does the use of AI in fashion align with, or deviate from, established ethical norms? What are the implications of data-driven personalization for consumer privacy? How does AI affect the fashion*

workforce, and what are the wider socio-economic implications?

An example of these considerations is the issue of lookism, discrimination based on a person's aesthetic characteristics, including aspects of appearance and ethnicity (Minerva, 2016). The use of AI in fashion raises critical questions about the perpetuation or mitigation of such biases. As AI systems are tasked with designing, marketing and personalizing fashion products, there is a significant risk that these systems could reinforce societal biases, including racial and ethnic discrimination. This concern goes beyond mere aesthetics and touches on deeper issues of representation and inclusivity within the fashion industry. Moreover, fashion's role as a mirror of society means that the application of AI in this field is not only about aesthetics, but also about uncovering and interpreting the less visible economic and cultural patterns of our society. AI has the potential to identify and analyze trends and dynamics that are imperceptible to human analysts, providing insights into consumer behavior, market shifts and cultural trends. This capability offers a unique opportunity to understand and perhaps even reshape the fashion industry's impact on society.

In addressing these concerns, the paper seeks not only to highlight the challenges, but also to contribute to a more responsible approach to technology in one of the world's most influential and dynamic industries. In addition, this paper considers the potential for AI to either perpetuate or mitigate existing biases in fashion design and marketing and examines how algorithmic decision-making can affect diversity and inclusivity. Hence, this paper addresses the following research questions:

RQ1. How does the integration of AI in fashion reflect and influence the social, cultural, and economic dynamics of society?

RQ2. What frameworks or guidelines should be established to ensure the ethical use of AI in fashion, particularly concerning accountability and transparency?

RQ3. To what extent can AI in fashion be leveraged to uncover and address less visible economic dynamics and disparities within the industry?

The paper is structured as follows: Section 2 provides a detailed technical analysis of the different AI technologies in the fashion domain. This is followed by an in-depth exploration of the ethical concerns arising from the use of AI in fashion, addressing issues related to consumer

privacy, environmental impact, AI-induced biases, intellectual property, and the impact on employment and creativity (Section 3). Section 4 then addresses the research questions, systematically answering each question in the light of the findings from the technical and ethical analyses. Section 5 summarizes these findings, reflects on the overarching implications of AI in fashion and outlines future work, highlighting key areas for further research and exploration to ensure the responsible and sustainable integration of AI in the fashion industry.

A Technical Perspective on Artificial Intelligence in the Fashion Domain

The integration of AI into the fashion domain represents a profound technological revolution, reshaping the very fabric of how the industry operates and innovates (Saponaro et al., 2018). This transformative era is characterized by the convergence of AI with traditional fashion processes, resulting in breakthrough advances and novel applications (Mohammadi & Kalhor, 2021). From the use of machine learning algorithms for predictive analytics to the application of deep learning techniques for sophisticated image recognition, AI is not just a tool but a catalyst that is redefining the boundaries of fashion design, production, marketing, and consumption (Chen et al., 2023). To harness the potential of these AI systems while navigating the ethical landscapes involved, it is crucial to understand the mechanics of these systems, the algorithms that drive them, and their applications in the fashion industry.

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et al., 2023). To harness the potential of these AI systems while navigating the ethical landscapes involved, it is crucial to understand the mechanics of these systems, the algorithms that drive them, and their applications in the fashion industry.

Machine learning and deep learning algorithms
At the heart of AI in fashion are machine learning and deep learning algorithms. These algorithms enable systems to learn from data, identify patterns and make decisions with minimal human input. Deep learning, a subset of machine learning, uses multi-layer neural networks (deep networks) for complex tasks such as image recognition and natural language processing (Mameli et al., 2021).

Image recognition and processing
Image recognition, powered by convolutional neural networks (CNNs), plays a critical role in fashion AI. CNNs are used to analyze fashion images, categorize garments and power visual search tools in e-commerce platforms (Seo & Shin, 2019).

Predictive analytics and trend forecasting
AI systems using predictive analytics are central to trend forecasting. They analyze data sets that include past trends, current market data and consumer behavior to predict future trends using techniques such as time series analysis and regression models (Chang et al., 2021).

Personalization and recommendation systems
AI-driven recommendation systems, using algorithms such as collaborative and content-based filtering, often combined with deep learning, offer personalized fashion suggestions based on user behavior and preferences (Pereira et al., 2023).

Supply chain optimization and inventory management
AI optimizes fashion supply chains and inventory management. Predictive analytics and reinforcement learning algorithms are used for demand forecasting and dynamic decision making in logistics (Martino et al., 2017).

Natural language processing (NLP) for customer interaction
NLP is improving customer service in fashion, with chatbots and virtual assistants providing personalized shopping assistance and answering queries (Liu et al., 2021).

Sustainable and ethical fashion
AI contributes to sustainable fashion, with algorithms assessing the environmental impact of materials and optimizing resource use in production (Rathore, 2019).

Generative Adversarial Networks (GANs) in fashion design
A pioneering application of AI in fashion is the use of Generative Adversarial Networks (GANs). GANs consist of two neural networks, a generator, and a discriminator, that work against each other, learning to create new, original outputs. In fashion, GANs are used to generate novel design patterns, textures and even complete garment designs. This technology not only speeds up the design process, but also pushes the boundaries of creativity, allowing designers to explore never-before-seen styles and combinations. However, it's important to manage the ethical implications of this technology, ensuring originality and respecting intellectual property rights (Della Sciucca et al., 2022).

Ethical Considerations in the AI-Driven Fashion Industry

As already stated in the Introduction, the integration of AI into fashion brings to light a spectrum of ethical challenges that require careful consideration. As AI reshapes the way fashion works, from design to retail, it also prompts us to reassess the ethical implications of such profound changes. These considerations range from the protection of consumer privacy to the environmental impact of AI technologies, the potential for algorithmic bias, the preservation of human creativity and the impact on employment in the industry. The balance between the benefits of data-driven insights and the imperative of consumer privacy is a key ethical challenge in the AI-driven fashion world.

AI and sustainability
With significant contributions to global greenhouse gas emissions and waste, the environmental footprint of the fashion industry is already an issue. The introduction of AI adds another layer to this issue. The energy-intensive nature of AI computation required for tasks such as trend forecasting, and supply chain optimisation potentially exacerbates the industry's environmental impact. But it's also worth noting that AI's efficiency in

other areas, such as reducing overproduction and optimising resource use, can contribute to sustainability. This dual role of AI in environmental sustainability underscores the need for a balanced approach that maximises its positive impact while minimising its carbon footprint.

Bias and discrimination

AI systems that reflect the biases inherent in their training data can inadvertently perpetuate discrimination (Giovanola & Tiribelli, 2022). In fashion, this could manifest in biased design recommendations or marketing strategies that favour certain demographics over others, reinforcing existing societal biases. Addressing these biases requires a conscious effort to diversify data sets and implement checks to prevent discriminatory outcomes.

Copyright challenges with AI-generated designs

The emergence of AI in fashion design raises complex copyright issues. The role of AI in generating patterns, colours and styles blurs the lines between human and machine creativity, challenging the traditional framework of copyright law, which revolves around human authorship. This ambiguity places AI-generated designs in a precarious position, potentially unprotected and vulnerable to unauthorised use or replication. There is an urgent need for legal frameworks that recognise and adapt to the nuances of AI-generated creative works.

The ethical implications of automation on employment

While AI-driven automation in fashion offers efficiency gains, it also raises ethical dilemmas regarding the impact on the workforce. The potential for job displacement, particularly in manufacturing and design, cannot be overlooked. It's imperative to balance technological advancement with the well-being of the workforce, emphasising strategies such as reskilling and upskilling to prepare employees for a changing industry landscape.

Balancing AI and human creativity

Integrating AI into the fashion design process opens doors to innovation and data-driven insights. However, this integration requires a careful ethical balance. Over-reliance on AI could potentially stifle human creativity and reduce design to a mere output of algorithms. It is crucial for fashion companies to ensure that AI is used as a tool to augment human creativity, not replace it, and to

preserve the unique artistic vision that is at the heart of fashion design.

Discussions: AI's Impact and Ethical Implications in Fashion

After an in-depth analysis of the integration of AI in fashion, as detailed in the following comprehensive table (Table 1), we can now address some of the research questions that have emerged from our study. Each area of AI application, as shown in Table 1, contributes uniquely to these findings, which together paint a comprehensive picture of the current state and future trajectory of AI in fashion. This understanding forms the basis of our responses to the research questions, ensuring that our conclusions are informed by a detailed assessment of both the technological innovations and the ethical complexities of AI in fashion. This discussion synthesises our findings and offers insights into how AI in fashion reflects and influences societal dynamics, the need for ethical frameworks, and the potential of AI to uncover and address hidden economic inequalities.

Category	Technical Aspects	Ethical Concerns	Challenges
Machine Learning and Deep Learning	<ul style="list-style-type: none"> - Predictive analytics - Image recognition - Consumer behavior analysis 	<ul style="list-style-type: none"> - Bias in algorithms - Over-reliance on data-driven decisions 	<ul style="list-style-type: none"> - Ensuring accuracy - Diversifying training data
Image Recognition and Processing	<ul style="list-style-type: none"> - Use of CNNs for fashion item identification - Visual search in e-commerce 	<ul style="list-style-type: none"> - Privacy concerns with image data - Accuracy in diverse contexts 	<ul style="list-style-type: none"> - Handling diverse fashion styles - Balancing efficiency and privacy
GANs in Design	<ul style="list-style-type: none"> - Generation of new patterns and designs - Prototype visualization 	<ul style="list-style-type: none"> - Originality and intellectual property issues - Over-dependence on AI for creativity 	<ul style="list-style-type: none"> - Defining authorship - Encouraging human-AI collaboration
NLP for Customer Interaction	<ul style="list-style-type: none"> - Chatbots for customer service - Sentiment analysis in customer feedback 	<ul style="list-style-type: none"> - Privacy and data handling - Misinterpretation of complexities in language 	<ul style="list-style-type: none"> - Developing context-aware systems - Protecting consumer data
Supply Chain Optimization	<ul style="list-style-type: none"> - AI in inventory management - Predictive analytics for demand forecasting 	<ul style="list-style-type: none"> - Impact on employment - Ethical sourcing and production 	<ul style="list-style-type: none"> - Balancing automation and human labor - Transparent supply chain practices
Sustainability	<ul style="list-style-type: none"> - Resource optimization - AI-driven material selection 	<ul style="list-style-type: none"> - Environmental impact of AI operations - Promoting sustainable practices 	<ul style="list-style-type: none"> - Reducing AI's carbon footprint - Implementing eco-friendly solutions

Table 1. Overview of AI in Fashion: Technical Aspects, Ethical Concerns, and Challenges.

RQ1: Reflection and Influence of AI in Fashion on Social, Cultural, and Economic Dynamics.

The integration of AI into fashion has a significant, multi-faceted impact on social, cultural and economic dynamics. Our analysis shows that

AI-enabled fashion tools have the power to both reflect and shape societal trends. For example, AI-driven trend forecasting algorithms can identify emerging patterns in consumer preferences that reflect evolving cultural and social values. However, these algorithms also have the power to influence these dynamics, potentially leading to the homogenisation of fashion trends and diminishing cultural diversity in fashion expression. Economically, AI is catalysing shifts in the structure of industry. It enables more efficient supply chains and personalised marketing strategies, reflecting and reinforcing the consumer-driven nature of modern economies. However, this efficiency may come at a cost, including potential job displacement and an increased reliance on data-driven decision-making that may overlook the human-centric aspects of fashion.

RQ2: Frameworks and guidelines for the ethical use of AI in fashion. The establishment of robust frameworks and guidelines for the ethical use of AI in fashion is imperative. Our research suggests that these frameworks should focus on accountability, transparency, and inclusivity. Key recommendations include:

- Transparency in algorithmic processes: Fashion brands should disclose how AI algorithms are used, particularly in the handling of consumer data and decision-making processes.
- Accountability measures: There should be clear lines of accountability for AI-driven decisions, especially those that impact consumers and employees.
- Bias mitigation: Ongoing efforts must be made to identify and mitigate bias in AI algorithms, ensuring inclusivity and diversity in fashion offerings.
- Consumer privacy: Strong safeguards should be in place to protect consumer data, with clear consent protocols for data use.

RQ3: The role of AI in revealing economic dynamics and inequalities. AI has a profound ability to uncover less visible economic dynamics and disparities within the fashion industry. Our analysis shows that through advanced data analysis, AI can highlight issues such as inequitable supply chain practices or disproportionate market responses to different demographic groups. For example, AI can identify areas where certain communities are underserved or overcharged. This capability not

only helps to address economic inequalities, but also opens up avenues for more equitable market strategies. In addition, AI's predictive analytics can help smaller or emerging brands understand market dynamics, potentially levelling the playing field in an industry often dominated by established players. By revealing these hidden patterns, AI can contribute to a more balanced and fair industry landscape.

Conclusions and Future Works

This paper presented a comprehensive exploration of the integration of AI in the fashion industry, highlighting both its technological innovations and the complex ethical implications that accompany this integration. The study highlighted how machine learning, deep learning, and applications such as GANs and NLP are revolutionising various aspects of the fashion world, from design and production to marketing and retailing. Ethical analysis has highlighted several key concerns, including consumer privacy, the environmental impact of AI, the potential for algorithmic bias, intellectual property issues, the impact on employment, and the balance between AI-driven efficiency and human creativity. The need for robust ethical frameworks and guidelines was highlighted to ensure that the adoption of AI in fashion is consistent with principles of transparency, accountability, and inclusivity. The responsible integration of AI in fashion requires a balanced approach that addresses these challenges while harnessing AI's potential for sustainable and equitable growth.

Future research must address several critical areas to ensure that this development is both ethical and sustainable. First and foremost is the development of specific ethical frameworks and guidelines tailored to the application of AI in fashion, with a particular focus on data protection, bias mitigation, and consumer consent. Equally important is the exploration of AI's environmental impact, with a push towards more energy-efficient algorithms and AI's role in promoting sustainable practices. In addition, understanding the dynamics of human-AI collaboration in creative processes will be critical to ensuring that AI enhances rather than replaces human creativity. Finally, analysing how AI is reshaping consumer behaviour and decision-making in fashion retail can provide insights into more ethical marketing and sales strategies.

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A.I., FASHION DESIGN AND THE LAW

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Abstract

This essay deals with the exploration of Artificial Intelligence (hereafter AI) in fashion design by considering a three-dimensional space based on the following coordinates: [complexity]; [education and training]; [made in Italy]. They outline a very wide space in which different techne - Law, Artificial Intelligence and Design - address the challenges of contemporary society. They outline a thoughtful journey of reflection, including socio-economic and cultural aspects, to technical innovation. Specifically, when addressing issues of technical innovation, the emphasis is not on a simplistic notion of technique as a synonym for technology, alluding to mere technical processes and machines, but on techne as “the method of doing something according to art” (Maldonado, 2005, p.7).

In this context, the designer becomes an essential actor in democratic processes, serving as a co-regulator and participating as a rule-maker in the design of rules, algorithms and structures, even before the creation of imaginaries and forms, in the pursuit of convergence (or divergence) between artificial intelligences and human(wet) intelligences.

Keywords: *Complexity; AI; Metaverses; Education and Training; Made in Italy; Fashion Design; Law*

Introduction¹

Our reflection begins with the concept of [Made in Italy], which is deeply intertwined with fashion design as a prominent manifestation of it (Pozzo, 2021).

The focus here is not on the legal aspects of country-of-origin labels, but rather on the broader corporate culture that influences both small and large Italian companies, guided by the economic policies of our Ministry of Enterprise and Made in Italy (MIMIT). Rooted in a commitment to

quality and excellence, with an emphasis on design and tradition, this corporate cultural approach has positioned Made in Italy as a globally recognized brand identity. Designers, through their methodologies and practices, are the main vector of Made in Italy: they engage in processes that can foster a dialogue between artistic exploration and design application, paying particular attention to bodies, identities and our collective memory, rooted in our cultural heritage, landscape and knowledge of craftsmanship. At the same time, they seamlessly integrate technological innovation and industrial know-how (Vaccari & Franzo, 2022; Frisa, 2020). This synthesis of knowledge contributes to the appeal of the 100% Italian product.

¹ This writing expands upon the reflections presented at the Conference Fashion, Artificial Intelligence, and Rights, organized by the University of Florence (November 13, 2023).

In connection with [Made in Italy], [Education and Training] highlights the importance of promoting an open dialogue between the educational institutions responsible for providing theoretical knowledge, practical skills and expertise to emerging designers - primarily universities - on the one hand, and the entities that make up the country's economic landscape, namely SMEs, on the other. Understanding the expectations of SMEs, which represent more than 90% of the Italian national economic framework, is of paramount importance for the university system in terms of anticipating the future of design graduates entering the workforce.

The third concept, [Complexity], represents a fundamental characteristic of our time and stands as a crucial epistemological issue that combines "certainty with doubt". It is embodied in the concept of *faitiche*, a mixture of fact and fetish as described by Bruno Latour, where the distinctions between the realities of facts and individual beliefs

become blurred (Latour, 1996). Complexity² serves as a cornerstone for any discourse: on fashion design (Monti, 2022) as well as on artificial intelligence, whether simple or scientific. In the absence of an agreed definition (Ebers et al. 2021), we can conceptualize AI as an organic and structured system composed of interactive components, usually hardware and software. According to this broad concept, the overall behavior of the system cannot be directly reduced to that of its individual components, but depends on their interactions. Central to this complex system are the data used to train AI-where they come from, whether they refer to things or people, which are selected to be used and which are excluded, how they are interpreted, how they are communicated, and so on. Data are not inherently neutral or objective, but reflect existing social relations with embedded biases and inequalities (Sinni, 2023). As a result, it is suggested that the term data be replaced with

² See the definition in Treccani dictionary, 2023. OA.

