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Virtual Try-On: An Overarching Bibliometric Analysis

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Abstract:

The study presents a comprehensive bibliometric analysis of Virtual Try-On (VTO) and allied technologies within the fashion, retail and e-commerce domains. It aims to identify key publication trends, the most influential contributors, the collaborative and intellectual networks underlying the field, together with its dominant research themes. The analysis draws on 1,265 documents (journal articles, conference proceedings, books, book chapters and reviews) retrieved from the Scopus database, spanning the period 1969 to 2025 and examined using Biblioshiny, the web-based interface of the Bibliometrix R package. Performance analysis (annual scientific production, Bradford's Law, Lotka's Law and author-, source- and country-level productivity and citation indicators) combined with science mapping (thematic evolution, keyword co-occurrence, three-field analysis and international collaboration networks) reveals a marked thematic shift from early computer-graphics and virtual-reality foundations toward augmented reality, computer vision and AI-driven personalisation, closely interlinked with e-commerce, online retailing and the metaverse. China leads the field in publication volume, whereas the USA records a higher citation impact (3,941 total citations at an average of 54 citations per article, against China's 3,203 total citations and an average of 10.5), pointing to a divergence between research productivity and research influence across countries. By consolidating more than five decades of VTO scholarship into a single productivity-, citation- and theme-based mapping, the study provides researchers and practitioners with a structured evidence base for tracking the field's evolution and identifying priority areas for future enquiry. Further research should explore cross-disciplinary innovation and emerging applications to deepen understanding of nascent areas within Virtual Try-On technology.

Keywords: Virtual Try-On, Bibliometric Analysis, Virtual Reality (VR), Augmented Reality (AR), E-commerce, Online shopping

1. Introduction

Extended Reality technologies (XR), Virtual Reality (VR) and Augmented Reality (AR) have seen widespread adoption in consumer-facing industries worldwide over the last decade (Cipresso et al., 2018). Alongside this trend has been rising integration of VR-enabled applications throughout several verticals (Kim et al., 2023), including among senior citizen populations who have benefited from virtual reality platforms to promote social involvement (Wang et al., 2024). In retail, one industry-specific challenge consistently identified by experts has been the inability of consumers to "try before they buy" prior to purchasing an item (Briedis et al., 2020), this reluctance impacts conversion rates and limits margins for apparel companies specifically (Hilken et al., 2017). Virtual Try-On (VTO) technology presents a solution to this issue and is the subject of the current report.

By allowing users to "try before they buy," VTO applications allow consumers to see how a product would look on their own image (or a digital representation), creating a subconscious sense of product-self relevancy that the consumer may not even realise (Lee, 2004; Seo et al., 2016). Fashion brands have leaned into AR-powered VTO as a means to more directly engage consumers throughout the purchase process and improve competitive market standing (Vonkeman et al., 2017). This adoption of VRAR hardware and software solutions across industries has been part of a wider trend toward what Ostrom et al. (2015) term "experiential retail," in which customer experience is mediated by technology. Retail sectors from tourism to healthcare to automotive have integrated XR solutions with the intention of enriching consumers' experience. In fashion retail, this enrichment has been linked to consumer perception specifically (Kim & Forsythe, 2008) as well as consumer enjoyment of using a digital representation of themselves or the item (Richins, 1991).

On the technical side, early advances such as DRAPE demonstrated that two-dimensional garment designs. It is computationally draped onto bodies of varying size and posture to generate three-dimensional visualisations (Guan et al., 2012). Subsequent deep-learning approaches, especially the Virtual Try-On Network (VITON), extended this capability by transferring a clothing item onto an RGB image of a person using a coarse-to-fine, then a multi-task encoder-decoder architecture was conditioned on detailed clothing attributes (Han et al., 2017). These technical foundations underpin the wide range of consumer-facing VTO applications reviewed in this study (Ghodhbani et al., 2022; Islam et al., 2024).

