Understanding Fashion AI Evolution: A Systematic Literature Review of AI Research in the Fashion Industry

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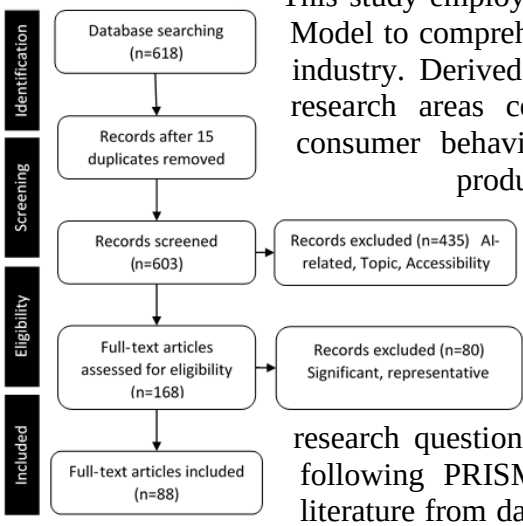
The fashion industry has experienced a significant transformation propelled by Artificial Intelligence (AI) advancements (Buttler, 2022). With the global AI market in fashion growing by 40% from $0.65 billion in 2022 to $0.91 billion in 2023 (Statista, 2022), understanding and adapting to these changes are paramount for fashion researchers. AI, characterized by algorithms trained on datasets, iteratively improves task performance without explicit human instructions (Brynjolfsson & McAfee, 2017). Das et al. (2015) emphasized AI research's aim: advancing machines to human-like intelligence. Machine learning, particularly deep learning, has emerged as a promising approach within AI. Maslej et al. (2023) pointed out that AI's rapid evolution in the fashion industry is primarily driven by the technology of computer vision (CV) and natural language processing (NLP). AI research involves proposing and addressing tasks and utilizing suitable datasets to train the model aimed at addressing real-world challenges.

In fashion AI research, there is an ongoing shift from addressing simple tasks such as object detection to comprehensive tasks such as text-image generation and multimodal recommendation systems (Maslej et al., 2023; Song et al., 2023). While previous AI studies in fashion have made strides, there remain gaps in understanding AI's specific impacts and mechanisms in this field. This study aims to examine how AI research in fashion progresses through task advancements. Analyzing the solutions to existing tasks and newly proposed tasks helps us understand the latest developments and directions in fashion AI research, which is crucial for understanding its impact on the fashion supply chain. Therefore, this study aims to: (a) examine recent AI research in the fashion industry, (b) investigate AI research conducted across various aspects of the fashion supply chain, and (c) explore potential directions for future research in AI for fashion.

Figure1. PRISMA flow chart



This study employed Ha-Brookshire's (2014) C&T Supply Chain Research Model to comprehensively assess the impact of AI research on the fashion industry. Derived from the fashion supply chain, this model categorizes research areas covering various aspects such as history, forecasting, consumer behavior, design, product development, sales, procurement, production, retail, and distribution. By aligning AI fashion research, particularly comprehensive tasks, with these aspects, the C&T model facilitates a structured examination of the current state of AI research in fashion, identifying research gaps. The study aims to explore new research areas and directions by integrating the latest AI developments into supply chain functions. To address research questions, the study employs a systematic review methodology following PRISMA guidelines (refer to Figure 1), accessing relevant literature from databases like DBLP IEEE Xplore, ACM, Web of Science, and arXiv. Filtering yielded 88 articles for detailed analysis, providing insights into achievements,

trends, challenges, and tasks in AI applications within the fashion industry, despite potential limitations.

In addressing our research questions, first, this study introduced a framework, categorizing AI research tasks into training datasets, simple tasks, and comprehensive tasks. This framework facilitates a systematic review of pertinent articles from 2022 and 2023. As the first category, fashion datasets are essential for training, testing, and refining artificial intelligence models in fashion AI research. This study compiled major new datasets in fashion AI, emphasizing their contribution to recent literature (Dodds et al., 2022; Kosar et al., 2022; Zhong et al., 2022; Bai et al., 2023; Long et al., 2023). Positioned at the forefront, these datasets drive advancements and insights in the evolving landscape of AI applications in fashion.

Next, we classified simple tasks into two categories: objective-related and training methods. The findings suggest that within the domain of objective-related simple tasks, deep learning models still dominate this domain. For instance, Yazici et al. (2022) introduced an approach for detecting main products in fashion images by leveraging relationships between bounding boxes across images, thereby enhancing detection accuracy. Song et al. (2023) aimed to address issues such as over-smoothing and lack of detail in clothed human reconstruction from a single image compared to existing implicit function (IF) based approaches. In the training category, fine-tuning methods based on the pre-trained large model were highlighted. For instance, Han et al. (2023) proposed FashionSAP, which facilitates more effective fine-grained fashion vision-language pre-training, leveraging tailored Fashion Symbols and Attribute Prompts, demonstrating clear gains.

At last, In the comprehensive task field, we organized these studies according to the supply chain research framework proposed by Ha-Brookshire (2013). This encompassed a diverse array of challenges spanning history research, forecasting, consumer analysis, design innovation, product development, and e-commerce integration. Notably, Hsiao & Grauman (2021) shed light on the historical context behind a century of fashion imagery, while a multitude of studies have contributed to forecasting trends in both fashion and sales, addressing aspects like popularity and new product sales forecasting. Consumer research has seen advancements in sentiment and cognitive analysis by Yuan & Lam (2022), Pang et al. (2022), Popli et al. (2022), and Seol et al. (2022). Design innovations encompass image, virtual try-on, and text-to-image generation, with contributions from various researchers like Kong et al. (2022), Shimizu et al. (2022), and Pernuš et al. (2022). Product development initiatives focus on size and fit optimization, fashion intelligence, and applications like robot cloth folding and VR experiences, as demonstrated by Pecenakova et al. (2022), Shimizu et al. (2023), and Moletta et al. (2023). E-commerce integration efforts span image retrieval, captioning, and multimodal systems for pricing decisions, alongside various recommendation systems, with contributions from Bao et al. (2022), Barroca et al. (2022), Chia et al. (2022), and Celikik et al. (2022a, 2022b), among others. These endeavors collectively illustrate the intricate integration of multiple AI techniques to address the multifaceted challenges within the fashion industry.

This study is significant because it revealed that the development of AI is driven by the setting of tasks and the improvement of specific task benchmarks. In the fashion domain, proposing

appropriate tasks is crucial for the benign development of fashion AI research. Particularly with the advancement of AI efficiency and the associated increase in costs, there is a shift towards industrial applications in this field. This transition from academia to industry has been significant, especially since 2014, with industry surpassing academia. For instance, in 2022, the industry released 32 significant AI models compared to academia's three (Maslej et al., 2023). However, industry-driven research has notable limitations. It is noteworthy that a review of AI research tasks in recent years indicates an apparent commercial drive. This trend underscores a deficiency in understanding the impact of AI on the fashion supply chain, exacerbating research gaps in various areas such as humanities, societal impact, and sustainability within the fashion industry. This study poses questions and potential directions for future academic AI research.

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