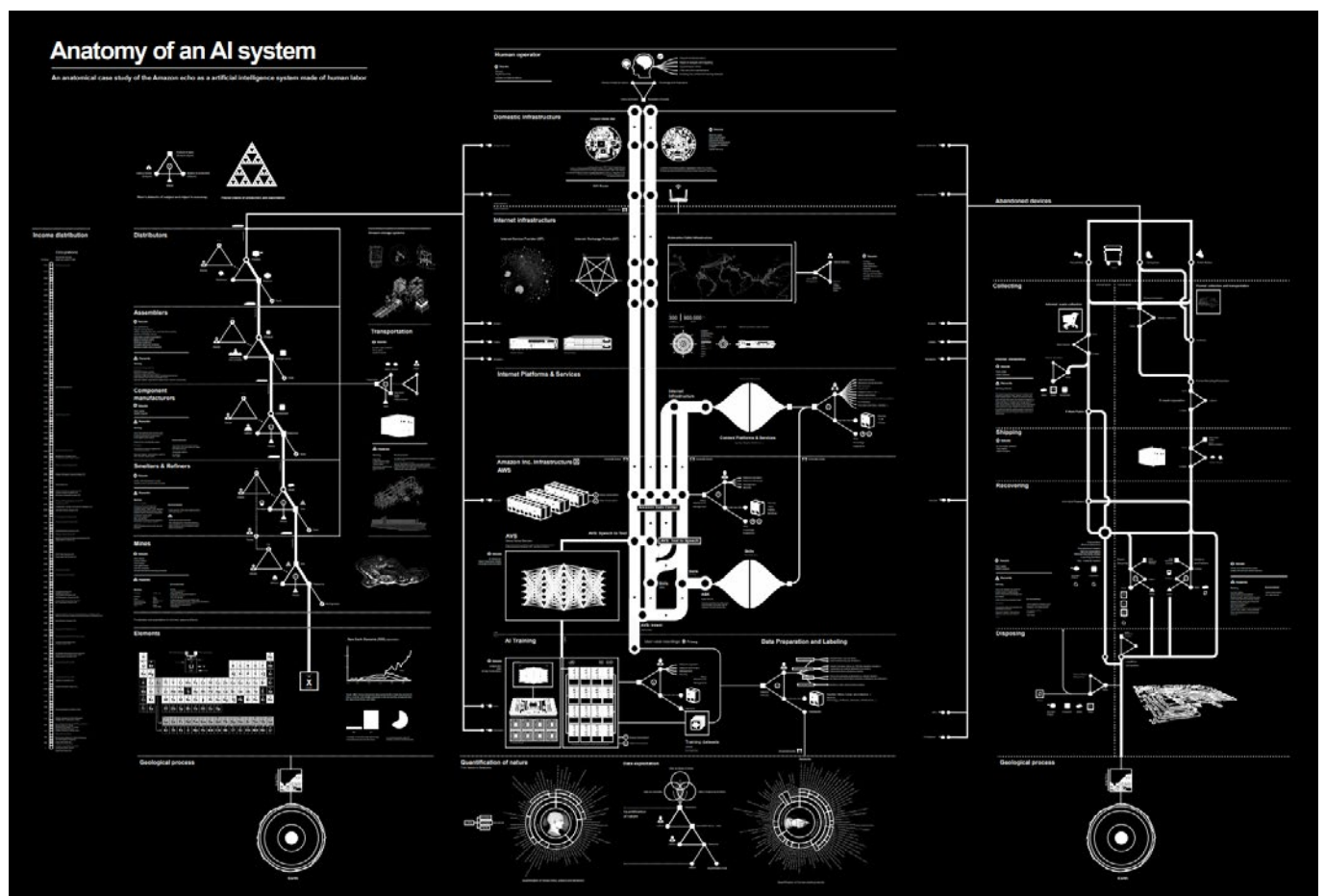


Fig. 1

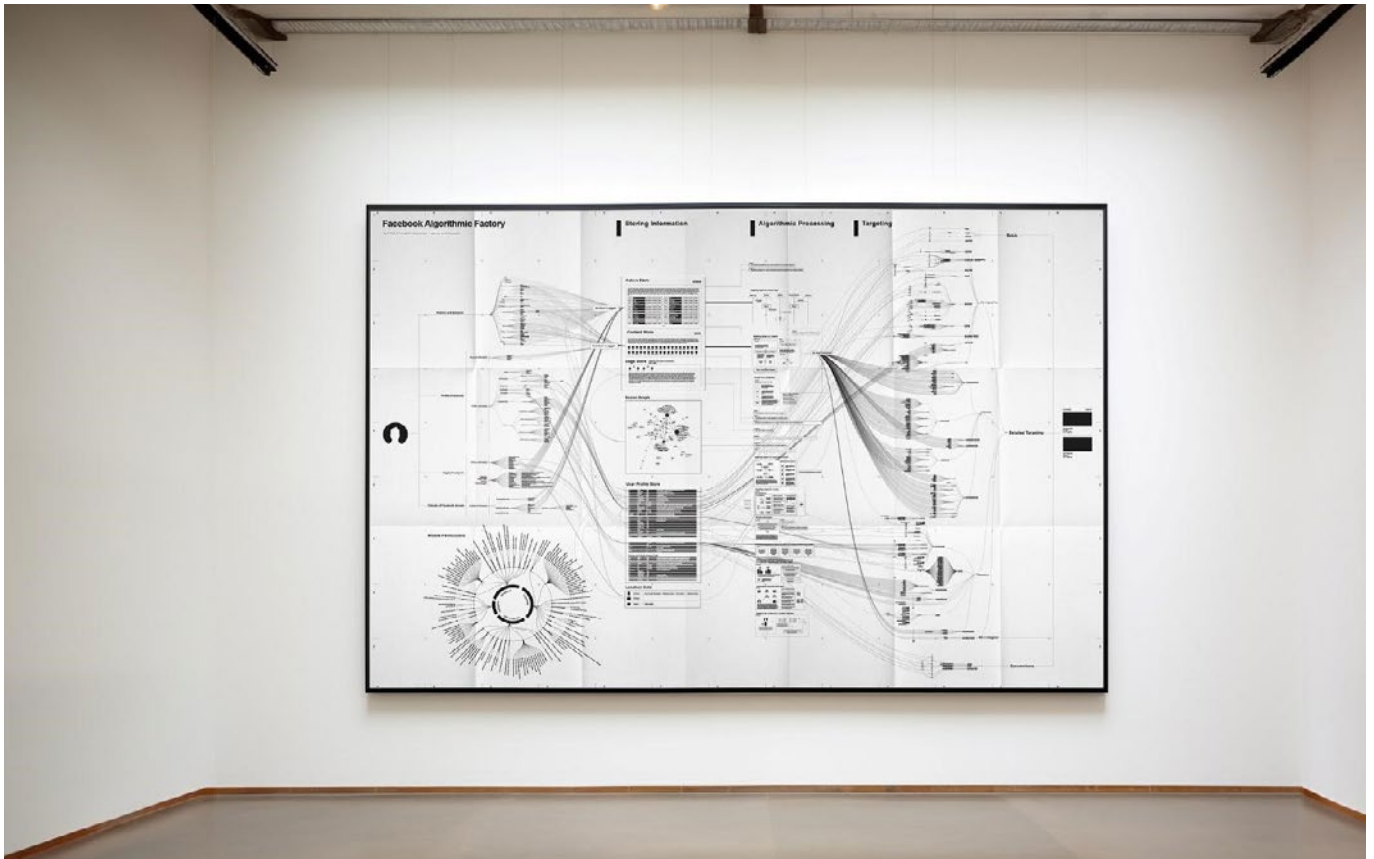


Fig. 2

capta, something that is taken (Drucker, 2019, pp. 122-123).

Visualizing complexity

Some works help in visualizing AI complexity: for example, through the *Anatomy of an AI System* [Fig. 01] and the *Black Box Cartography, A critical cartography of the Internet and beyond* [Fig. 02], our inadequacy and unpreparedness are palpable. Trying to understand how AI works by asking computer scientists or mathematicians would lead to rather complex explanations. Take *Stable Diffusion (infra)*, for example; understanding its basic elements through a picture [Fig. 03] would still be a challenge, even with expert help. But complexity is not just about AI. It's also about the world's legal systems, which are equally complex, as shown in the figure below [Fig. 04]. Admittedly, condensing a taxonomy such as that presented in [Fig. 04], which typically categorizes the world's two hundred or so legal systems using the notion of legal transplants (Watson, 1974) related to Western colonization,

results in a highly compressed summary. What's more, this concise account does not provide further details and distinctions, such as the differences between civil law systems and Anglo-American common law systems, between customary rights and those rooted in religious beliefs, such as, for example, the law within the Islamic tradition. In other words, complexity qualifies legal knowledge. Moreover, the legal community is diverse, not a homogeneous, monolithic epistemic entity. Jurists and legal professionals, such as lawyers and judges, deal with different legal rules, including areas of law that are accessible to non-experts (such as constitutional law, think for instance to the freedom of expression) and very technical fields requiring a high level of expertise: take, for instance³, the civil law concept of *droit de la personnalité* also known as 'personality rights', which protects dignity, privacy and integrity and is considered part of a person's fundamental human rights: e.g. right to image,

³ The purposeful selection of this example serves to discuss the legal category of 'personality rights', which will be further addressed in these notes

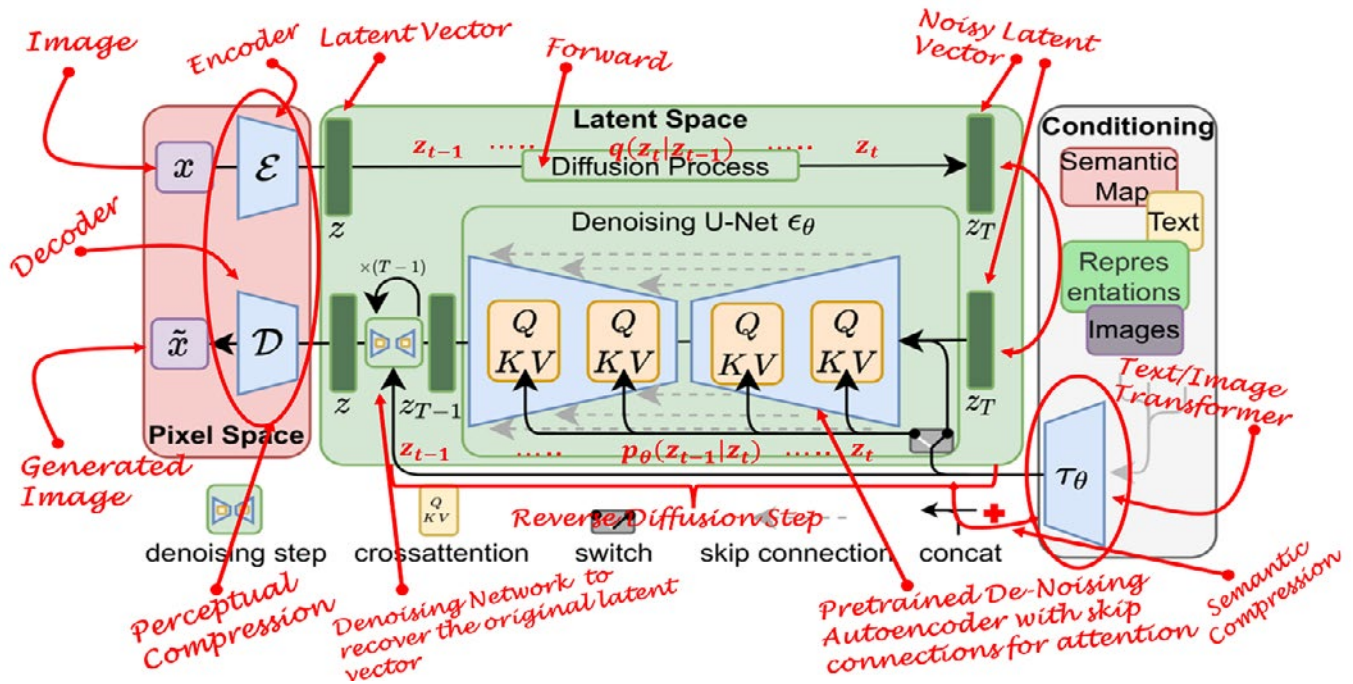


Fig. 3

name, reputation, honor, which in common law are encompassed by the so called ‘right of publicity’, the legal right of individuals to control the commercial use of their name, nickname, stage name, picture, likeness, image, identity, act, traits, walk, habits, style, reputation, etc., but they are also treated under the law of torts, e.g. defamation, invasion of privacy, etc. (Resta, 2011).

Lawyers are masters of other subjects that are fundamental to our discourse, from cybercrime to breach of contract and others. The following sections explore some legal challenges at the intersection of AI developments.

Education and Right to Work

“The Republic recognises the right of all citizens to work and promotes those conditions which render this right effective (Article 4, Italian Constitution).”

News like the this is often read:

“Between 2024 and 2029, generative artificial intelligence will result in the loss of 14 million

*jobs”*⁵;

*“Companies would use A.I. to eliminate a quarter of all current work tasks in the United States and Europe.”*⁶

But there is also information of the opposite kind:

“Skills related to communication, problem-solving, creativity, and teamwork gained relative importance over time, as did complementary software-related and AI-specific competencies”;

*“AI has huge potential to drive growth and create jobs”*⁸

The information available on analog media and on the World Wide Web is often ambiguous, requiring the ability to understand uncertainty (Morin,

⁵ World Economic Forum, Aprile 2023 <https://initiatives.weforum.org/ai-governance-alliance/home>. OA.

⁶ Goldman Sachs, “Global Economics Analyst: The Potentially Large Effects of Artificial Intelligence on Economic Growth” (Briggs/Kodnani) 26 March 2023. OA.

⁷ OECD Science, Technology and Industry Working Papers (2021), https://www.oecd-ilibrary.org/science-and-technology/demand-for-ai-skills-in-jobs_3ed32d94-en. OA.

⁸ “A pro-innovation approach to AI regulation” Updated 3 August 2023, Policy paper presented to Parliament by the Secretary of State for Science, Innovation and Technology by Command of His Majesty on 29 March 2023, cf par. 20, <https://www.gov.uk/government/publications/ai-regulation-a-pro-innovation-approach/white-paper#fnref:12>. OA.

⁴ English version of the Italian Constitution https://www.prefettura.it/FILES/AllegatiPag/1187/Costituzione_ENG.pdf. OA.

2015), by interpreting different modalities of partial and progressive assertion, correction, and self-correction, falsification and revision (Lorusso, 2018). These pieces of information, easily found online, don't necessarily generate knowledge, but rather evoke sensations and emotions. They contribute to raw data expressed as opinions in social network communications and informal online texts, which are then subjected to text and data mining by AI systems. There is also the question of how to use data related to the emotional sphere, since a person's perception of what is positive or negative depends on many factors, such as their life experience, personality, etc. (Thelwall, Wilkinson, Uppal, 2009).

The quality of these datasets is an important concern, which is also addressed in the European Artificial Intelligence Act currently under approval⁹. Quality includes the production of technical documentation, compliance with EU copyright law, and the dissemination of detailed summaries of the content used for AI training. However, it is not easy to find first-hand sources for verifying the quality of data, and the very notion of a "source" becomes a challenge as it loses its effectiveness by fading into the murky opacity of the data used for AI training. Beyond the difficulty of obtaining official or authoritative sources, there remains the problem of defining the meaning of "authoritative" and its paradigmatic value for research in contemporary social sciences.

Complexity is inherent not only in the collection of data, but also in the communication phase, especially through media such as infographics and data visualization (Sinni, 2023). In infographics, designers selectively present only the information that is deemed important for communicating a particular concept. Data visualization involves the visual representation of both quantitative and qualitative information to facilitate dissemination, analysis, and exploration. While visualizations enhance the communicative value of data, they are susceptible to manipulation by less scrupulous, opaque, or outright deceptive techniques. In practice, information is always subject to transformation (Kazakoff, 2022), while the

critical levels of indeterminacy and uncertainty persist and must persist in the transformation process. According to the paradox of communication (Eco, 2016), indeed, the creation of space for the unexpected and uncertainty is essential for information to exist. This space allows for continuous exploration of details and unlimited search for additional information. The role of the information designer is to ensure this space and to explicitly communicate the degree of uncertainty affecting the data using perceptual aids and graphical techniques such as color, saturation, blurring, or resolution (Burgio, 2021). Effective design of data visualizations and infographics should rely heavily on visual storytelling as the most effective method of highlighting connections and guiding the reader to insights that may remain hidden in a mass of data. Unfortunately, this type of information design is not widespread, just as the public's ability to decode the meaning of complex images such as visualizations is limited and may even be lower than their comprehension of written text (Cairo, 2019).

A recent report by 2023, *The Future of Skills*

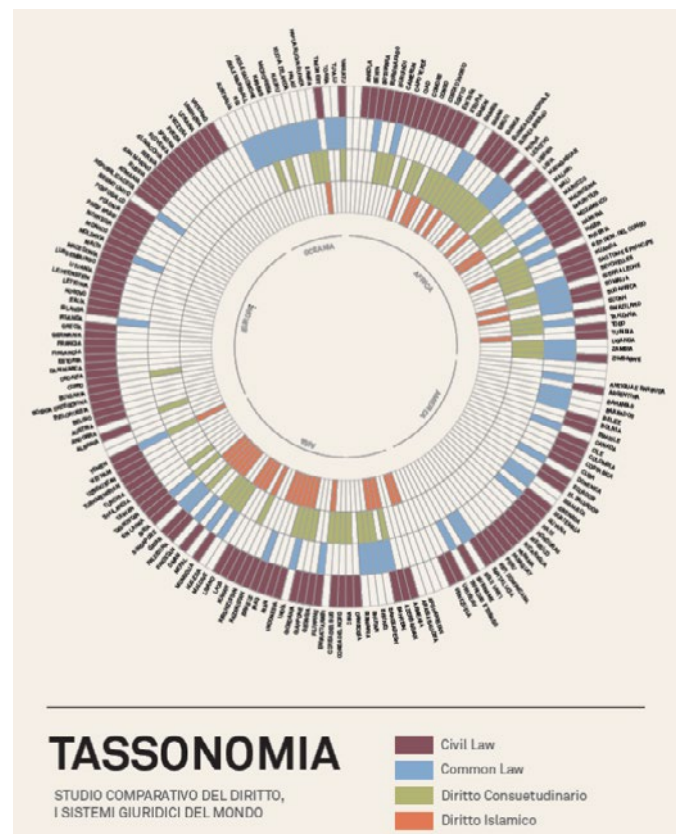


Fig. 4

⁹ A provisional agreement on the proposal of Regulation on harmonised rules on AI in Europe has been reached on the 9th, December 2023, a synthesis is available here: <https://www.consilium.europa.eu/en/press/press-releases/2023/12/09/artificial-intelligence-act-council-and-parliament-strike-a-deal-on-the-first-worldwide-rules-for-ai/>. OA.

*in the Era of Artificial Intelligence*¹⁰, can shed light on these issues of data transparency and opacity. The study produced predictive models of job demand and skill-set transformation across various occupations using a complex algorithmic pipeline for data collection, categorization, and processing. Despite this, the datasets used by the AI to make predictions remain hidden, making their robustness and reliability unclear.

For example, industrial design graduates have a remarkably high mismatch index (98.9%)¹¹, suggesting that skill reorganization (such as the introduction/elimination of certain skills and their cross-fertilization) is an imperative change for labor market demands.

The study suggests an increase in skills mismatch for most occupational groups and programs compared to those demanded by the labor market, and implies a potential need for intervention in university curricula to align with evolving occupational skills. However, it also shows that the widespread use of AI and other technologies will have a disproportionate impact on lower-skilled occupational groups, reducing the demand for jobs by 2030, while intellectual occupations, especially in highly specialized creative fields¹², are expected to remain unaffected¹³. Ultimately, this may suggest a need for education and training reforms¹⁴, but it is important to note that thorough fact-checking dispels claims that AI poses an “extinction risk”¹⁵. In fact, AI is currently “the shortcut” that almost everyone uses to create various types of content, including movies, books, avatars, and digital

environments. Not by chance the term shortcut has been used by Virgil Abloh, founder of the Off-White brand in 2013 and art director/designer of the Louis Vuitton menswear collections from 2018 to 2021, to define his personal procedure as “in tune with the readymade, because to renew an object you only need to modify it by three percent (...)” (Abloh, 2018). Generative AI, in particular, can be seen as both a valuable tool and a threat¹⁶.

Artificial Intelligence, Fashion Design, and the Law

As is well known, AI is a broad concept that encompasses a variety of tasks using techniques such as machine learning, deep learning, and rule-based systems. It involves the creation of computer systems or programs capable of performing activities that typically require human intelligence, such as learning, reasoning, problem solving, perception, language understanding, and decision making. AI can be broadly categorized into two types: narrow or weak AI, designed for specific tasks, and general or strong AI, which possesses human-like intelligence for a wide range of intellectual tasks.

Within AI, generative AI is a subset that focuses on content creation, using techniques such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) to generate new data or content based on learned patterns from existing data sets. For example, Amber Jae Slooten’s work uses GAN algorithms to process photographic images from Paris Fashion Week 2021. GANs are machine learning systems that use interacting neural networks to extract recurrent rules in shapes, colors, and combinations. These algorithms involve two digital models, one providing input data and the other estimating the probability of influence and checking for errors. For her 2018 Deep collection, Slooten collaborated with the Asimov Institute to develop a GAN that processed photos from Fashion Week. The surprising results were used to generate pixelated images that inspired the design of the collection’s pieces (Ciammaichella, Monti, 2024).

10 EY, ManpowerGroup, Sanoma Italia, November 2023, available only upon request at the link https://www.ey.com/it_it/news/2023-press-releases/11/nuovo-studio-di-manpowergroup-ey-sanoma.

11 Table 6 on page 122, of the Report quoted in the previous footnote.

12 Cultural and Creative Industries (CCIs) have been defined by the European Commission as follows: “CCIs encompass a wide variety of sub-sectors. This includes architecture, archives, libraries and museums, artistic crafts, audiovisual (including film, television, video games and multimedia), tangible and intangible cultural heritage, design (including fashion design), festivals, music, literature, performing arts, (including theatre and dance), books and publishing, radio, and visual arts.” https://single-market-economy.ec.europa.eu/sectors/cultural-and-creative-industries_en. OA.

13 Table 56, page 130, of the Report quoted in footnote 9.

14 As early as 2018, the European Parliament Resolution made Recommendations to the European Commission on Civil Law Rules on Robotics, and underlined the importance of appropriate education, training and skill strategies for matching the needs of the so called ‘robot economy’ (2018/C 252/25), OA.

15 Cf The Statement on AI Risk, May 2023, available at <https://www.safe.ai/statement-on-ai-risk>. OA.

16 Cf the <https://alai-paris2023.org/en/questionnaire/>. OA. ALAI 2023 Conference on Literary and artistic property through the prism of artificial intelligence. ALAI (Association Littéraire et Artistique Internationale) is an independent scholarly society dedicated to the study and discussion of legal problems arising from the protection of the interests of authors and other creatives.

Metaverses and fashion design

Generative AI plays a central role in metaverses, which are virtual, immersive, and interconnected digital spaces where users interact with computer-generated environments in real time. The idea of the metaverse, which originated in science fiction some thirty years ago, has gained considerable attention with technological advances because metaverses go beyond traditional two-dimensional online experiences. They provide a three-dimensional, interactive, communal, and increasingly decentralized space, often using VR and AR technologies. Generative AI helps designers rapidly build these virtual worlds and also enables users to actively participate by designing virtual spaces, creating digital objects, and developing interactive experiences within the metaverse (so-called user-generated content UGC). Prominent brands are increasingly using metaverse platforms to increase consumer engagement and loyalty by overcoming geographic limitations. Fashion brands in particular are actively participating in the digital space and collaborating on innovative projects.

In 2021, the realm of disruptive fashion in the digital space saw various ventures, including Nike's Nikeland on Roblox, Ralph Lauren's Winter Escape on Roblox, and Balenciaga's collaboration with Fortnite, which allows players to purchase in-game clothing (skins) as well as real-world apparel. Moncler also partnered with Fortnite to offer a collection of digitally responsive clothing, while Burberry launched its first in-game NFT collection in collaboration with Mythical Games. Dolce & Gabbana unveiled Collezione Genesi, the first luxury NFT collection designed exclusively for UNXD. Adidas engaged with the NFT community through partnerships with Bored Ape Yacht Club, Gmoney and Punks Comic, creating a metaverse character named Indigo Hertz. The *Into the Metaverse* collection included 30,000 NFTs priced at 0.2 ETH each. In 2022, Tommy Hilfiger streamed a New York Fashion Week show on Roblox, and Nike collaborated with RTFkT on the innovative AR Genesis Hoodie, featuring both physical and digital versions for avatars. Louis Vuitton's June 2023 announcement introduced phygital 'treasure trunks' that cost 39,000 euros each and give owners access to future products, experiences, and a community. In addition, the fashion industry has embraced computer-generated personas, including Prada's Candy, a computer-generated avatar, and

virtual influencers such as Lu do Magalu and Lil Miquela, who gained popularity on Instagram as a California-based influencer, model, and singer. The user-friendly features of platforms like RED EYE, which include avatar creation with ReadyPlayerMe support and personalized room customization, have fueled the widespread adoption of virtual reality to communicate fashion content and themes. The Metaverse Fashion Week on Decentraland in March 2022 was a groundbreaking event, allowing users to virtually attend shows and participate in shopping experiences without restrictions. Platforms like Decentraland, a fully decentralized metaverse owned and governed by its users, allow users to create their own virtual worlds, providing a new realm for individual expression in the metaverse. Not all platforms have the same characteristics.

Some platforms are 'open', e.g. such as Opensea, the first decentralized NFT marketplace platform, or Rarible; some others are open but 'exclusive' - such as Foundation, which sells only a specific type of digital asset, digital art collectibles; others are more a mix of social media and NFT marketplace platforms - such as SuperRare, which provides innovative ways to appreciate, collect, and interact with digital art. Spatial is another notable open platform where content creators and visitors can design 3D spaces to showcase art, fashion projects, and other experimental endeavors within the metaverse.

In summary, metaverses share some basic characteristics in terms of social perception, economic model, and legal structure.

Metaverses are service platforms¹⁷, characterized by their emphasis on social interaction, serving as an imaginative platform for self-expression and activities such as playing, socializing, and attending virtual events. The concept of status and luxury extends into the metaverse, creating a unique space for user engagement. Decentralization is a prominent feature in recent metaverse developments, in line with the Web3 paradigm based on blockchain technology. This challenges the dominance of big tech companies and introduces

17 The Digital service act package -the Digital Services Act (DSA) and the Digital Market Act (DMA)- came into force at the end of 2022, and it will apply to all platforms (even to online intermediaries established outside the European Union that offer their services in the single market) from 17 February 2024. See <https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package>. OA.

decentralized finance (DeFi) models through DApps, revolutionizing economic transactions in the metaverse. In fact, metaverses have their own economies that allow users to buy, sell and trade virtual assets: by adopting a freemium model (through which these platforms generate revenue by selling accessories and skins) and, more and more often, blockchain technology (used to secure transactions and authenticate ownership through non-fungible tokens NFTs), these digital spaces are establishing a decentralized economy.

In the fashion industry, blockchain can be used to validate rights, authorship, traceability, and manage intellectual property through smart contracts. As a digital ledger, blockchain technology is designed to record business transactions, allowing a fashion item to be traced from its design process to its purchase.

Metaverse also aligns with the growing sustainability demands of the fashion industry. Studies show that digital clothing, which exists solely in the virtual realm, is significantly more environmentally friendly than its physical counterpart, with a 97% reduction in CO2 emissions and a significant reduction in water consumption (Yan, 2022). Replacing physical samples with digital equivalents in the design and development phase of products has the potential to reduce the carbon footprint by up to 30% and directly address environmental concerns such as water consumption, pollution, landfill contamination and animal rights violations, thus reducing pollution in supply chain logistics. In addition, the use of digital apparel is proving beneficial in pre-production processes such as modeling, sampling and marketing, minimizing the overall environmental impact throughout the lifecycle of a fashion item prior to physical production. In this regard, metaverses and digital twin technology offer a solution to the challenges faced by fashion companies, such as allowing customers to virtually try on garments through their digital twins. Digital twins act as dynamic representations of physical things, capturing operational data that is analyzed by AI algorithms to provide valuable insights. With sensors relaying information and two-way Internet of Things (IoT) object connections, this technology can synchronize the digital environment with the physical world and vice versa. Any change or movement in the material world is reflected in the digital representation of the twin. In this case, the metaverse ingests, mines, and responds to masses of data almost instantaneously. This

approach can reduce size-related returns, improve customer satisfaction, and create value for both fashion companies and the service platforms that support this technology. Embracing the metaverse is therefore essential for fashion brands that want to adopt sustainable practices (Periyasami & Periyasami, 2023).

Some legal issues

There are many issues of interest to legal experts in the context of generative AI and metaverses.

In open metaverses characterized by extensive user-generated content (UGC), users can modify the core elements of digital environments and introduce entirely new functionalities related to various content they create, such as virtual real estate, digital art, fashion and design objects, and others. Much of the content uploaded by users can qualify for copyright protection if it meets the criteria of being the Author's Own Intellectual Creation (AOIC), reflecting the author's personality and involving his or her free and creative choices - a standard known as the European AOIC test. However, in exchange for access to many of these metaverses, users are required to grant these platforms a broad license over the content they share, including text, video, and images.

This meant that users had to grant the platform significant rights to use and distribute their UGC. Often, Terms of Services (ToS) not only influence the commercial use of copyrighted user-generated content (UGC), but also affect users' freedom of expression online (Macmillan, 2020), as the platform's standard contractual rules governing the availability, accessibility, visibility, and removal of such content can significantly affect this fundamental freedom for users (Quintais, De Gregorio, Magalhães, 2023). In addition, users can create and manage multiple digital identities, each with unique characteristics and attributes. Protecting against avatars (when they are manipulated to commit fraud through malicious acts on behalf of the people behind them) and our avatars (which represent an extension of our digital identity) in metaverses can be a matter of great concern. This could not only be a threat to one's reputation, but also potentially result in real-world liability for the individual involved (Cheong, 2022). These digital embodiments go beyond static images and can also reflect our identity and personality through physical aspects, gestures, sounds, and movements. This is a complex issue that raises many legal concerns in terms of the protection

of personality rights (mentioned above), such as the right of publicity, to prevent one's image from being commercially exploited without permission or compensation, and also the right to privacy, to be left alone, and not to be publicly represented without permission.

Understanding the management of copyright and intellectual property rights in the context of digital reproductions presents other challenges, including: a) determining the usability of archival datasets, as many databases¹⁸ lack clear policies on how their contents can be used for personal and/or commercial purposes; b) determining whether a work is out of copyright or in the public domain, given the lack of full harmonization of copyright law in Europe (Sganga, 2023; Rosati, 2023);¹⁹ and especially within the Western legal tradition, including common law countries; c) understanding fair use policies in Anglo-American terms, which do not fully correspond to the European system of exceptions and limitations to copyright; d) defining when a work of art or design resulting from adaptations of an original work is considered a derivative work and requires the permission of the original author.

Even when works are in the public domain, obstacles arise due to the interplay between cultural heritage law and copyright law. Indeed, Articles 107-108 of the Italian Code of Cultural Heritage and Landscape grant the public authorities extensive control over the digital reproduction of cultural property²⁰, thus limiting access, in terms of reuse, to this material by individuals and collectives. Specifically, the Cultural Heritage and Landscape Code will be applied if I were to create a virtual space within these metaverses using digitized material of landmarks such as the Colosseum or the Leaning Tower of Pisa, Michelangelo's David, or Leonardo da Vinci's Vitruvian Man (Caso, 2023; Dore, Beltrame & Buunk, 2021). To put it simply, in Italy these are cultural objects and are protected by the above-mentioned code, while

the concept of freedom of panorama²¹ is essentially absent.

This intertwined and strict legal framework creates ambiguity as to whether cultural heritage or copyright law applies.

As noted above, in metaverses, users can create digital content that may be protected by copyright (if it passes the AOIC test), but copyright may conflict with intellectual property (IP) rights owned by others, such as trademarks, copyright-related rights such as photographers' rights, sui generis rights of database makers (those who take the initiative, risk, and investment in obtaining, verifying, or presenting database content).

And what if copyright is at odds with AI-produced works (Iaia, 2022)?

When the algorithm is fed with data (input phase), the processed data may refer to works (or parts of them) that are protected by copyright, or by specific protections such as those for databases, at least in the European Union: as we said above, we cannot 'open' a database and indiscriminately use everything it contains, or delete all the social platforms without thinking about the consequences.

There are copyright exceptions and limitations for what is called Text and Data Mining (TDM)²²: for research and educational purposes, and for any "lawful access" to content that is "freely available to the public online", but it is uncertain whether the notion of "lawful access" includes content made available online without the consent of the rights holder (Margoni, Kretschmer, 2022). AI training does not automatically qualify as an "educational activity" (!) that we perform on the machine. There are numerous ongoing cases, such as the well-known US District Court for the Northern District of California, 2023, in which some visual artists filed a copyright lawsuit against Stability AI, Midjourney, Dall-E, Devian Art and others for using their works to train generative AI²³; or

18 Cf Directive 96/9 that protects databases by copyright and by the sui generis right; both can apply if the conditions of protection for each right are fulfilled. It has been transposed in Italy by Legislative Decree no. 169/1999.

19 Cf Directive 2019/790 on copyright and related rights, transposed in Italy through Legislative Decree no. 177/2021, that introduced amendments to Italian Copyright Law, no. 633/1941.

20 Cultural property is defined into Article 2 of Legislative Decree 42/2004 (Code of Cultural Heritage and Landscape), as amended.

21 Cf Directive 2001/29 on copyrights and related rights in the information society: Article 5, para. 3, h), that introduced the freedom of panorama (or panorama exception): that is the users' freedom to take photographs, make videos (also for creating derivative works in the digital realm) to buildings or monuments or other cultural objects, which are visible at public spaces, and are not private. In some jurisdictions (Germany), it also covers indoor spaces, such as public museums, public libraries, etc., and in almost all jurisdictions (for example, Germany and France) the reproduction of the work is not allowed if it is done for a commercial purpose. Italy did not implement the provision.

22 Cf Directive 2019/790, Articles 3-4 (and others EU acts).

23 See at <https://tmsnrt.rs/46G3nBo>. OA.

the Getty Images against Stability AI, some legal proceedings in the High Court of Justice in London and in the United States District Court in Delaware, 2023, for Getty copyrighted material was (mis) used to train AI models²⁴. Similar lawsuits are also pending against Meta Platforms, Microsoft, GitHub and Google (Campus, 2023).

Therefore, the extent to which this input stage data (copyrighted images, text and video) can be used for training remains unclear, creating fascinating fair use battles (Frosio, 2023).

On the other hand, when the algorithm generates content (output phase), the problems are no less significant. Who owns the copyright to the artistic work or the patent rights to the invention generated by an AI system? As the DABUS dispute shows, where Mr. Thaler, owner and creator of the AI machine DABUS, claimed that AI can be the inventor²⁵, the machine, being non-human, currently lacks the basic requirement for recognizing authorship: an embodied human intelligence; however, there are no definitive answers. The United States Copyright Office, for example, has stated that only human creativity can be protected by copyright or patent; other offices, such as South Africa²⁶, have taken a different position, recognizing the “artificial inventor”. Other interpretations propose copyright or patent protection based on the presumption of a “joint creative effort” between the machine and the author(s), which may be multiple. So far: the artificial intelligence system, the designer, the programmer, the user-content creator; or no one, but the collective (Rotolo, 2023; Riccio & Rotolo, 2021; Ajani, 2020; Gervais, 2020; Ginsburg 2018).

Enforcing copyright, patent, or trademark laws in the metaverse is one of the greatest challenges of our time, in part because it is not easy to identify and hold users accountable for violations. For example, users can share content semi-publicly: users can create “movie worlds”, virtual spaces in the metaverse where embedded video players illegally stream copyrighted movies in real time. These spaces can be semi-public (publicly listed with access restrictions) making it difficult for

copyright owners to monitor them.

Metaverses need to proactively prevent intellectual property (IP) infringement in real time, rather than dealing with it after it has occurred.

The use of blockchain technology increases the complexity of tracing individuals and holding them accountable for infringement, due to the privacy and pseudonymity that blockchain provides.

In particular, a significant portion of copyright infringement cases in the metaverse are related to non-fungible tokens (NFTs)²⁷. NFTs, which are described as units of data stored on a digital ledger, typically a blockchain, are unique and designed to authenticate ownership of virtual assets and their provenance; they record the creation and ownership of an asset that could be a work of art or similar, but is not a work of art or similar. When we acquire an NFT, we gain exclusive access to and authority over the smart contract associated with the NFT, which is stored on the blockchain. This creates a record that identifies us as the “registered owner” of both the NFT and the associated artwork. NFTs do not automatically grant copyright; the buyer and the creator of the NFT can enter into an agreement to assign or license the copyright (Murray 2023). Typically, smart contracts²⁸ convey licensing terms in their code. In such cases, the blockchain will not only record the sale, but also all other contracts related to the work, providing greater certainty about the rights acquired. There are numerous legal aspects related to blockchain and smart contracts that we do not want to touch upon in these notes. The convergence of intellectual property law and privacy and data protection law raises other concerns: about compliance with data protection

24 See <https://www.thefashionlaw.com/stability-ai-cant-escape-getty-images-copyright-lawsuit-in-uk-court-says/>, December 5, 2023. OA.

25 See European Patent Office (EPO), patent applications EP18275174 and EP18275163.

26 See The Patent Journal, July 2021, VOL 54 No. 07 at 255, URL: <https://artificialinventor.com/patent/> OA.

27 Ethereum’s blockchain, using its ERC-721 standard token, is commonly employed for NFTs. An NFT is non-fungible because it is unique and cannot be replaced by another token. In contrast, cryptocurrency are fungible tokens.

28 To name just one related to what a smart contract is, we can highlight that there are at least four different hypotheses: 1. it may refer to mere code and there is no contractual agreement behind it; 2. there may be an off-chain contract, i.e., outside the blockchain upstream that oversees the execution of the agreement; 3. there may be a legally binding declaration of will on-chain; or 4. there may even be an on-chain and off-chain contract. This again highlights the complexity. Cf ELI Principles on Blockchain Technology, Smart Contracts and Consumer Protection, Report of the European Law Institute, 2023. OA.

laws²⁹ as well as legal rules on open data and the reuse of public domain information³⁰, for both commercial and non-commercial purposes. Most often, the concerns relate to personal data, previously defined as sensitive data (such as IP addresses, vehicle license plates, facial images, names, surnames, health-related data), which in Europe fall under the protection of the GDPR. Sure, let's pause here. The intention was to reflect on the complexity of this fragmented regulatory framework, rather than to try to solve highly complex issues.

Summary and conclusions

Complexity permeates the 'behind the scenes' of generative AI and metaverses, revealing the intricacies of their construction.

Large Language Models (LLMs) are widely used in these digital ecosystems to generate content, such as OpenAI's various versions of ChatGPT, Google's Bard, Amazon's Bedrock, Baidu's Ernie Bot, Huawei's Pangu- Σ , Anthropic's Claude, Musk's xAI, Quora's Jais in Arabic, and DATABRICKS' open-source Dolly 2.0, to Google DeepMind's recent Gemini: they can understand, operate on, and combine different types of information such as text, code, audio, images, and video. Also, 3D image and scene generation systems such as Stable Diffusion, Midjourney, Dall-e, or HOSNeRF based on Neural Radiance Fields (NeRF) technology, which generate 3D scenes or dynamic videos from 2D static images, are widely used and adopted by young designers. The list is growing. All models have one basic element in common: they are trained to follow instructions and provide detailed responses to prompts, much like powerful search engines that generate output based on training data and information gathered from the Internet. For now, natural intelligences query artificial intelligences, not the other way around.

So, to get to the fateful question: Is generative AI a means by which the human creative process is realized, like the camera, the brush, or the sculptor's

chisel? AI can be seen as another tool, though not an ordinary tool, but one that "massages us much more than usual" (McLuhan, 1967) and, like other tools, is transformative. Taking a neutral perspective on this transformative effect of AI, we can say that it's a matter of contexts and perspectives, as illustrated by a scene from the film that is part of Western visual and material culture, 2001: A Space Odyssey by Stanley Kubrick. Consider the moment when the monkey throws a bone (which is also used as a tool to kill, as the following shots show) into space, and the bone turns into the spaceship... what does that mean? Tools change and become more powerful. From Homo faber to the techno infosphere, humans have always invented tools that allow them to go beyond the limits of their place and explore possible worlds.

From simple mechanical prosthetics (hammer, scissors, and chisel) to sensorial prosthetics (glasses, microscopes, telescopes) to intellectual prosthetics (language, writing, computers) to syncretic prosthetics, where different types of prosthetics converge in a functional aggregation, such as intelligent robots (Maldonado, 2005, 14). Until robots reach a state of absolute self-reference and self-sufficiency, guided by a self-designing and self-programming AI, they will remain our creation.

In conclusion, generative AI and metaverses highlight the need for a multidisciplinary skill set for future designers. Among the future professional figures, there will be a need for designers who can formulate appropriate prompts, work on language(s), and verify that their algorithmic translation makes sense; use generative AI to improve user interfaces and experiences for virtual and physical products, personalize digital content to ensure a tailored user experience, create immersive and engaging communication experiences within metaverses, create virtual prototypes of physical products to allow testing and refinement within metaverses; or present virtual product collections within metaverses, blending design and storytelling. In fashion design, for example, new professionals will specialize in designing virtual clothing and accessories within metaverses, creating digital textiles and patterns for virtual fashion items, exploring innovative materials and styles, curating virtual fashion collections and experiences within metaverses, and blending art and fashion.

It is essential that designers are deeply engaged

²⁹ For instance, the General Data Protection Regulation (GDPR) in the European Union, the Health Insurance Portability and Accountability Act (HIPAA) in the USA, or the Children's Online Privacy Protection Act (COPPA) in the USA, and the Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada.

³⁰ Cf Directive 2019/1024 on open data and the reuse of public-sector information, the transposition of which came into the Italian Legislative Decree No. 36/2006 (recast).

in these transformations (Cianfanelli, 2019), fostering a bottom-up “AI by design”. Generative AI and metaverses require cross-disciplinary teams where even a new language will be invented just to communicate with each other.

Captions

[fig. 01] Anatomy of an AI System: The Amazon Echo as an anatomical map of human labor, data and planetary resources, by Kate Crawford and Vladan Joler (2018)

[fig. 02] Black Box Cartography – A critical cartography of the Internet and beyond, by Vladan Joler, Francesco D’Abbraccio, Andrea Facchetti (2023)

[fig. 03] AI model. Stable Diffusion, by Michale Wu, How to protect your online art from being used to train AI Models (OA)

[fig. 04] a project by Carbone and Del Debbio, Course: Laws, Markets, and Globalization, led by Barbara Pasa. Bachelor’s degree program in Design, University Iuav of Venice, 2018-19.

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Sitography

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OVERCOMING THE CREATIVE CRISIS OF THE FASHION INDUSTRY

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Abstract

The paper uses the advent of generative AI in fashion to critically examine the tenets of contemporary fashion design. As an exemplary case study, the work of Demna Gvasalia's at the helm of Balenciaga is critically scrutinized and discussed as the result of the fashion industry's ever-increasing speed and high demand of products at every price range. Within a hyper-globalized industry, fashion designers are forced to accelerate their design process with low production costs and high profits in mind. Given the systematic denial of fashion design understood as intentional creation by mainstream luxury fashion labels, fashion's creative process is already heavily revolving around self-reference and copying, much like generative AI. The integration of visual literacy and academic referencing competences in fashion design education are proposed as strategies to break the cycle of copying and self-reference in fashion and to expand, deepen and diversify the practice of fashion design.

Keywords: *Fashion Design, Fashion Industry, Artificial Intelligence, Research Competences, Visual Literacy*

Introduction

“The End of Fashion” was the title of a book published in 1999 by Wall Street Journal fashion correspondent Teri Agins (Agins, 1999). In seven essays, Agins described the slow demise of revered Parisian fashion houses, and argues that garments designed with attention to details, complex construction and original silhouettes had been replaced by simpler, more wearable clothes inspired by street wear and pop culture. Agins concluded that the role of the fashion designer had profoundly changed: “Today, a designer’s creativity expresses itself more than ever in the marketing rather than in the actual clothes. Such marketing is complicated, full of nuance and innovation – requiring far more planning than what it takes to

create a fabulous ballgown, as well as millions of dollars in advertising.” (Agins 1999, p. 38-39) From a design historical perspective, Agins’s book was an attempt to articulate how the globalization and economic growth of the fashion industry propelled by multi-national luxury conglomerates was accompanied by the simplification of fashion design and the cutting of production costs for garments made for mass-consumption. Over twenty years after “The End of Fashion” was published, the hyper-globalized fashion industry shows no sign of defeat, and after a brief hiatus during the pandemic, it is still growing. The global fashion industry is valued at \$1.7 trillion as of 2023 and the number of retail sales in the fashion industry is expected to grow to three trillion USD by 2030 at an estimated annual growth rate of 5,8%

(Ariella, 2023).

We are currently witnessing yet another systemic transformation of fashion, and once again this transformation will have consequence on the creative practice of fashion design: the rapid evolution of generative artificial intelligence. In a report on generative AI in fashion published by the consultancy firm McKinsey in March 2023, a highly optimistic prognosis is made: “From codesigning to speeding content development processes, generative AI creates new spaces for creativity. It can input all forms of ‘unstructured’ data – raw text, images, and video – and output new forms of media, ranging from fully-written scripts to 3-D design and realistic virtual models for video campaigns.” (Harreis et al., 2023, p. 2)

This boundless confidence in generative AI makes sense from an economic perspective, as the nascent technology promises to “help fashion businesses become more productive, get to market faster and serve customers better”, to quote the McKinsey report again (ibid., p. 1). The fashion industry is a global behemoth with an enormous environmental and social footprint, and it is deeply entangled in the current climate crisis (Hibberd, 2018). If generative AI can augment the fashion industry and make it more efficient in its current hyper-globalized state, which aspects will be optimized, and which ones will become increasingly obsolete?

What makes contemporary fashion so ideally suited to be enhanced by generative AI? In this paper, I use the advent of generative artificial intelligence in fashion as a starting point to critically examine the tenets of contemporary fashion design.

My claim is that in the past decade, the fashion industry has paved the way for generative AI to take over its creative processes. The fashion industry has been suffering from a deep creative crisis for years, and I will use an exemplary case study to describe and analyze this crisis, and discuss the dedication to visual literacy and academic referencing competences in fashion design curricula to overcome the stasis of self-reference in fashion.

Self-Reference in Contemporary Fashion

A simple yellow cotton T-shirt with the red logo of global logistics company DHL, of all things, was one of fashion’s “key pieces” of 2016. The T-shirt was presented on October 1st 2015 during Paris Fashion Week, when the fashion show of Vetements’ women’s collection for Spring/Summer 2016 was opened by a shaven-headed male model.

It was Russian fashion designer Gocha Rubchinskiy, who wore the ominous DHL T-shirt under a plain black short-sleeved shirt paired with black leather trousers. Rubchinskiy is close friends with Lotta Volkova, who back then was the stylist and muse of Vetements designer Demna Gvasalia. The T-shirt sparked heated debates, not least because of its hefty price tag of 245 € and the provocation of turning the most mundane of garments into a high-fashion object. The almost identical T-shirt was also available in the DHL merchandising shop at a price of around 6 USD for orders of 250 or more. Nevertheless, of course, the version by Vetements became an internet sensation and purportedly was sold out in no time.

In an interview with the British daily newspaper “The Telegraph” a few months after the runway show, Demna Gvasalia explained the choice of printing a DHL logo on a T-shirt by saying that he is constantly confronted with DHL in his work and that DHL had therefore logically become part of the collection (Finnigan, 2016).

Indeed, DHL exemplifies the logistical challenges associated with the globalization and acceleration of the fashion industry. Shipping services like DHL ensure that fabrics, samples and collections arrive on time at factories, studios, showrooms and shops, that the tightly timed cycle of design, presentation, production and distribution runs smoothly, that delays and hold-ups in the production chain are made up for and that customers can hold the coveted pieces in their hands. Anyone who has ever bought fashion online knows about the fundamental importance of tracking numbers and the anxiety about missed DHL deliveries.

Marcel Duchamp originated the gesture of alienating an industrially manufactured object from its original purpose, placing it in a new context and declaring it a work of art. With the DHL T-shirt, Vetements re-signified a symbol of capitalist commodity circulation and declared it a fashionable “must have” in a process reminiscent of the alienating reinterpretation of the ready-made object in art. However, while Duchamp recalibrated the relationship between artist-subject and artwork-object with the famous urinal, a bottle dryer, a snow shovel and other so-called *objets trouvés*, the incorporation of the DHL T-shirt into Vetements’ prêt-à-porter show amounted to a shallow commentary on the fashion system’s fixation on logos, names and designers as celebrities (Titton, 2016, p. 72).

Retrospectively, it is mindboggling to reconstruct

the hype around that DHL T-shirt, and sadly, its story reads as a blueprint for what the rise of influencers and clickbait-marketing has grown into. Shortly after it was shown on the runway in Paris, the Vetements for DHL T-shirt was available online in much cheaper versions, as was the long black Vetements mackintosh presented in the same fashion show. For the fake version, the white logo lettering on the back of the rain coat was replaced with the word “VETEMEME”, thus creating a product that meme-fied the label, but also the corresponding virtual hype.

In October 2015, just days after the fashion show featuring the DHL T-shirt, Demna Gvasalia succeeded Alexander Wang as Artistic Director of the venerable Parisian fashion house Balenciaga. Since then, Gvasalia has essentially cloned the design strategy of Vetements at the fashion house owned by luxury conglomerate Kering. He has radically rebranded the company, and has turned Balenciaga into one of the most hyped global fashion brands. The brand became famous for drawing on an aesthetic of 1990s anti-fashion infused with post-Soviet nostalgia, and for elevating everyday garments into the high fashion sphere (Bartlett, 2019, p. 35). Gvasalia and his team design at Balenciaga revel in memories of their teenage years, of a time before the internet and the constant availability and global dissemination of fashion images, when all you had to keep up with trends were fashion magazines that were difficult to get, and when styling what you owned was the only fashionable resource available. In this sense, Balenciaga's fashion is not contemporary at all; rather, Gvasalia resuscitates fashion scenes from his past and mixes them with references to the work of 1990s anti-fashion designers like Martin Margiela. Gvasalia has turned Balenciaga into a fashion label that is based largely on internet hype and has turned a Parisian fashion house into meme fashion or Post-Internet fashion, making enormous profits from garments that are essentially Balenciaga merchandise sold at very high prices. The latest provocation by the brand is a skirt made out of a terry cloth towel sold at a price of 695 €.¹

The lack of refinement and creativity in Balenciaga garments and designs are compensated for by a skillful use of the aesthetics of contemporary dystopias. For example, in the campaign video

produced for the presentation of the Spring/Summer 2020 collection, a fake television news channel features models as news anchors whose facial expressions have been manipulated by AI. The model-avatars present fake news reports and encourage the viewers to buy Balenciaga sunglasses to protect them from an upcoming solar eclipse. The advertising campaigns of Balenciaga regularly draw on visual motives of the climate catastrophe (floods, wildfires) to sell merchandise, and the brand uses catastrophes of the present (climate change, mass migration, war) as aesthetic inspiration. The brand deliberately associates itself with new simulation technologies in its advertising campaigns and fashion events. The Balenciaga imaginary is animated with characters who are alienated from their reality, who wear even more alienating clothes, the textile wrecks of an urban uniform for a generation that refuses to signify an identity or that resorts to other means to construct an identity. In other words, Gvasalia has elevated copying to the leading design principle and trolling² to a PR gag at Balenciaga.

Balenciaga currently stands at the tail end of the long end of fashion declared by Teri Agins two decades ago: the brand thrives from its mass following in social media and season after season it repeats its formulaic, anonymized uniform of sweatshirts, leggings, denim, hoodies and oversize outerwear, like a very poorly prompted generative AI. Gvasalia's work at Balenciaga epitomizes the end of the cultural significance of fashion design: with his denial and devaluation of originality, creativity and experiment, and with little attention to details, materials, shapes and silhouettes, he has paved the way for fashion generated by AI. The Balenciaga garments (whether they are real or fake is irrelevant) all look the same, and they do because they lack the creativity and inventiveness that distinguishes fashion design as a unique craft tradition and *savoir-faire*. Of course, it is unfair to castigate Gvasalia alone for steering fashion design into cultural and social obsolescence. His work at the helm of Balenciaga is only the tip of the iceberg, and the result of an industry whose ever-increasing

1 <https://www.balenciaga.com/en-it/balenciaga-towel-skirt-beige-768726TPP919501.html>, last accessed on Dec. 26, 2023.

2 The Urban Dictionary defines trolling on the internet as “the deliberate act, (by a Troll – noun or adjective), of making random unsolicited and/or controversial comments on various internet forums with the intent to provoke an emotional knee jerk reaction from unsuspecting readers to engage in a fight or argument.” See <https://www.urbandictionary.com/define.php?term=Trolling>, last accessed on Dec. 26, 2023.

speed and high demand of products at every price range force fashion designers to accelerate their design process, and to do so with low production costs and high profits in mind. Given the systematic denial of fashion design understood as *intentional* creation by mainstream luxury fashion labels, fashion's creative process was already heavily revolving around self-reference and copying. However, this time around it is the technology of generative AI that is drawing on auto-reference, prompted by fashion's own self-referential human protagonists.

Teaching Fashion Design and Visual Literacy

If fashion designs produced by generative AI are so uncannily realistic and often much more constructed and nuanced than the actual garments we can buy in stores, that has to do with the fact that AI is trained on already existing source material. If the source material consists of a visual fashion culture that is itself the result of a generation of fashion designers who draw on the same, repetitive and narrow visual canon, then it is the lack of creative power of human fashion designers like Demna Gvasalia that needs to change.

As James Hutson remarks, “the original human creativity that serves as the bedrock for the work generated is an inescapable factor that must be considered.” (Hutson, 2023) In fashion design, the creative process revolves around the conversion of creative ideas into shapes and silhouettes. How are these creative ideas developed? Sketching, drawing, experimenting with material on a doll, and making collages are among the ways to generate ideas, but also extensive primary and secondary research. It is at this crucial stage of design development that the process of fashion design can be expanded and deepened. A broader, expansive, extensive research praxis has the potential to open and diversify the creative process of fashion design, and ultimately, to have a lasting and systemic impact on the fashion system. I argue that the logic behind academic research should be incorporated into the practice of fashion design, so as to substitute the dictum of copying and referencing and to expand the practice of fashion design.

Between 2021 and 2023, I have co-supervised the development of research books with students in the third and final, fourth year of their studies at the Fashion Design diploma program at the Universi-

ty of Applied Arts Vienna³. As a starting point and on-going practice accompanying their design development, students were asked to put together a research book with a length of 150 pages for third year students, and 300 pages for diploma students. A selection of the most interesting research books was exhibited at the annual end-of-year graduation festival, and the research books were thus given equal weight as finished outfits and silhouettes. For their research book, students were encouraged to assemble visual and textual material from a wide variety of sources, and took part in a research strategies workshop led by myself. A crucial requirement for the research book was that every single item in the book – textual or visual – had to be included in a bibliography. This also means that every image had to have both a caption and a citation. In the research strategies workshop, students were taught not only how to properly reference images, but they were also introduced to research in the so-called “deep web”, that is, to research in the infinitely vast and ever-expanding world of databases, digital archives, catalogs and research tools. As an avid user of the deep web in my own research practice, I refused to merely send students back to the library as a panacea to cure their addiction to research in the so-called “surface web” (i.e., in social media and Google search). Rather, I persuaded my students to expand and deepen their research practice and to embrace curiosity and the quest for knowledge as guiding principles for their design development. They were motivated to cultivate a spirit of inquiry in their research process, and to use all the resources and tools available to them. In my experience, this approach was much more productive and constructive than demonizing online research in toto while glorifying research in the library with physical books as the only legitimate research strategy. The research book as a veritable catalog for design development stands in stark contrast to the mood board, a collage of “mute” images found for the most part on Pinterest, Instagram and Google Image Search. The mood board yields associative visual assemblages that might be aesthetically appealing and explorative, but it usually lacks complete, traceable and comprehensible informa-

³ British fashion designer Grace Wales Bonner was the head of the Fashion Design Department during this period and has introduced the research book into the list of requirements for fashion design students. She draws on an extensive research practice for her own fashion label but also in her projects as curator.

tion about the images it comprises, and therefore, it lacks crucial contextual knowledge about the authorship, history and layers of meaning that inform the visual material that often forms the basis of design development. The mood board contributes significantly to breeding the visual monoculture of fashion because it implicitly supports the outdated idea of the creative process as the result of spontaneous aesthetic inspiration and as an inherently unintelligible activity.

Visual literacy, understood as the capacity to read images, to place them in their context and to understand the many layers of meaning and history that images transmit, should be considered an essential skill in every academic fashion design curriculum⁴. Visual literacy should be integrated in the very process of design development with the requirement to provide essential contextual information about visual and textual material alike. By extension, this means that the praxis of academic referencing should not remain confined to subjects such as fashion history or cultural studies. The following quote by visual studies scholar James Elkins underlines the didactic potential of visual literacy: “It is time to consider the possibility that literacy can be achieved through images as well as texts and numbers.” (Elkins 2007, p. 5). While Elkins discusses visual literacy as an essential competence in the humanities, in particular in art history, I argue that it is equally important for design disciplines.

Conclusion

In the wake of the global uproar of the Black Lives Matter movement and the simultaneous quest for the decolonization of Eurocentric knowledge in institutions such as museums and universities, scholars and educators are faced with the challenge to update, deepen and broaden their syllabi and expand their research libraries (Cheang et al., 2021; Gaugele & Titton, 2019). Visual literacy is instrumental in decolonizing fashion education, which means first and foremost de-centering the Eurocentric view on fashion and assuming a multitude of perspectives on fashion, dress, clothing, culture, capitalism and politics. Given the enormous environmental footprint and

the human and societal cost of the fashion industry, it is our shared responsibility as fashion educators to work towards a better, more sustainable and ethical future. A commitment to visual literacy as the result of a deep and extensive research practice in every stage of the design process will contribute to educating students to think critically and develop design solutions that are conscious of the systemic crises the fashion industry is affected by and responsible for. An ever-growing and diversified sustainability movement operates on a local and global scale towards at least a mitigation of the effects of inevitable climate change and towards a renewal of the fashion industry. There are countless highly innovative, productive and constructive initiatives and propositions to address sustainability issues and to ultimately curb the uncontrolled growth of the fashion industry. While much scholarly attention and research has been devoted to the search for solutions to tackle the environmental and social crisis of fashion, the consideration of the creative crisis of the fashion industry deserves more academic interest and more attention from critical fashion scholars and practitioners.

Like every major technological evolution before, the rapid growth of generative AI puts long-standing hierarchies and long-held beliefs into question (Manyika, 2022). This historical moment offers the possibility to update the way in which we teach fashion design, and to move beyond the closed loop of self-reference, instead of just following the industry's beaten paths.

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⁴ For reasons of brevity, the many debates around the definition of visual literacy are omitted from this paper, but the interested reader is directed to the work of Elkins (Elkins, 2003, 2007).

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WEAVING FASHION WITH A.I.

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Abstract

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

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

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

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

Introduction

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

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

Personalised shopping experience

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

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

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

Supply chain optimization and quality control

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

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

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

AI-generated fashion

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

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

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

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

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

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

Biases in AI-powered systems

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

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

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

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

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

Bringing ethics and pluralism to AI-powered design

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

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

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

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

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

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

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

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

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

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

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

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

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

Feminist design as a way to AI-powered fashion

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

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

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

Pluralism

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

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

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

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

Participation

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

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

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

Advocacy and self-disclosure

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

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

Ecology

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

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

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POISONING ARTIFICIAL INTELLIGENCE

CONTEMPORARY FASHION AND JEWELRY ACTIVISM AGAINST SURVEILLANCE

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Abstract

Over the past decade, the proliferation of electronic devices, wearables, and information technology has enabled the collection and extraction of vast amounts of personal and behavioural data, penetrating our physical nature until biological. We are witnessing the gradual transformation of data mining into life mining. The big data collected feeds machine learning algorithms and artificial intelligence systems, which effectively implement real-time surveillance of our lives, mainly for commercial purposes. Starting from theoretical reflections on the human and non-human component inside AI, the essay identifies some projects by fashion and jewellery designers that subvert the ubiquitous surveillance system, acting concretely in specific processual and technological dynamics. By supporting a disruptive approach, the essay seeks to chart new spaces of design thinking that disobey or begin to question the prevailing logic involved in AI on our bodies.

Keywords: *Artificial Intelligence; Fashion activism; Contemporary Jewellery; Bodily Datification; Disruptive Design*

Artificial intelligence between humans and non-humans

In technical terms, Artificial Intelligence is the result of a branch of computer science that, since the 1970s, has developed algorithms capable of improving computational computation within hardware and software systems. Their evolution, by introducing machine learning - which consists of artificial learning through neural networks and databases - has led to the construction of functional systems increasingly similar to human intelligence, equipped with visual perception, understanding of space-time factors, and decision-making capacity. Influenced by the transdisciplinary nature that pervades design and the emergence of a range

of open software that has bypassed the ability to program, AI has also invaded the realms of design and fashion over the past decade. Among the most impactful industries in the world, fashion is also involved in the potential strategic and economic exploitation of AI. The opportunities for use propagate along the entire chain of design, production, distribution, and communication processes, ranging from the analysis of big data and giga maps to social computing, from the visual processing of images and videos to writing, from the construction of blockchain and NFT to the design of avatars and social influencers. The technological acceleration of AI we are witnessing is no accident but an integral part of the evolving nature of the human species. Bound by the

capitalist logic of maximum output in the shortest possible time, it pushes humans and machines towards more performative and immediate outputs, thinning the boundary between natural and artificial and, consequently, between human and non-human (Jacque et al., 2019).

Contrary to what we thought, instead of freedom given back in terms of time, resources, and opportunities, technology is also handing back a set of complex criticalities to manage. In this sense, the problem linked to advanced technologies, such as AI, concerns the observation of how contemporary individuals risk turning into passive subjects traversed by gigantic quantities of data that are difficult to understand and govern.

However, the terminological question can come to our aid and reveal new awareness due to its ability to bring the arguments back to the root: artificial intelligence is not correctly artificial but rather the result of a complex set of factual data produced by humans. Consequently, we can downgrade its dominant potential since it should be understood

primarily as a product of human creativity. (Dreyfuss, 1992).

From an extractivist perspective, relocating humans from a passive and defensive position to an active and co-creative one is essential. According to some studies, through a co-evolutionary relationship, we generate data at the same rate as they shape and modify our lives, becoming, at the same time, producers and consumers. (Iaconesi & Persico, 2021).

This alignment between technology and humanity leads to an ever-closer relationship between the artificial and the organic, the synthetic and the living, the human and the non-human. However, unlike living organisms, artificial intelligence often appears weightless on the horizon, penetrating the surface of things with difficulty. Far from organic bodies' granular, porous materiality, artificial intelligence's results are often reflective, lucid, and alien. The ever-changing and dazzling aesthetics and images that return to us in a continuous whirlwind of prompts seem like exoskeletons,

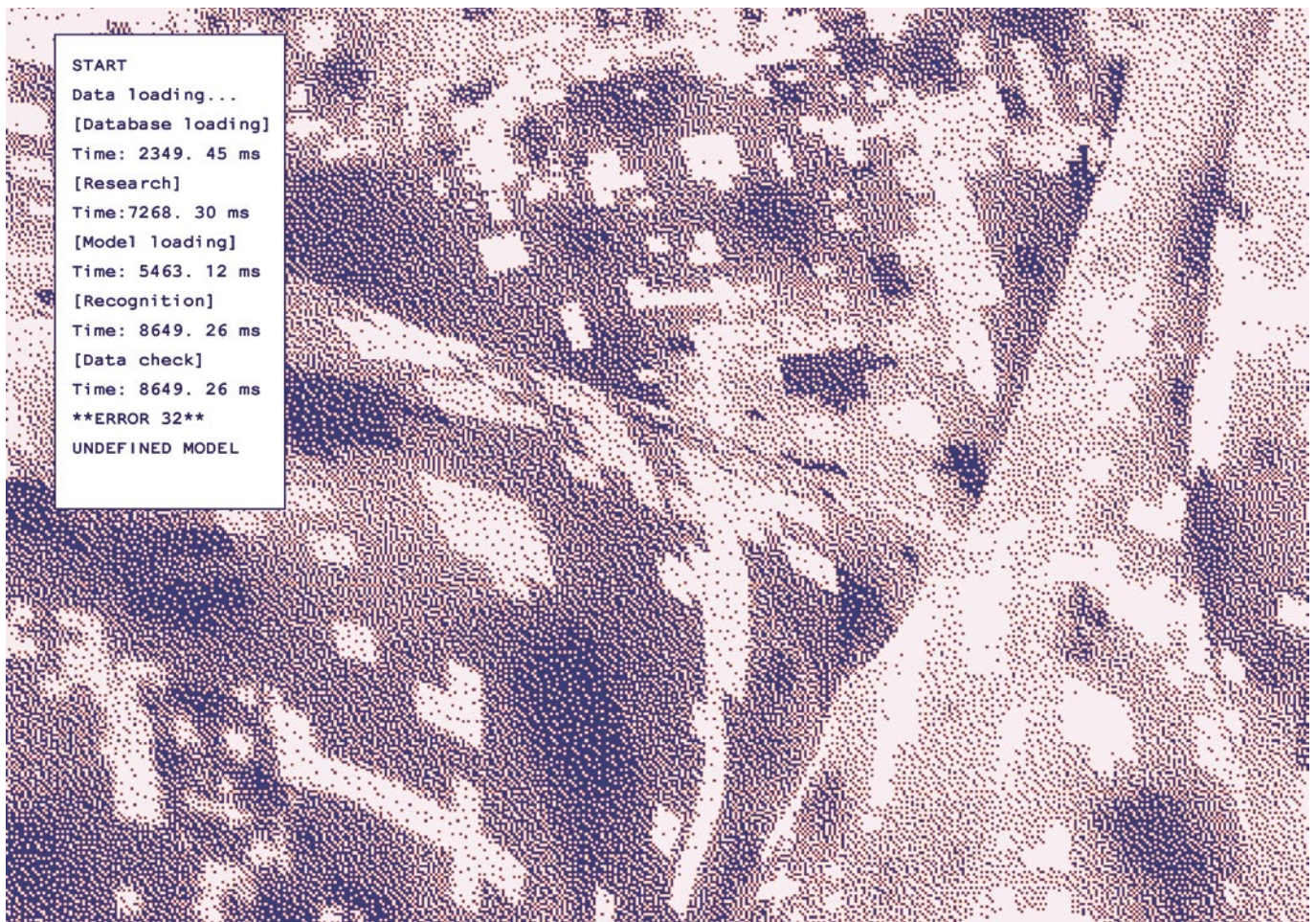


Fig. 1

beautiful empty shells devoid of consistent meaning. They emerge from the unknown, from remote places, from an unknown elsewhere. The indecipherable in the field of techno-informatics is depicted perfectly by AI. The crypticity hidden behind the computing capabilities of artificial intelligence has been the subject of contemporary art, film, and literature on several occasions and still represents an evolutive phenomenon that is difficult to interpret. Shrouded in an aura of mystery, AIs arouse curiosity and wonder and represent a valuable expedient for a visual imagination able to constantly reinvent new combinations contaminated by a weird taste. The problematic issues related to AI, both in terms of the free will of the human will and the protection of its privacy and space of existence, are inherent in the complex interaction between the human factor and the no-human one [fig. 01]. An interaction where the human being is more often a passive agent than an active one.

In the book *'New Dark Age'*, the British critic James Bridle states, *'We consider automated information more reliable than our own experiences (...) When confronted with complex problems, particularly under time pressure, people use the least amount of cognitive energy, preferring solutions as easy to follow as they are to justify.'* (Bridle, p.34).

This consideration is expressed in the complete confidence in machines, a faith that reinforces the prejudice that automated shortcuts are a priori more reliable than non-automated ones. In a way, AI rides on the biological human tendency to unquestioningly entrust a decision to a computerised system to optimise cognitive effort and time. Hence, there is the fear that AI-related technological advancement does not foster the evolution of deep critical thinking but is the beginning of a new way of co-creating more on the surface with the no-human.

Starting from these human and non-human relations, and also to avoid a loss of consciousness, the contribution intends to explore the theme of AI by applying it to the human body by identifying a series of critical design projects.

In particular, the intention is to focus on the individual's freedom through their physical body, related to contemporary fashion and jewellery.

If it is true, as Jean Luc Nancy states, that *"this body is not mine, but this body is me"* (Nancy, 1995, p.102), it is also true that the human body becomes

synonymous with local existence, occupation of space, personal thought, and the individual's inalienable right to do with it what they want. Our body indicates the space from which we can separate, multiply, expand, or, on the contrary, introject ourselves, protect ourselves, and live from within. Awareness of the ownership of our body as a *'datum'* can give us back, in this sense, the freedom to express ourselves, act, and become a *'numerical input'* or not of artificial intelligence. Insofar as bodies can open up and trespass, mingling with artificial intelligence and thus with non-human agencies, they become discursive phenomena, as continuous reconfigurations of the world, through which we can declare boundaries, properties, and meanings since boundaries never stand still.

Bodily Datification

The widespread deployment of personal electronic devices and information technologies (sensors, actuators, IoT, IoE), along with the pervasiveness of wireless communication technologies, enable the extraction of enormous amounts of data. These data describing the physical world's processes, phenomena, and behaviours populate and build an invisible cybernetic layer. In the virtual dimension, the collected information is accumulated to form massive databases and big *Data*, which feed the learning systems of Artificial Intelligence. Machine Learning algorithms process the data by returning representations of the corresponding physical entities and phenomena.

In addition, the miniaturisation of devices and increased computational capabilities have enabled collecting and monitoring increasingly accurate biometric data. Using bioinformatics technologies quantifies the self beyond epidermal superficiality and relates to our bodies' biological and organic nature (Mancuso, 2023). Indeed, sensors embedded in wearables are constantly connected to the network, enabling the process of dataification, that is, the transfer of more and more aspects of our lives in the form of data (Pedersen & Iliadis, 2020). These relate to the biological body and its computational image, composed of objective parameters and real-time data streams [fig.02]. The scenario described outlines a new Internet paradigm, surpassing the Internet of Things and Internet of Everything models, referred to as the *Internet of People* or IoP (Conti et al., 2017).

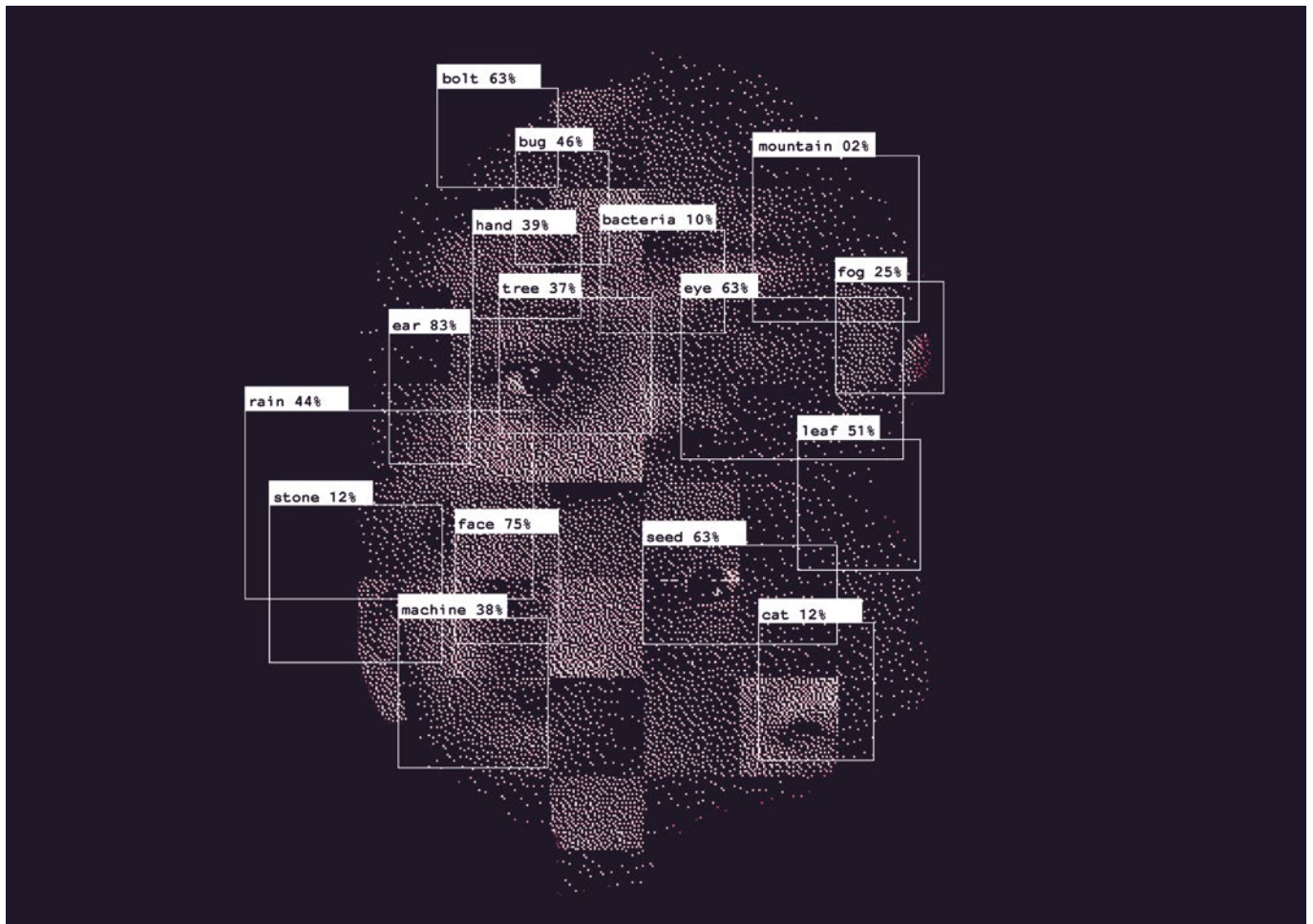


Fig. 2

Eye displays, virtual iris, hand recognition, tracking systems using satellite technologies, detection of heart rate, breath, body heat, and sleep monitoring are the technologies deployed today in both mobile phones and a range of wearables, wearable electronic devices, on the market. The body is no longer bounded by skin, a membrane separating the outside from the inside, but is enveloped by an intangible surface of information, communication and data collection.

Biofeedback systems and biosensors can monitor body processes and chemicals: they investigate physiological and biochemical processes by detecting the most common substances emitted by the body, such as enzymes, amino acids, and carbon dioxide; they assess the activity of the microbiome, the bacterial flora that influences our psycho-somatic state; and they quantify the external substances and pollutants to which bodies are exposed. The current relationship between the body, biosensors, 3D printing, DIY electronics

and fashion-oriented design is being explored by a growing number of designers who are exploring the possibility of hybridising textile and electronic experiments - soft circuits- capable of tracking the body's biochemical states and collecting data from the environment. Marco Mancuso points out that *“biosensors mediate new relationships, straddling medical practice, self-care, self-education, and collective knowledge”* (2023).

If collecting data encourages new practices concerning bodily and somatic knowledge, computational extractivism raises many ethical questions: the individual is transformed into a user profile composed of the summation of modelling data - personal, bodily, and behavioural. Moreover, machine learning algorithms make it possible to aggregate this information in an utterly never-seen way. Beyond the logic of classical statistics, neural networks identify correlations and create new associations between data according to criteria that are incomprehensible to users and even

programmers (Benasayag & Bastien, 2022). Personal information of various kinds is replaced by the objectivity of quantitative and numerical data in a new technocratic vision, datism, which considers the universe as a set of bit streams in which “*the value of each phenomenon or entity is determined by its contribution to data processing.*” (Harari, 2018, p.). As Harari points out, datism benefits from advances in the biological and computer sciences, asserting that biological or digital organisms operate according to the same mathematical laws. It blends the view of organisms as biochemical algorithms, inspired by Charles Darwin’s theory, with the capability of computer scientists to design and interpret digital algorithms in the wake of Alan Turing’s insights. This perspective erases the distinction between animals and machines, predicting that computerised algorithms will surpass their biochemical counterparts. This process builds up an algorithmic “*simulacrum of a dematerialised world*” (Benasayag & Bastien, 2022, p. 16) in which humans can no longer effectively distil information from data due to its vastness; they can only be interpretable by increasingly sophisticated processors.

From the life-mining to the *Adversarial Design*

The scenario outlined confronts us with what Braidotti calls the “*capitalisation of living matter,*” which reduces matter itself to its ability to transform both biological and intangible aspects into quantifiable information and values. Currently, the “real capital is the databases of biogenetic, neuronal, and media information about individuals” (Braidotti, 2020, p.67); therefore, “*data mining*” increasingly takes on the characteristic of “*life-mining,*” whose fundamental selection criteria are dictated by the degree of marketability of the data themselves. All these technologies are employed as surveillance devices (Braidotti, 2020, p.68) functional to generate an “*algorithmic governmentality*” detached from law, discipline and biopolitics. Subjects disconnected from the organic, social and symbolic dimensions of existence (Braidotti & Jones, 2022, p.11) are simplified and flattened by computational reality.

In this context, the design world does not relinquish the instrumental use of Artificial Intelligence. Wizinsky described the instrumental-

isation of design practices that conforming to market demands become useful means of data mining, manipulation, and exploitation for commercial purposes. “*Artificial intelligence creates a technocratic design in which data collected from billions of users are applied to generative methods of producing physical and informational products and services.*” (Wizinsky, 2022). Rather than developing new products, brands are more interested in proposing experiences and lifestyles supported by platforms and chatbots for sales assistance. The posthuman and neo-materialist approach to information technology could be a valuable tool to guide designers in delineating new realities that ethically incorporate A.I. technologies and to reorient and overcome this surveillance and control scenario. The Neo-materialist informatics (NMI) approach involves using data to imagine new assemblages of bodies and technology, models of “*alternative lives and even species*” divergent from current limited models (Braidotti & Jones, 2022, p.108). NMI is a multidisciplinary field that includes the humanities, social sciences, robotics, and artificial intelligence research. Taking up neo-materialist and post-humanist feminist perspectives, they intend to promote an approach to the design and development of technology that emphasises the active role in the reality-defining process played by non-human and technological agencies (Braidotti & Jones, 2022, pp.87-108). Following this approach, many designers and makers are adopting disruptive design practices and rebellion against the status quo, fuelling critical thinking, hypothesis formulation, imagining new models, and constructing narratives that move away from the contingent will of markets.

As evidenced by the case studies outlined in section five, designers employ a critical approach and make “*speculative design proposals to challenge narrow assumptions, preconceptions, and facts about the role that products play in everyday life.*” (Dunne & Raby, 2013, p. 34). Moved by ethical principles, they reflect on the possibility of a fair evolution of the relationship between humans and artificial intelligence. They highlight critical issues and distortions of a technocratic system, bringing out responsible process design and artefacts: objects capable of triggering divergent thinking, transforming the product from commodity to signifying object, able to promote an approach that allows people not to

be passively subjected to new technologies but to co-create with them. Design as a political tool is a discourse already initiated in the 1970s by Victor Papanek but which, considering the digitisation process, finds a re-actualization in *Adversarial Design* practices such as hacking, poisoning, and interference. According to Carl Di Salvo, design can play a political role in contestation by highlighting the inconsistencies of the productive and social systems. With such an approach, design becomes a tool to provide, acknowledge, and express dissent and to build pathways for change (Di Salvo, 2012, pp.12-13). Starting from the Critical Design framework, the antagonistic role of *Adversarial Design* results in artefacts that materialise and solicit recognition of political demands, express dissent, and advance claims. On a practical level, designers intersecting fashion-oriented design practices and hacker ethics try to shed light on political, social, economic, and cultural relations to identify new methods for contestation and new trajectories for action. As pointed out by Otto von Busch, “*hacking*” does not mean destroying the system but instead using design to manifest dissent, bring out the critical points of the current society, and actively promote development in a desirable direction through practical interventions (Von Busch, 2014, p.50).

The *Ubiquitous Surveillance* through A.I.

The *Internet of People* scenario outlined so far thus unveils how uncontrollable and profound the growing invasion of *A.I.-based* technologies and their absorption actions are now. Having highlighted the operations of bodily datafication and consequent tracking of biometric data, let us now turn our gaze to the *neuromarketing* and behavioural monitoring actions to which we are continually subjected online. We can speak of actual *ubiquitous surveillance* as the dominant mechanism of the contemporary scenario, which sees the invasion and appropriation of personal experience as the basis of a new economic order. Although we have already been surrounded for years by smart devices that can answer our questions and with which to engage in short conversations (think of Siri, Echo and so-called *conversational agents* or “CAs”), it is in recent times that the exaggerated rise of deep learning systems, based on self-learning, has fuelled doubts

about how they work and the obscure processes that govern them, in terms of privacy and protection of sensitive data. Companies such as Google or Apple have long understood the immense potential that the action of collecting data from users could have in the dynamics of contemporary digital capitalism (Zuboff, 2018).

Data, or as Zuboff calls it, “*the behavioural surplus*,” gives companies insight into the interests and habits of users. For strategic and commercial purposes, user monitoring results in covert conditioning to personalise the experience on online platforms. Inputs and advertisements continually target users, all born from scanning registered interests to engage and trigger unconscious processes to sell further products or fuel other interactions.

The extreme tracking to which we are subjected, the ability of devices to anticipate our choices, to pick up on our interests “*through increasingly abstract, invisible and automated control systems*” (Monahan, 2015, p.3) trigger deep and troubling reflections on our privacy security. The contemporary CAs with which we weave networks of conversations and requests and from which we get personalised feedback function as “*a single collective machine...a reservoir of human attention and input that acts as a reservoir of information for computational inference.*” (Finn, 2018, p.191)

The predictive systems that govern the algorithms are based on databases, which, unintentionally or unconsciously, we are the ones who build through our online interactions, researching and buying products, and choosing a movie or a piece of music. Like contemporary oracles, the algorithms behind platforms that have now permeated our daily lives, such as Netflix or Amazon, “*know our tastes even before we imagine them.*” and through collaborative filtering, manage to return us products or services we did not know we needed (Vespignani & Rijntano, 2019, p.149).

Surrounded by increasingly intelligent devices, individuals are constantly under observation; algorithms can read our emotions, predict our choices, and invade our unconscious. “*The new frontier of surveillance triangulates all data to increase accuracy and achieve omniscience over individuals...the global growth of ubiquitous computing enables Ubiquitous Surveillance.*” (Bianchini & Morozumi, 2021, p.136).

Poisoning A.I. through Contemporary Fashion and Jewellery

The growing fear that this relentless surveillance and data collection endangers the privacy of individuals is becoming increasingly accurate. The realisation that the predictive work of devices often removes us from autonomous choice by depriving us of countless possibilities, almost forcing us to accept suggested outcomes, has triggered and found a response in the design field. Some designers are picking up on the rising need to counter the action of tracking personal data and have designed products that can circumvent or combat surveillance operations. Several designers have imbued their products with countervailing power, from parasite devices to disruptive fashion proposals, by implementing poisoning or interfering operations against surveillance devices. The case studies presented in the section are divided into two categories: artefacts that counter

the behavioural monitoring process and objects that oppose body datification [fig. 03].

Concerning the first category, *Accessories For The Paranoid* (2017) is a project born from the collaboration of designers Katja Trinkwalder and Pia-Marie Stute, who conceived of a series of devices capable of interfering with the data collection system implemented by commonly used devices. Parasite devices have been designed to avoid using technology just to safeguard privacy. These objects exploit the data collection mechanism to their advantage, intervening in the relationship between the user and technology and creating a series of fictitious feedback. Linked to *conversational agents* or about platforms such as Amazon, accessories can create “noise” or confuse algorithms by distracting them with random queries or searches. As described by the designer, “Amazon wish lists will be filled with unexpected wants...social media accounts will spread non-specific likes. In Google search, partially typed requests will be dynamically continued through autocomplete.” (Stute, 2019) is an operation that keeps sensitive data safe under a blanket of false information.

Similarly, exciting case studies include *CounterBug* (2019) by Erlend Prendergast, which likewise interferes with the devices, blocking their surveillance; *Smell of Data* (2016) by Leanne Wijnsma, and *Winston* (2019) by U.S. start-up Winston Privacy, that instead implement an alert action, in order to signal possible dangerous monitoring activities.

Concerning the second category, several design projects aim to counter the increasingly widespread use of technologies that can track individuals’ biometric data. Born from this same need is *Cap_able* (2019), an Italian start-up launched by Rachele Didero and Federica Busani to inform and raise awareness about the danger and ethicality of the spread of the surveillance phenomenon.

The *Manifesto* collection includes knitted garments characterised by patterns called adversarial patches that can interfere with the artificial intelligence algorithms with which cameras are equipped and fool them to avoid the identification of the wearer. Also based on the same principles is *Jammer Coat* (2014), launched by Coop studio Himmelb(l)au. The coat, characterised by a unique polka dot texture, would be able to distort the figure of the wearer, hiding the wearer’s identity from the eyes of

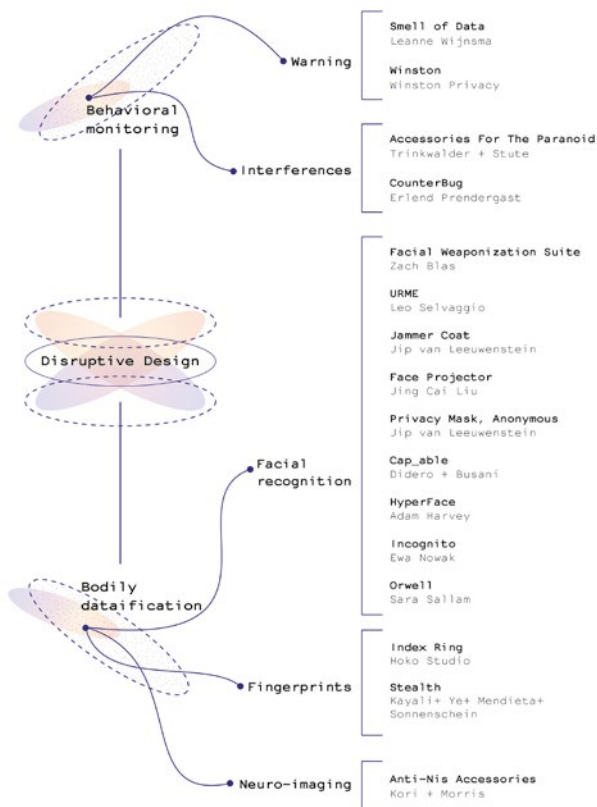


Fig. 3

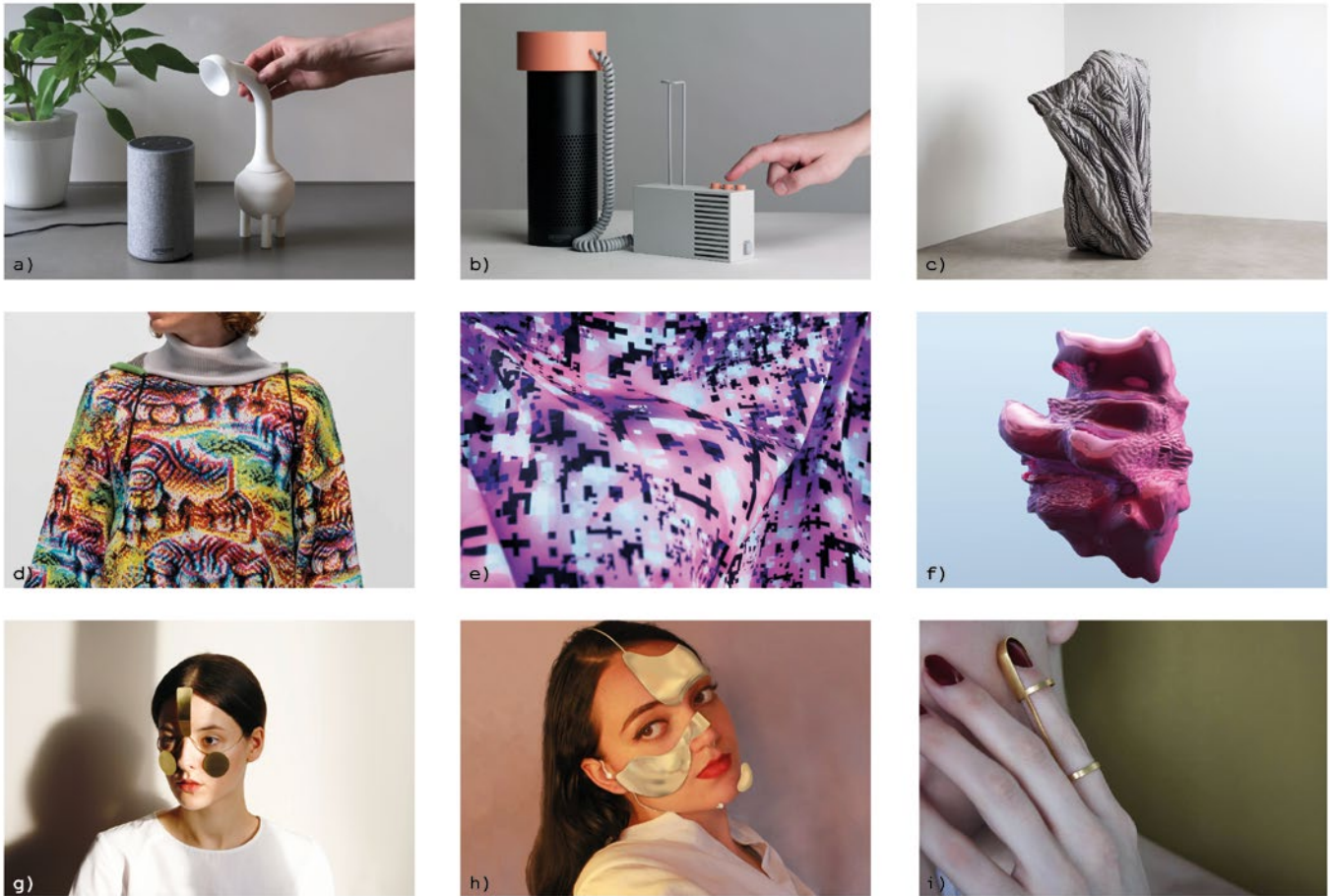


Fig. 4

the cameras. Also equipped with special internal metal coatings, it could shield our devices and credit cards from being tracked or cloned, even eluding the geolocation system. Similarly, Adam Harvey created *HyperFace* (2017), an anti-surveillance camouflage pattern that circumvents the action of facial recognition. American designer Sara Sallam has been working in a kindred way to create face and body jewellery that can render the recognition action of public cameras futile. *The Orwell* (2020) anti-tracking capsule collection consists of different accessories that protect the wearer and preserve their privacy. The mask devised by the designer modifies the proportions and geometries of the face, making the wearer invisible to surveillance; the armour bodice would instead protect against laser technologies capable of picking up the heartbeat; finally, the shoe accessory, by interrupting bipedal symmetry, would be able to fool technologies capable of detecting someone by their gait.

Before Sallam, other designers conceived jewellery that counteracts the action of recognition and tracking, including *Incognito* (2019) face jewellery by Ewa Nowak and *Index Ring* (2013) gold jewellery that hides fingerprints by Hoko Studio. Other designers made facial accessories and masks like *URME* (2013) resin masks by Leo Selvaggio, which reproduced a faithful copy of the designer's face, *Facial Weaponization Suite* (2012) "collective masks" by Zach Blas, amorphous masks, made to counter the inequalities and biases triggered by the use of biometric tracking technologies, *Privacy Mask*, *Anonymous* (2017) deforming masks by Jip van Leeuwenstein [fig. 04].

Conclusions. A disruptive approach to A.I.

The projects of the identified fashion and jewellery designers reflect the needs and worries of a critical contemporaneity about A.I. We have official-

ly entered the era of covert surveillance and conditioning by A.I.. How can design culture actively provide us with an alternative to freedom and privacy protection?

The contribution intends to solicit actions concerning these questions, placing in fashion and design practice a real possibility of 'poisoning' and subverting the prevailing technological system. It is not a question of opposing A.I. definitively but, on the contrary, of understanding it in depth and cooperating with it to redefine our irreducible characteristics as humans.

With a disruptive approach to A.I., the project can become a driving agent for a vision that foregrounds the human being with his qualities, re-orienting the integration and acquisition of data, behaviours, and influences according to trajectories of potential governability.

Combining critique and creativity, the projects illustrated here are part of this partnership between humans and non-humans through a conscious processuality capable of governing aesthetic languages and bodily interactions with the self. Extending hacking practices to fashion and jewellery allows for acts of contestation, provocation, and dissent through the typical design tools. These strategies can affect the cultural substratum, its rituals, objects, and meanings, succeeding in reorienting everyday practices. By acting on individuals and thus on the community, the aim is to encourage the emergence of a counter-system and the construction of paths of change.

By rethinking our bodies as part of a continuum between natural and artificial, in a dialectical relationship between heterogeneous subjectivities, the contribution restores to the human the decision-making possibility of assuming behaviours of active responsibility and personal choice. But, only by entering AI's processual and technological dynamics can we think it is possible to initiate concrete trajectories of modelling and conscious use of technologies.

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Author Contributions

C.S. is mainly responsible for paragraphs 1 and Conclusions; A.B. is mainly responsible for paragraphs 2 and 3; R.L.M. for paragraphs 4 and 5. The authors wrote the Abstract collaboratively.

Captions

[fig. 01] Computer vision algorithms rely on codified rules to interpret the world. Through the lens of a camera, sensor, or scanner, they look for specific configurations of data, sets of relationships, patterns, and predefined geometries. The programs search the image databases used in the training phase for specific light and shadow configurations. Some camouflage patterns are designed to fool detection mechanisms, preventing subject identification. Image by the authors.

[fig. 02] Biometric data is collected from various sources, including public and private devices, software, and applications. The image illustrates the supervised machine learning (ML) prediction process using the "object detection model". This technique uses bounding box labels, which are rectangular regions used in computer vision (CV), to identify the contents of an image. The model learns from the information within the rectangle to predict the presence of similar objects in new, unseen data. Image by the authors.

[fig. 03] The diagram summarises the case studies analysed, divided according to the tracking technology they intend to counter. The sabotage of behavioural monitoring occurs through Warning and Interference, while the hacking of body tracking technologies blocks facial recognition, fingerprinting, and neuroimaging. Image by authors.

[fig. 04] Images of the main case studies: a) Counter-Bug (2019) by Erlend Prendergast. b) Accessories For The Paranoid (2017) by Katja Trinkwalder and Pia-Marie Stute. c) Jammer Coat (2014) by Coop Himmelb(l)au studio. d) Cap_able (2019) by Rachele Didero and Federica Busani. e) HyperFace (2017) by Adam Harvey. f) Facial Weaponization Suite (2012) by Zach Blas. g) Incognito (2019) by Ewa Nowak. h) Orwell (2020) by Sara Sallam. i) Index Ring (2013) by Hoko Studio.

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I ASKED CHATGPT WHAT THE NEXT TREND WOULD BE THIS IS WHAT IT TOLD ME

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Abstract

This critical review explores AI's impact on trend research within fashion, scrutinising its capacity for ethical and nuanced analysis amidst industry reliance on its speed and perceived neutrality. Highlighting the risks of oversimplification and ethical oversight, it questions AI's role in shaping a future that should reflect diverse cultural and professional integrity. It argues for a responsible AI utilisation that respects cultural nuances and social equities, urging for co-designing with diverse voices to ensure equitable and inclusive futures. Through a conversation with ChatGPT, this study underscores the need for a deeper understanding of AI's application in creative processes, advocating for a thoughtful approach beyond mere replicating trends.

Keywords: *Trend Research; AI; Fashion; Pluriversality; Ethics*

Introduction

The art of predicting the future, particularly in fashion, is invaluable for gaining a strategic advantage through foresight, enabling the anticipation of market trends and informed decision-making. As industries and design realms become more volatile, trend research is critical for staying ahead in a mercurial landscape. Advancements in technology, especially AI, have revolutionized trend forecasting, providing analysts and designers with powerful tools to process vast data, discern patterns, and obtain rapid insights. AI's role has become foundational, influencing every facet of the fashion system from logistics to creative decision-making, and reshaping industry paradigms. This review critically assesses

ChatGPT's capabilities in forecasting trends within the complex legal and ethical landscape it operates. It explores the risks of AI-induced oversimplification and the pressure for swift creative processes, prompting the question of AI's suitability for qualitative trend analysis. By examining conversations with ChatGPT, the paper critically navigates the intersection of AI's convenience with the integrity of human-led creative evaluation.

Methodology

The core of this paper is a dialogue with ChatGPT, powered by GPT-4, shaped by research into ethics, AI, and fashion, encompassing extensive literature review and thematic investigation. This preparatory work fostered the creation of incisive questions that

challenged ChatGPT to demonstrate its analytical and self-reflective abilities. Sohail et al. (2023) reflect a prevalent research methodology with ChatGPT, where questions target specific themes for response analysis. ChatGPT's utility is often debated in terms of its prospective impact and functional capabilities, notably in academic and educational contexts. Its role in predictive research and the ethical implications of its use merit attention. This underscores the potential to delve deeper into ChatGPT's effects on creative industries such as fashion, where its influence is yet to be fully understood.

Conceptual framework

On how fashion shapes the future

The interplay between trend research, fashion, and the future is a multidimensional relationship that shapes each component significantly. Trend research meticulously observes contemporary culture to identify early change indicators or weak signals, which are essential for understanding shifts in behavior and consumption patterns (Naisbitt, 1982; Hiltunen, 2006; Vejlgard, 2008; Celi & Colombi, 2020). This process is not just about recognizing what is, but about envisioning what could be, providing designers with the insights needed to explore new meanings and design possibilities (Celi & Colombi, 2020; Raymond, 2019). Fashion's system, historically reliant on color and fabric forecasting, now thrives in a digital era where global platforms offer immediate access to analyzed data, promoting a proactive approach to consumer behavior (Blaszczyk & Wubs, 2018; Rodriguez Schon & Colombi, 2023). This evolution showcases the industry's push to mitigate risks and adapt to dynamic markets.

Qualitative cultural analysis, pivotal to understanding the cultural dimensions of trend research, is now complemented by quantitative methods that appraise products' perceptual qualities and market performance, integral for product launch timing and risk minimization (Colombi & Zindato, 2019). Horizon scanning, which investigates cultural factors without geographical constraints, dives into societal zeitgeist and socio-political systems, affecting collective behaviors and values (Fuel4Design, 2021). Trend research thus frames the conceptual groundwork for creative journeys in fashion, guiding design processes from inception (Celi & Rudkin, 2016). Trend research in fashion balances

commercial and creative objectives, leveraging innovation and obsolescence (Blaszczyk & Wubs, 2018). Design scapes emerge from this practice, where scenario planning and strategic foresight in fashion design are crucial for navigating future social and economic challenges, preparing for stakeholder engagement, and informing design decisions (Colombi & Zindato, 2019). In essence, trend research in fashion transcends mere aesthetic prediction; it involves strategic planning and visualization to explore and prepare for alternative futures, thereby shaping the industry's evolution and its response to market and societal transformations.

On how to train an AI model

In the landscape of technology and fashion, weak signals such as the emergence of ChatGPT indicate a paradigm shift in the utilization of AI. ChatGPT, which operates on OpenAI's GPT-4 technology, has become a significant innovation, offering interactive dialogues through a user-friendly interface that demonstrates advanced reasoning and creative capabilities (Chen et al., 2023; Sohail et al., 2023). Initially developed from InstructGPT, this model is trained on extensive datasets, enabling it to recognize patterns and provide predictive responses. ChatGPT's ease of use has contributed significantly to its widespread adoption (Murray et al., 2023). GPT-4's deep learning algorithm facilitates multimodal communication, which has been applied to various sectors, including aiding visually impaired individuals and improving search and retrieval processes in fashion (OpenAI, 2023c; Chen et al., 2023). The training regimen of GPT-4 incorporates vast datasets and human feedback, which helps in generating contextually relevant and factually accurate responses. Despite comprehensive pre-training on internet text, potential biases in the training data are addressed through a fine-tuning phase under human supervision. This phase ensures adherence to ethical standards and improves the model's output quality (OpenAI, 2023d). ChatGPT's conversational abilities are further enhanced through reinforcement learning, which leverages feedback to fine-tune its responses (Sohail et al., 2023; Chen et al., 2023).

ChatGPT was meticulously trained to enhance its dialogue skills, and it stands alongside other LLMs like Microsoft's Bing and Google's Bard that have also made remarkable progress in recent years. ChatGPT's usage has expanded beyond its initial creative writing applications, attracting over a

billion monthly users and generating substantial user engagement, as evidenced by the volume of user-created content and tutorials (Bender et al., 2021; Sohail et al., 2023). However, there is a noted opacity in the model's workings and application, with most knowledge about its operation being user-generated (Murray et al., 2023:84). ChatGPT, while capable, is not without its shortcomings; it may not consistently deliver nuanced answers and is subject to errors due to its dependency on statistical training data. These limitations have guided the hypothesis and investigative approach of the current study. This exploration into ChatGPT's capabilities and its role within the broader scope of AI's influence in fashion and design highlights the need for a nuanced understanding of its operational mechanisms and ethical implications. The findings point to the essentiality of human oversight and the integration of diverse perspectives to ensure that AI tools like ChatGPT serve the collective good and contribute positively to the evolution of creative industries.

Experiment

Conversation with ChatGPT

The aim of the experiment was to understand under what values ChatGPT operates, the sources used, and how it understood the questions. The chat snippets are summarised for clarity, alternated with the research's analysis.

Researchers: Can you predict the future?

ChatGPT: I cannot predict the future. My responses are based on a vast amount of information and data available up to my last training completed in April 2023.

The practice of any anticipatory discipline works with possible, probable, plausible, and preferable futures, through a qualitative and quantitatively supported interpretation of possible trajectories that describe scenarios (Voros, 2015; 2003). Spotting trends includes observation, data scraping, analysis, archiving, diving into relevant concepts, and recognizing patterns (Raymond, 2019). Several tools support this process, such as data scraping and analysis or AI-powered platforms that interpret patterns into formalised trends. The combined work of AI and expert analysis enhances the understanding of social consumption behaviours

in depth (Powers, 2019); also bringing competitive advantages since data support enhances the decision-making process (Holland & Jones, 2017). The AI is based "on historical data and observable trends" (ChatGPT, 2023); nevertheless, it stated:

ChatGPT: The future is inherently uncertain; unexpected events can drastically alter trajectories. Predictions are only as good as the data and models used to make them, inaccurate or biased data can lead to erroneous conclusions. Most predictions are probabilistic; it's about understanding the range of possible futures. Human behaviour is complex, making it challenging to predict with high accuracy.

Futurists have long advocated the plurality of futures, recognising the multiplicity of its potential (Candy & Potter, 2019). Various scholars explore this perspective (Candy, 2010; Dunne & Raby, 2013; Yelavich & Adams, 2014; Candy & Dunagan, 2017; Escobar, 2018), emphasising the importance of considering diverse possibilities. "[P]redictions should be viewed as educated estimates." (ChatGPT, 2023). Acknowledging the inherent limitations within ChatGPT includes challenges like bias and discrimination, privacy and security, potential misuse, and the overarching need for accountability and transparency (Sohail et al., 2023).

When asked about possible future trends regarding personal finance and furniture design, the responses included evaluations that generalised applications across the world, what does it mean for blockchain technologies to penetrate regions without internet reception?

Researchers: Did you base your information on a particular region? What cultural values do you find to be responding to? Do you find the same response you gave me would be valuable for trends in the United States and Argentina, for instance?

Detailed lists of the difference between personal finance, furniture design, and cultural values both in the United States and in Argentina followed, showing that the AI recognises that local conditions may vary the outcomes, "The same broad trend can take on different characteristics in different regions" (ChatGPT, 2023).

Researchers: Can you predict fashion trends for the next summer season?

Chat GPT: Predicting fashion trends for the next summer season involves considering current trends, cultural influences, and emerging design innovations. Here are some potential trends: sustainability and eco-conscious fashion, bold colours and patterns, relaxed and comfortable silhouettes, retro and vintage revivals, etc.

Most of these are already well-established trends; including general claims with no differentiation between style, macro trends, or micro trends, with different penetrations in the number of users and duration (Vejlgaard, 2008). The disclaimer on regional variations brings the question: is there such a thing as localised trends? What does it mean when a trend is global? The prevailing methodology behind trend research, predominantly emanating from hegemonic contexts of the Global North, threatens to dictate single-sided futures that may reinforce existing inequalities and the status quo. The bias inherent in the networking mechanisms of trends leads to a homogenisation of culture, where novelty is not about uniqueness but similarity, and trends become tools to summarise and commodify visions of the future (Powers, 2019).

Trends, deeply embedded in consumer culture and capitalism, have the power to dictate future ways of being, integrating past, present, and future into a complex dynamic (Dator, 2019; Powers, 2019). However, this dynamic, as Dussel (1993) points out, often serves as a tool for modernity to legitimise itself, with trends acting as cultural colonisers in their pursuit of the new and edgy (Powers, 2019). The critique of trend research is thus twofold: it's a manifestation of global futurity and proactive optimism- which idealises the future and can result in self-fulfilling prophecies that replicate superficial values and miss the intricacies of modernity (Dussel, 1993)- that remains geographically and socially biased, and risks perpetuating inequities and cultural homogenisation as forecasters inadvertently shape the very trends they predict (Lantz, 2016; Powers, 2019).

Researchers: how did you weave into the response your interpretation of the collected data from which you based your answer?

ChatGPT: When formulating predictions about

future fashion trends, I integrate and interpret data from various sources: Historical fashion trends, current fashion industry developments like fashion shows or collections, consumer behaviour and preferences to understand habits, cultural and social influences like popular culture and social movements, technological advances, global events and economic factors, media and fashion influencers, industry forecasts and research reports.

Researchers: being more particular, what could be the most popular colours for the next summer season?

ChatGPT: For the next summer season, based on recent trends and forecasts, the following colours could be particularly popular: vibrant and bold hues, earthy and natural tones, pastels and soft neutrals, etc. It's important to note that colour trends vary by region and demographic.

The response lacked critical perspective and creative spark, offering predictable suggestions such as “refreshing aquatic shades: colours that evoke a sense of water, like aqua or turquoise, might be popular, for beachwear” (ChatGPT, 2023). The increasing reliance on AI for inspiration risks leading to a creative plateau where new ideas are less frequent, and outputs become predictable. Despite this, AI acknowledges the importance of originality, suggesting individual designers and brands can still pioneer influential trends (Rogers, 2003). Yet, the prevalence of algorithms in shaping digital content may lead to a uniformity in visual expression, potentially diminishing the richness of the creative landscape (Blond, 2023).

Researchers: How would these colours change from one region to the other? For example, in Scandinavian or Caribbean countries.

ChatGPT: Scandinavian fashion often aligns with minimalist and functional design principles, using soft neutral tones, nature-inspired hues, etc. Caribbean fashion is known for its vibrant and lively aesthetic, using vibrant and bold hues, cultural and artistic influences from their rich heritage, etc.

Researchers: Do you find a gap between the first so-called global trends and the locally-based ones?

ChatGPT: Yes, this gap arises due to several factors: cultural influences, climatic conditions, economic and market factors, historical and artistic backgrounds, consumer preferences and lifestyles, and media and influencer impact. While global trends provide a broad overview of where fashion is heading, local trends offer a more nuanced view that reflects a region's specific tastes, values, and conditions. This gap between global and local trends underscores the diversity and complexity of fashion as a form of cultural expression.

Researchers: Do you consider global fashion to be focused on some specific places? What does global mean? Where is global?

ChatGPT: "Global" in fashion denotes widespread trends and practices adopted across cultures. It originates from fashion capitals hosting pivotal events, while digital media has democratized trendsetting, allowing global diffusion of styles from anywhere. Cultural exchanges and aesthetic blends inform designs, with prominent markets and brands influencing global trends. The sustainable fashion movement is redefining industry standards. Global fashion, unfixed and ever-changing, encapsulates a shared fashion consciousness beyond geographic limits.

AI mirrors its data environment, often presenting a Western-centric view that can skew consumption behaviors in non-Western societies, creating a mismatch with local histories and contexts. This is compounded by an overreliance on automation, which may neglect the intricate differences across cultures (Mohamed et al., 2020; Gebu, 2020). Fashion, historically perceived as a universal evolution of dress styles, faces criticism for its Western-dominated narrative (Welters & Lillethun, 2018). Simmel (1905) contrasts the rapid changes in European fashion with the static nature of other traditions, suggesting a narrow definition of fashion centered on Western practices. The capitalist dynamics of Western urban culture are often seen as the nexus of fashion, with a focus

on constant innovation and consumption (Lillethun et al., 2012). The term world fashion typically denotes everyday apparel influenced by Western styles (Eicher, 1995; Eicher & Sumberg, 1995). Yet, considering Spivak's (1997) concept of planetarity, the global fashion system is problematic, as it may marginalize indigenous knowledge and production systems, leading to a simplified, binary view of global dress that favors a Westernized aesthetic. This perspective risks losing the richness of global clothing traditions and alternative fashion futures, relegating non-Western dressing practices to a 'timeless' past. Furthermore, the fashion industry's anthropocentric focus, prioritizing human desires over environmental concerns, contributes to its growing unsustainability (Jansen, 2020). Niessen (2020) introduces Sacrifice zones, areas bearing the brunt of the clothing lifecycle's environmental and social costs, often located in regions disregarded by the fashion narrative. These areas illustrate the stark disparities within the fashion industry, highlighting the need for a more equitable and ecologically responsible approach.

Researchers: Do you find this description of how the global fashion system works somewhat biased?

ChatGPT: The global fashion narrative, traditionally centered around Western cities and consumer markets, tends to overlook the diversity of fashion practices worldwide. This bias marginalizes non-Western cultural contributions and allows major brands to dominate the conversation, overshadowing regional trends. Issues of cultural appropriation exemplify underlying power imbalances. Emerging markets like Mumbai and São Paulo are gaining recognition, contributing perspectives that challenge traditional hierarchy. The proliferation of digital platforms democratizes fashion discourse, enabling a broader range of voices to reshape the narrative.

Researchers: What about predicting digital technology use in places with limited access to it or feeling reluctant about it? Would this be a positive change or an innovative solution? It's close to proactive optimism or a technological deterministic view.

ChatGPT: The assumption that adopting digital technology is inherently positive and a one-size-fits-all solution can be seen as technologically deterministic and overlooks essential cultural and social nuances.

The answer explained how different cultures have varying relationships with technology, its unequal accessibility, overlooking of sustainable and ethical implications in pursuit of technological modernity, and how in many cultures, traditional methods of fashioning the body are integral to cultural identity, where digitalisation might not be compatible. Techno-determinism posits technological progress as a universal driver of change, such a narrow focus on progress can marginalise diverse cultural and social futures, creating exclusion and inequality.

Researchers: Considering this, can you predict next summer's fashion styles?

ChatGPT: Predictions account for global and regional interpretations of trends. Sustainable fashion's uptake will vary, with some areas preferring local materials and others high-tech solutions. Regions with vivid traditions may favor bright colors, while areas with muted aesthetics could opt for bright accents. These trends, shaped by global currents, are tailored by fashion's cultural diversity.

Critical analysis and insights

The conversation revealed intrinsic and usage-related issues with AI models like ChatGPT (Sohail et al., 2023). Intrinsic problems involve generating plausible yet incorrect or fabricated responses, often due to biased training data and outdated algorithms. This can lead to misinformation, reinforcing stereotypes and ethical issues. Usage issues include unethical applications, potential violations of copyright, and dependency on AI without critical evaluation. Mitigating these risks requires refining algorithms, updating training data, and educating users about AI's capabilities and limitations.

Ethical considerations, especially regarding the role and responsibilities of the AI platform and its users bring questions like: "Can a chatbot truly provide approval for work and be held accountable for its content?" (Sohail et al., 2023:11). Users

must approach these platforms with an informed perspective, the interface must provide clear instructions and contextual information about their capabilities and limitations. Despite efforts to educate users about the risks of employing language models, there remains a gap in ensuring users are fully aware of these issues (Murray et al., 2023). It is crucial that platforms alert users to the potential for generating erroneous content and guide them on using AI responsibly and understanding its outputs critically.

OpenAI is addressing AI challenges by diversifying DALL-E's image generation to better reflect global demographics (OpenAI, 2022b). Increased training data and user feedback are broadening AI's cultural and regional understanding, as seen with ChatGPT, which now tailors dialogue by learning from user interactions and new trends, aiming for more culturally nuanced responses (Sohail et al., 2023). Commitment to ethical data use, advanced computing, and continual updates ensures AI aligns with moral standards, bolstered by policy regulations and auditing for reliable decision-making. Virtue ethics and pluriversal approaches address AI's ethical dimension, promoting harmony between technology and moral values (Vallor, 2016; Escobar, 2018). Such frameworks advocate for AI that is fair, transparent, and adaptable, supporting diverse perspectives and cooperative design practices (Sohail et al., 2023). Moving away from a monolithic progress model, these methods prioritize inclusivity and contextual sensitivity, ensuring AI benefits all stakeholders equitably (Geburu, 2020; Mohamed et al., 2020; Rodriguez Schon & Colombi, 2023).

Conclusion

In addressing the dual aspects of user engagement with AI platforms and their design, three critical issues emerge: the simplification of complex topics, the deceptive appeal of rapid AI-generated solutions perceived as unbiased, and the replacement of nuanced analysis with AI's interpretation. As trend research is foundational in setting future creative directions (Celi & Rudkin, 2016), the reliance on AI for qualitative analysis poses risks to ethical and critical judgment, potentially leading to homogenized and superficial outcomes. Users must also recognize their responsibility for the tool's results, as the increasing adoption of these platforms often correlates with the allure of swift,

cost-free outputs mistakenly equated with fairness and justice.

To counter these challenges, it is vital to scrutinize and dismantle hegemonic legacies in design, empowering a future that respects diverse ways of knowing and being. Design transcends mere aesthetics, involving knowledge creation practices that honor cultural nuances and address social disparities (Joyce et al., 2021). By integrating the perspectives of marginalized groups into the design process, AI can be directed towards more inclusive and beneficial outcomes for society at large (Luján Escalante et al., 2021). Such an approach ensures that design meaningfully contributes to a future that is equitable and embraces diversity. As AI's influence grows, its responsible and informed application becomes ever more crucial.

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SYNERGIES IN THE EVOLUTION OF ARTIFICIAL INTELLIGENCE AND FASHION

A PROSPECTIVE ANALYSIS

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Abstract

This study provides an in-depth analysis of the intersection between artificial intelligence (AI) and fashion, focusing on the potentials and ethical challenges related to the intensive use of large datasets. Using methodologies such as “Envisioning” and the “Scenario Planning Model”, the aim is to develop clear and structured approaches to the deployment of AI in the fashion industry, exploring how this technology can transform and enrich the creative process, extending human capabilities. Among the main ethical challenges are training on culturally connoted data, which risks introducing formative bias, and the need to explain AI processes and decisions in understandable terms (explainability). The possible formalization of AI methods to make their processes and results formal is also discussed. The potential capabilities of these technologies to overcome the limits of human intellect are also considered. The conclusions highlight the importance of a balance between technological innovation and ethical considerations to promote ongoing dialogue among diverse stakeholders, ensuring that AI in the fashion industry evolves inclusively, ethically, and responsibly, fostering a future where technology and human creativity coexist harmoniously.

Keywords: *Artificial Intelligence (AI), Fashion and Technology, Envisioning and Scenario Planning Models, Creative Innovation, Human-AI Harmony*

Foreward

The evolution of Artificial Intelligence (AI) is radically transforming various sectors, including the field of fashion, traditionally guided by human creativity and sensitivity. This article explores how AI is influencing fashion, not only in terms of design and production but also in trend analysis and marketing strategies. Authors such as Hennigs et al. (2015) have examined the impact of AI on consumer behavior, while Tuarob and Tucker (2019) have discussed the potential of AI in design innovation. A crucial aspect of this transformation is the use of large datasets. Analyzing vast volumes of data - from consumer preferences to sales trends - allows AI to offer valuable and personalized insights, as emphasized by Smith and Linden

(2017). To understand and predict the future implications of AI in fashion, this study employs two main methodologies: Envisioning and Scenario Planning Model. Envisioning, as described by Dunne and Raby (2013), enables imagining possible futures and exploring how current technological trends may evolve. This approach is particularly useful for considering how AI can influence not only the technical aspect of fashion but also its cultural and social perception. On the other hand, the Scenario Planning Model, illustrated in the works of Schwartz (1996), provides a framework for developing and analyzing various future scenarios. This methodology is effective in evaluating the different trajectories AI could take in the fashion industry and planning strategies that are resilient to various possible

developments. To explore the intersection between Artificial Intelligence (AI) and fashion, this article utilizes two advanced methodologies: Envisioning and Scenario Planning. These approaches provide a framework for analyzing and predicting the potentials and challenges that AI brings to the world of fashion. Through Envisioning, we imagine future scenarios and potential developments of AI in fashion. This method allows us to explore how new technologies can influence not only production and design processes but also consumer trends and the cultural perception of fashion. Envisioning serves as a tool to anticipate technological advancements and understand their impact on society and the fashion industry. Scenario Planning, on the other hand, allows us to examine a variety of possible futures in which AI could evolve in the context of fashion. By creating different scenarios, from optimistic to more cautious ones, we can assess how fashion companies and consumers might have to navigate these futures. This approach helps identify flexible and resilient strategies to address uncertainty and rapid technological transformations. After the introduction, we will focus on the potential of AI in fashion, exploring how it can transform the creative process, enhance human capabilities, and drive data-driven design innovations. Subsequently, the issue of originality and intellectual property in the era of AI will be explored, highlighting the challenges posed by machine learning models. The article will conclude with a synthesis of the main points, emphasizing the importance of finding a balance between technological innovation and ethical considerations, and proposing a perspective for constructive dialogue and responsible evolution of AI in the fashion industry.

Research Methodologies: Envisioning and Scenario Planning

To explore the intersection between Artificial Intelligence (AI) and fashion, the use of the Envisioning and Scenario Planning Model methods plays a fundamental role in analyzing and predicting the potential trajectories of this emerging technology. The Envisioning method, rooted in long-term thinking and interdisciplinary creativity, as discussed by Dunne and Raby (2013), allows us to explore how AI can open new horizons in the field of fashion. This approach, integrating various perspectives from engineering to design, will guide us in imagining future scenarios, evaluating both

the social and cultural impacts that AI could have on fashion. For example, we will consider the ways in which AI could influence the perception of value and luxury, as highlighted by Hennigs et al. (2015), as well as the implications for consumers and designers. Here is how these methods will be employed.

The processes enabled by Envisioning are as follows:

- *Creative Exploration*: through Envisioning, the article will explore creative visions of how AI can transform the fashion industry. Future scenarios will be imagined, where AI could personalize the shopping experience, influence fashion trends, or even autonomously create designs.
- *Assessment of Future Impacts*: we will use this method to assess the social and cultural impacts that AI could have on fashion. It will be important to examine how AI may influence the perception of value and luxury, as well as the implications for consumers and designers.
- *Identification of Opportunities and Challenges*: Envisioning will help us identify new opportunities for AI in fashion, such as supply chain optimization and sustainable production, as well as challenges, such as ethical and privacy issues

The Envisioning method is a technique used for design and futuristic analysis, especially in the context of technological innovation and design. This method is based on some fundamental assumptions:

- *Long-Term Thinking*: Envisioning requires a perspective that extends beyond the immediate, considering how technologies, society, and the environment may evolve in the long term.
- *Exploration of Different Scenarios*: It involves exploring a variety of future scenarios, including those that may seem unlikely at the current moment, to better understand potential developments and their implications.
- *Interdisciplinarity*: It combines knowledge and approaches from different disciplines, such as technology, sociology, economics, and design, to achieve a holistic and integrated view of the future.
- *Creativity and Innovation*: Envisioning encourages creativity and innovative thinking, allowing for the imagining of new possibilities and solutions that are not constrained by current limitations or conventions.
- *Human Focus*: It centers attention on the human experience and the social implications of emerging technologies, placing the user and society at the

core of the envisioning process.

- *Impact Assessment*: It includes the assessment of the potential impacts of new technologies, both positive and negative, on people, societies, and the environment.

- *Agility and Adaptability*: It recognizes that the future is inherently uncertain and that plans and visions must be flexible and capable of adapting to new information and circumstances.

Stakeholder Involvement: It often involves a variety of stakeholders in the envisioning process to ensure that different perspectives and interests are considered.

The use of the Scenario Planning Model in analyzing the potential of Artificial Intelligence (AI) in the fashion industry proves to be a strategic methodological approach to anticipate and prepare for future technological developments. This model, as outlined by Schwartz (1996), is particularly valuable in the context of AI in fashion, an industry undergoing rapid evolution and characterized by significant uncertainty and complexity.

1. Development of Multiple Scenarios: Using Scenario Planning, the article is dedicated to developing various future scenarios based on current trends in AI in the fashion industry. Following the example of Ringland (1998), who emphasizes the importance of considering a broad spectrum of possibilities, these scenarios will range from optimistic ones, where AI seamlessly integrates into the industry, to pessimistic ones that anticipate significant challenges and potential negative impacts. Realistic scenarios, offering a balanced and probable view of the use of AI in the fashion sector, will also be considered.

2. Analysis of Strategic Implications: In each proposed scenario, the strategic implications for various stakeholders in the fashion industry will be analyzed, following the approach suggested by Van der Heijden (2005). This includes examining the impact on fashion brands, designers, retailers, and consumers. Special attention will be given to adaptability to emerging technologies and resilience in the face of rapid market changes. Reflections on how companies can anticipate and respond to these developments will be provided, following Chermack's (2004) analysis of the importance of strategic preparedness.

3. Planning and Preparation: Finally, based on

the developed scenarios, the article will formulate strategies for stakeholders to prepare for and adapt to possible future developments of AI in fashion. This segment will focus on recommendations in terms of innovation, training, and regulatory policies. The goal is to provide stakeholders in the fashion industry with tools to navigate a continuously changing landscape, as suggested by Bradfield et al. (2005) in their research on strategic planning and change management.

The combined use of Envisioning and the Scenario Planning Model will be crucial to guide an informed and in-depth discussion on the evolution of AI in the fashion industry, navigating through a territory that is both promising and complex. Both methods will be essential for steering an informed and in-depth discussion on the evolution of AI in the fashion sector, assisting in navigating a landscape that is both promising and complex.

Potential of AI in Fashion

In this section dedicated to the potential of Artificial Intelligence (AI) in the fashion industry, we will examine how AI is transforming the creative process, expanding human capabilities, and driving data-driven design innovations.

Transformation of the Creative Process: AI is revolutionizing how fashion designers conceive and create their products. The integration of AI into design offers new possibilities for customization and innovation. As emphasized by Tuarob and Tucker (2019), AI can analyze real-time consumer trends and preferences, providing designers with valuable insights that can inspire new creations. Furthermore, AI can automate parts of the design process, such as fabric selection and modeling, allowing designers to focus on the more creative and innovative aspects of their work.

Extension of Human Capabilities: AI represents an extension of human capabilities in the fashion industry. Through machine learning and data analysis, AI can offer a deeper understanding of consumer needs and preferences, as illustrated by Smith and Linden (2017). This enables fashion brands to create products more in line with customer expectations, improving the shopping experience and increasing consumer satisfaction.

Data-Driven Design Innovations: The use of data

has become a fundamental pillar in fashion design innovation. AI can process and analyze large datasets to identify emerging trends, predict future demand, and suggest new styles and patterns. This ability to translate complex data into concrete design insights is crucial for remaining competitive in a rapidly changing industry, as highlighted by Zheng et al. (2020).

More than human

In this section dedicated to the potential of Artificial Intelligence (AI) in the fashion industry, we will explore how AI capabilities can surpass those of human intellect and the implications this could have for the fashion sector, particularly regarding the concept of creativity.

Exploration of AI Capabilities Beyond Human Intellect: The progressive evolution of AI has led to the development of systems capable of performing tasks that go well beyond human cognitive abilities. Authors like Brynjolfsson and McAfee (2017) have discussed how AI can process vast amounts of data, identify complex patterns, and even generate creative ideas in ways that surpass human limitations. This capability extends to the fashion industry, where AI can analyze emerging trends and create innovative designs based on extensive databases of styles, fabrics, and patterns.

Implications of AI Capabilities for the Fashion Industry: The rise of 'more than human' creativity in AI in the fashion industry raises significant questions. For example, as emphasized by Bostrom (2016), while AI can generate a wide range of designs and styles, its integration into the creative process must be carefully managed to maintain a balance between technological innovation and the human essence that traditionally characterizes fashion. The question that arises is how to reconcile the potentially infinite creativity of AI with the limitations of human capabilities. An area of particular interest, as explored by Webb et al. (2020), concerns the impact of AI on creativity and design in fashion. While AI can offer new possibilities for design generation, it is crucial to consider how these innovations fit into the broader context of human fashion traditions and practices. Another area concerns the development of computational agents managed by AI. In particular, Nicenboim et al. (2020) focus on how AI agents can be studied and designed from a more human perspective,

integrating approaches such as ethnography of things and material speculations. This approach is relevant to fashion as it allows for examining conversational agents and other AI systems not only as technological tools but also as active participants in a broader social and cultural context. In fashion, the more-human approach could help better understand how AI agents, such as voice assistants or automated design systems, interact with human users and influence design and consumption decisions. For example, AI could be used to personalize the shopping experience or generate new designs, taking into account a variety of human and environmental factors.

The article raises important issues regarding ethics and design in AI, such as the need to consider AI agents within their ecological and infrastructural networks, addressing themes like privacy, security, and business interests. Additionally, how AI agents are presented and perceived by users (e.g., the use of female voices in virtual assistants) can have gender and cultural implications that must be considered in the design of more inclusive and conscious systems. Therefore, adopting a more-human approach in the evolution of AI in the fashion industry can lead to a deeper understanding of human-AI interactions. This will enable the development of technologies that not only enhance design and production capabilities but are also sensitive to the social, cultural, and environmental contexts in which they operate. These are the challenges and opportunities that fashion designers currently face, examining how fashion can benefit from the advanced capabilities of AI while maintaining the uniqueness and authenticity that only the human touch can provide.

Two Perspectives in the Evolution of AI: Risks and Opportunities

Two crucial perspectives regarding the evolution of Artificial Intelligence (AI) in the fashion industry involve both the evolutionary aspects of AI and the dangers arising from it without adequate legislation, as well as aspects that would lead us to view these technologies as opportunities for advantageous growth for humanity, moving towards harmonizing humans and the planet with such technologies.

Uncontrolled Growth of AI and its Dangers: Uncontrolled and unregulated growth of AI in the

fashion industry could lead to a series of challenges and dangers. Authors like Bostrom (2016) have highlighted the potential risks of technological advancement surpassing human capacity for control and understanding. In the context of fashion, this could mean the creation of designs that disregard ethical, social, or environmental norms, or the emergence of new forms of monopoly by companies using AI to dominate the market. Additionally, the lack of transparency and explainability in AI decisions could result in a loss of trust from consumers and stakeholders.

Opportunities for Harmony between Human and AI: On the other hand, there are significant opportunities for a harmonious integration between human and artificial intelligence in the fashion industry. Authors like Daugherty and Wilson (2018) have emphasized how AI can amplify human capabilities, enhancing creativity and efficiency. In fashion, this could translate into collaboration between human designers and AI algorithms to create innovative designs that combine human intuition with AI data analysis. Such an approach could also lead to a higher level of customization in fashion products, meeting individual consumer needs in previously unimaginable ways.

Therefore, as we explore the growth of AI in the fashion industry, it is essential to consider both potential risks and opportunities. A balanced approach could lead to synergy between human and AI, where the strengths of both are utilized to promote innovation, sustainability, and inclusivity in the world of fashion.

Final Considerations: Balancing Innovation and Ethics

We have explored how AI is transforming the fashion industry, from its potential to renew the creative process and expand human capabilities to the ethical challenges and risks associated with the use of large datasets. We have discussed the need to address issues such as training bias, explainability, and intellectual property in the era of AI. Additionally, we have considered the role of AI in future scenarios, examining both the dangers of uncontrolled growth and the opportunities for harmonious collaboration between human and artificial intelligence.

In conclusion, this study has provided a thorough and multidimensional analysis of the intersection

between Artificial Intelligence (AI) and fashion, exploring transformative potentials and ethical challenges arising from the intensive use of large datasets in this dynamic sector. We have seen how AI can revolutionize the creative process in fashion, extending human capabilities and leading to data-driven innovations, while facing significant ethical challenges related to training bias and the explainability of decisions made by AI systems. Through the use of Envisioning and Scenario Planning methodologies, we were able to imagine and assess possible futures for AI in fashion, considering both potential opportunities and risks. This approach allowed us to examine scenarios in which AI not only enhances human creativity and productivity but also raises crucial issues regarding intellectual property, regulation, and the balance between technological innovation and human values.

In particular, the discussion on the risks of uncontrolled AI growth and the opportunities for harmonization between human and AI has revealed the need for a balanced and conscious approach. In this context, regulatory policies play a key role in ensuring that progress in AI occurs responsibly and sustainably, considering social and ethical implications.

Ultimately, the future of AI in fashion depends not only on technological innovations but also on ongoing and constructive dialogue among all stakeholders involved. It is imperative that this dialogue includes ethical, cultural, and social considerations, ensuring that the evolution of AI in the fashion industry develops in a way that is beneficial for society as a whole. Looking ahead, AI has the potential not only to transform the fashion industry but also to do so in a manner that respects and values the uniqueness of human creativity and principles of fairness and sustainability.

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ETHICAL CHALLENGES IN THE EVOLUTION OF ARTIFICIAL INTELLIGENCE AND FASHION

A PROSPECTIVE ANALYSIS

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Abstract

The present study pays particular attention to issues of originality, intellectual property, and potential biases in machine learning models. European legislation on AI, along with various legislative acts that have followed this initial attempt at regulation, is examined as an essential reference point for initiating a technologically responsible and sustainable prospective discussion. The article analyzes two main perspectives: the risks of uncontrolled AI growth, with emphasis on the damage to the conceptualization of technological primacy over human cognition, and the opportunities for harmonization between human and AI. These themes are contextualized in relation to technological development, regulatory policies, consumer trends, and social values.

Keywords: *Artificial Intelligence (AI), Fashion and Technology, Ethical Challenges in AI,, Intellectual Property, Regulation of AI*

Introduction

The evolution of artificial intelligence (AI) is radically transforming various sectors, including the field of fashion, traditionally guided by human creativity and sensitivity. A crucial aspect of this transformation is the use of large datasets, which also presents significant challenges, particularly regarding data privacy and security, as discussed by Zheng et al. (2020). The first section opens with a discussion on ethical challenges related to the use of large datasets, addressing issues such as data bias and the need for increased transparency and explainability of decisions made by AI. The second section shifts focus to the analysis of European AI regulations and the impact of legislative acts on AI regulation in the fashion industry. This leads to a

discussion of two contrasting perspectives in the third section: the risks associated with uncontrolled AI growth and the opportunities offered by harmonization between humans and AI. Finally, the relationship between technological development, regulatory policies, consumer trends, and social values will be explored to better understand how these aspects influence the evolution of AI in the world of fashion.

Ethical Challenges of Using Large Datasets

In this section dedicated to the ethical challenges associated with the use of large datasets in the field of artificial intelligence (AI) in the fashion industry, we will address three crucial issues: formative bias, the challenge of explainability, and the need

to formalize AI methods to ensure clarity and transparency.

Formative Bias Due to Training on Culturally Connoted Data: One of the main ethical concerns in the use of AI in fashion revolves around the bias that can arise when systems are trained on datasets that do not equally represent diverse cultures and populations. This can lead to outcomes that favor certain groups at the expense of others, as discussed by Barocas and Selbst (2016). In an industry like fashion, where diversity and inclusivity are becoming increasingly important, it is crucial to ensure that AI does not perpetuate stereotypes or cultural biases.

The Challenge of Explainability in AI: Explainability, the ability to elucidate AI decision-making processes in understandable terms, is another significant ethical challenge. According to Doshi-Velez and Kortz (2017), explainability is crucial for building trust and accountability in the use of AI. In the fashion industry, where decisions can directly impact consumers and market trends, it is essential for stakeholders to understand how AI arrives at its conclusions.

Formalization of AI Methods for Clarity and Transparency: Lastly, there is a need to formalize AI methods to ensure greater clarity and transparency. This involves the development of clear standards and guidelines for AI usage, as suggested by Jobin et al. (2019). This formalization is particularly important in a regulated and visible industry like fashion, where AI-based decisions can have broad social and economic impacts. In summary, while AI offers significant opportunities for innovation in the fashion industry, it is crucial to address these ethical challenges to ensure that its implementation is fair, transparent, and responsible.

Novelty and Intellectual Property in AI

This section of the work analyzes the complex issues related to originality and intellectual property in the context of using artificial intelligence (AI) in the fashion industry, as well as potential biases in machine learning models.

Discussions on Novelty and Intellectual Property in the Era of AI: With the advent of AI, new

challenges arise concerning the definition and protection of originality and intellectual property. Authors like Bodó et al. (2020) have discussed how works generated by AI challenge our traditional concepts of creativity and originality. In the fashion industry, this raises questions about who holds the rights to designs generated or influenced by AI. For example, if an algorithm creates a unique fashion design, who owns the rights to it? These questions are at the center of the debate on integrating AI into fashion and require careful consideration to ensure that intellectual property rights are adequately attributed and protected.

Potential Bias in Machine Learning Models: Another important issue is the potential bias in machine learning models. As examined by Obermeyer et al. (2019), AI models can unintentionally perpetuate pre-existing biases present in the data on which they are trained. In the context of fashion, this could mean that certain styles, fabrics, or even body representations are favored over others, creating a partial and potentially distorted view of consumer trends and preferences. Addressing and mitigating these biases is crucial to ensure that AI in the fashion industry is fair, inclusive, and representative of a wide range of styles and preferences.

In summary, this section will explore the challenges posed by AI in terms of originality and intellectual property, as well as examine ways to identify and reduce biases in machine learning models, ensuring that AI's contribution to the fashion industry is both innovative and fair.

Regulating AI: The European Model in Its Relevant Features

Concerning the proliferation of AI, the design of specific regulatory foresight has been advocated globally. As has already happened with *privacy*, the European Union (EU) has positioned itself at the forefront, but it is not on this journey alone.

Concurrently with the initial provisions of *soft law* on the part of the EU¹ In the United States of America (USA), the '*National Artificial Intelli-*

1 Casonato, C., & Marchetti, B. (2021). Prime osservazioni sulla proposta di regolamento dell'Unione Europea in materia di intelligenza artificiale. *BioLaw Journal - Rivista di BioDiritto*, 3, 415–437. <https://doi.org/10.15168/2284-4503-1793>: among the most relevant, we find the White Paper on Artificial Intelligence by the Commission (February 19, 2020).

gence Initiative Act of 2020² was enacted: the similarities to the general provisions, encompassing definitions to objectives, are numerous, although the strategies are different. The USA, in fact, positions itself with the perspective of continuing a path to maximize the benefits of AI for ‘all American citizens,’ positioning the country as a leader ‘in the development and use of reliable artificial intelligence systems in both the public and private sectors.’³ The EU, on the other hand, has set as its primary objective “the protection of fundamental rights and the safeguarding of the democratic process”.⁴ To achieve this goal, however, soft law and self-regulation are not sufficient.

To this end, the EU has determined that a regulation for AI was necessary: the latest text, the definitive one, is the result of a political agreement between the Council and the European Parliament. It will be the first and, for now, the only unified source of AI regulation worldwide. It consists of 85 articles and 9 annexes, and the system is united by a specific underlying logic, that of ‘*variable geometry risk management combined with choices and data governance obligations primarily aimed at avoiding or limiting deceptive effects of artificial intelligence systems on individuals, while ensuring the reliability of the systems*’.⁵

The legislative proposal aims to improve the functioning of the internal market and promote a conception of AI that is ‘*human-centric and trustworthy*’⁶. For this reason, it aims to create a system of rules applicable within the Union territory and to prohibit certain AI applications. Likewise, the regulation proposal pays attention to the transparency of certain AI mechanisms designed to

interact with individuals⁷.

The essence of the regulation

The essence of the regulation lies in Title II of the proposal, where Article 5 identifies a series of prohibited practices, reflecting the risks to which individuals are exposed. The article is extensive but focuses on systems that employ subliminal, manipulative, or deceptive techniques to distort individuals’ behavior, or exploit the vulnerabilities of a person or a group of people, such as age, disability, or socio-economic status, causing significant harm. Biometric categorization of individuals is also prohibited, as well as the assessment or classification of individuals based on a social score that leads to disadvantageous treatment in social contexts unrelated to the data collection or genesis, where such treatment is unjustified or disproportionate to social behavior or its severity. The use of real-time remote biometric identification systems in publicly accessible places is also prohibited, except for a series of exceptions, mainly related to public order, security, and the fight against crime, unless the risk assessment of an individual committing a crime is based solely on the profiling of a natural person or the assessment of the traits and characteristics of their personality. In any case, the aforementioned systems require prior authorization from a judicial authority or an independent administrative authority, whose decision is binding on the Member State where the use is to take place or has occurred in the last 24 hours. Finally, AI systems that create or expand *databases* of facial recognition through non-targeted exploitation of facial images from the Internet - known as *scraping* - or from closed-circuit camera footage, or that infer the emotions of a natural person in the fields of work and educational institutions are prohibited, except in cases where the use of the artificial intelligence system is intended for medical or security reasons and is to be implemented or brought to market⁸.

The changes, compared to the previous text, lies in the remedies provided in Articles 68a and following of the regulation proposal⁹.

2 <https://www.congress.gov/bill/116th-congress/house-bill/6216/text#toc-H5C24E8CE4C60488783014BB97405E96C>

3 National Artificial Intelligence Initiative Act of 2020, Title I, Sec. 101; translation by the authors.

4 Resta, G. (2022). Cosa c'è di 'europeo' nella Proposta di Regolamento UE sull'intelligenza artificiale? in *Il diritto dell'informazione e dell'informatica*, 38(2), 323–342.

5 Catanzariti, M. (2023). Rischio e vulnerabilità nel modello europeo di intelligenza artificiale. *SocietàMutamentoPolitica*, 13(25), 73–82. <https://doi.org/10.36253/smp-13804>.

6 Proposal for a regulation of the European Parliament and of the Council establishing harmonized rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union acts, 2021/0106, Article 1; hereinafter referred to as the AI Regulation. Regarding the ‘Human-centric approach,’ emphasis is placed on the provision in Article 14, where effective human oversight of AI is envisaged with a view to maximizing the prevention or minimization of potential harms that may be caused.

7 Proietti G., Una normativa per l'intelligenza artificiale. La proposta di regolamento europeo, in *Rivista Trimestrale Responsabilità d'impresa e antiriciclaggio*, n. 2/2021, 198.

8 For the full content, please refer to the AI Regulation Proposal, Article 5.

9 AI Regulation Proposal, Chapter 3b.

In addition to administrative or judicial remedies, there will be the possibility to file a complaint with the market surveillance authority in case of violation of the provisions contained in the regulation proposal. Furthermore, there are a series of actions aimed at preventing and encouraging operators to adhere to the regulation proposal, through the joint action of several entities - the AI Office, the AI Board at the Commission, and the Commission itself in certain cases. All of this is associated with the sanctions provided in Article 71 and following, which must be 'effective, proportionate, and dissuasive,' including warnings and non-monetary measures¹⁰.

As a result, it is crucial, especially for high-risk AI systems, to establish an effective *compliance* system to be carried out before market entry or service deployment. This system should lead operators to identify, assess, and estimate potential risks, both direct and indirect, as well as to adopt appropriate and targeted risk management measures¹¹. In this regard, specific provisions are established for training and datasets and for AI training, which include tests on datasets and their characteristics, even specific ones, that must be met¹². Finally, high-risk AI systems must technically enable the automatic recording of events ('logs') throughout the system's lifetime, as well as be designed and developed to ensure that their operation is sufficiently transparent to allow installers to interpret the system's results and use them appropriately.¹³ All of this results in a series of obligations on the part of providers and implementers, always in accordance with a ratio of adequacy to the requirements and oversight of high-risk AI systems, with the perspective of preventing and correcting *biases*¹⁴.

Another relevant innovation is the 'impact assessment on fundamental rights for high-risk artificial intelligence systems.' Indeed, before using a high-risk AI system - see Article 6 of the regulation proposal - those responsible for distribution, whether public law entities or private operators providing public services, and operators distributing high-risk systems, must conduct an impact assessment according to the specified

requirements. The assessment must be updated when the factors listed in the first paragraph change - such as the frequency of AI use or the categories of individuals who may be affected by its use. Once the assessment is completed, it must be notified to the supervisory authority using a questionnaire developed by the AI office¹⁵. Obviously, the reference to the Data Protection Impact Assessment (DPIA) of the European General Data Protection Regulation (GDPR) is evident; not coincidentally, the regulation proposal specifies that if the DPIA has already fulfilled one of the obligations provided by the *AI Act*, then they must be conducted jointly. The impact assessment on fundamental rights replaces the obligation for providers to undergo the conformity assessment procedure¹⁶, however it still remains to obtain the EU conformity declaration¹⁷ and the CE mark¹⁸. Providers, together with operators, are still obligated to the aforementioned transparency requirements outlined in the sixth title of the regulation¹⁹.

Another innovation concerns the classification of general-purpose AI models²⁰ with systemic risk, defined as such in the presence of the following criteria: the AI has high-impact capabilities, which are assessed based on appropriate technical tools and methodologies, including indicators and reference parameters; based on a decision by the Commission, *ex officio* or following a qualified report by the scientific group, that a general-purpose AI model has capabilities or impact equivalent to those of the previous criterion. General-purpose AI is presumed in any case when the cumulative amount of computation used for its training, measured in floating-point operations (FLOP), exceeds 10^{25} ²¹. The providers of general-purpose AI models are subject to the obligations outlined in Articles 52c and following of the regulation

15 AI Regulation Proposal, Article 29a; the provision must be read together with Annex 3; translation by the authors.

16 AI Regulation Proposal, Article 19.

17 AI Regulation Proposal, Article 48.

18 AI Regulation Proposal, Article 49.

19 AI Regulation Proposal, Article 52 and following.

20 An AI for general purposes is defined as 'capable of serving a variety of purposes, both for direct use and for integration into other AI systems' by Article 2.5g No. 44e) of the AI Regulation Proposal. Consideration 60a) also identifies two characteristics useful for making it known, namely its 'generality and the ability to competently perform a wide range of distinct tasks. These models are typically trained on large amounts of data, using various methods such as self-supervised, unsupervised, or reinforcement learning'; translation by the authors.

21 Proposal for a regulation on AI, art. 52b; translation by the authors.

10 AI Regulation Proposal, Article 71; translation by the authors.

11 AI Regulation Proposal, Article 9; translation by the authors.

12 AI Regulation Proposal, Article 10; translation by the authors.

13 AI Regulation Proposal, Article 13; translation by the authors.

14 AI Regulation Proposal, Chapter 3.

proposal, including transparency requirements and the maintenance and updating of specific technical documentation, ensuring adequate levels of cybersecurity.

Conclusions and Critical Considerations

Even from this partial overview of the provisions, two important interconnected criticisms, previously emphasized by scholars, can be identified.

The first concerns the structural model, based on a so-called 'top-down approach,' where upstream, the legislator has established a hierarchical level of risk divided into categories: unacceptable risk with a broad prohibition of use; high risk, with a system of preventive and subsequent control; limited and minimal risks, respectively under Titles IV and IX, where the use of codes of conduct is recommended. This approach, so different from the GDPR, could lead to excessive resistance to the possible development of AI in the fields of innovation and industry, despite the provision of specific sandboxes and exceptions for scientific research²².

The regulation moves towards a foundational concept, namely that of the anthropocentric approach. It has rightly been noted that, compared to a concept of technological self-determination, the regulation proposal remains quite distant. Criticisms regarding the exclusion of individuals from decision-making processes and the absence of class action continue to be relevant, confirming that the established perspective is one of reporting to supervisory authorities²³. In this regard, in the opinion of the writer, there is a greater emphasis on balancing the theme of democratic participation of European citizens with that of an increasingly technocratic remedial framework.

Technological and Social Development

In this section, we will focus on the complex interaction between technological progress, particularly the evolution of artificial intelligence (AI) in the fashion industry, the regulatory policies guiding its use, and consumer trends. We will also explore how social values influence and are influenced by these dynamics.

Relationship between Technological Development,

Regulatory Policies, and Consumer Trends: The introduction of AI into the fashion industry is not just a technological issue but also interacts with regulatory policies and consumer trends. Authors like Sundararajan (2017) have examined how technological innovation can alter market dynamics, requiring new forms of regulation and adaptation by businesses. This is particularly true in fashion, where AI can change how consumers interact with brands and make purchasing decisions. Regulatory policies must, therefore, balance promoting innovation with protecting consumers and ensuring fair practices.

Impact of Social Values on the Evolution of AI in Fashion: Social values play a fundamental role in the adaptation and acceptance of AI technologies in the fashion industry. According to Auty and Elliott (2001), cultural and social values influence not only consumer choices but also the direction of technological development. In the context of fashion, this means that consumer expectations regarding sustainability, ethics, and diversity can guide the evolution of AI towards applications that reflect these values. Additionally, public perception of AI can influence how companies implement it in their business and design strategies.

How AI is shaping and being shaped by the social and regulatory environment in the fashion industry is an open issue. We will analyze how a balance between innovation, regulation, and social values is essential for a sustainable and acceptable evolution of AI in fashion.

Conclusions

The future perspective for constructive dialogue and responsible evolution of AI in Fashion: Looking ahead, it is essential to promote a constructive dialogue among all stakeholders involved – designers, fashion brands, consumers, regulators, and AI developers. As suggested by West et al. (2019), such a dialogue should aim for a responsible evolution of AI in the fashion industry, where decisions are made considering both technological innovation and its social and moral consequences. A collaborative and multidisciplinary approach will be crucial to ensure that AI in fashion develops in a way that is beneficial for society as a whole.

We believe a balance between technological innovation and ethics is important: As highlighted

²² Resta, G. Op. cit.

²³ Catanzariti, M. Op. cit.

in our analysis, finding a balance between the technological advancement offered by AI and the ethical implications that arise is crucial. Authors like Floridi and Cowls (2019) have emphasized the importance of an ethical approach to technology, ensuring that innovation is guided not only by technological progress but also by moral and social considerations. In the fashion industry, this means implementing AI in ways that respect human rights, promote diversity, and ensure fair and sustainable practices.

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