The mechanism through which AR- enabled VTO shapes the relationship between brands and consumers remains comparatively underexplored (Virginie, 2022). Professor Parry Beti from the University of Toronto stated that "Digital avatars are widely reported to contribute a more realistic dimension to this virtual experience as the underlying technology matures".

Virtual Try-On has consequently become integral to fashion and e-commerce, materially shaping how digital shopping trends unfold. Despite this growing practical relevance, the academic literature on VTO remains segmented across disciplines, spanning from computer vision, human-computer interaction, marketing and retail management. The existing reviews are typically confined to narrow technical sub-domains or short publication windows (see the comparison with prior reviews in Section 2.4). A broad, long-run bibliometric mapping of the field's productivity, influential contributors, thematic evolution and collaborative structure has not yet been undertaken. The present study addresses the gap by analysing the full available Scopus publication record on VTO and related technologies from 1969 to 2025. This order helps to identify key contributors, collaborative networks, thematic development and keyword trends within the field. Accordingly, the study addresses the following research questions

RQ1: How do the works of most influential authors impact VTO research globally?

RQ2: How do collaborative networks shape the field of VTO along with its citation pattern?

RQ3: How has VTO technology evolved thematically, setting up trends on a periodic basis?

RQ4: What are the most used keywords in the field of VTO research?

1. Literature Review

1.1 Technological and Computer-Vision Foundations of Virtual Try-On

Virtual Try-On technology has achieved substantial growth in the retail sector, offering consumers a reliable means of trying on clothes virtually. This acts as a substitute for in-store participation (Matiur et al., 2020). An online optimisation module for OVITON refines the visual appearance of the generated try-on image (Neuberger et al., 2020). It is further observed that single-stage, image-based VTO processing doesn't deliver a fully convincing try-on experience solely and introduces warped cloth learning to improve the quality. Also, computational efficiency of the VTO method to enhance the realism of the virtual experience (Pathak et al., 2024).

1.2 VTO Applications in Fashion, Retail and E-Commerce

Virtual fitting room technology has become a significant point of competitive differentiation among fashion brands operating within Retail 4.0, itself grounded in XR technology. The textile and apparel industry is shaped by a combination of socio-cultural (Ceschin et al. 2010) and economic structural factors, within which innovation plays a central role: an evaluation of Amazon's initiative demonstrated how its business model advanced digital fashion platforms, positioning Amazon as a top-ranked fashion retailer in the United States (Akhtar et al., 2022). Using advanced technology, Fabricant creates virtual garments and accessories as a digital-only fashion brand, offering an experience regarded as more authentic and immersive than comparable applications (Särmäkäri, 2021). Similarly, the use of Amazon Alexa's voice commands within VR fashion stores has been shown to enhance the shopping experience (Morotti et al., 2021). Several AR/ VR applications have extended VTO into mainstream retail, including Snapchat's Snapwear (Oikonomou et al., 2021) and AR filters developed in partnership with Fartech and Prada for virtual try-on via mobile cameras (Spajić et al., 2022).

Established fashion companies including Gucci, Nike, Adidas, Ray-Ban, Tiffany & Co., Crocs and Converse have likewise integrated VTO technology into their e-commerce platforms through Snapchat's AR lenses and other mobile applications (Ricci, 2022). Feedback from fashion designers further indicates that 3D objects support an interactive design process within VR environments.

2.3 Consumer Behaviour and Marketing Perspectives on VTO

From a consumer behaviour perspective, Gu et al. (2020) applied a Stimulus-Organism-Response (S-O-R) framework to AR-enabled retail settings, showing how AR features shape consumer experience and behaviour within the fashion and apparel domain, with algorithmic and data-mining techniques used to refine preference recognition and generate personalised recommendations.

2.4 Positioning of the Present Study Relative to Prior Reviews

Two recent reviews have similarly sought to synthesise the growing VTO literature, though with different scope and method. Table 1 compares these studies with the present analysis to clarify the specific contribution made here.

Table 1. Comparison of the Present Study with Prior Reviews of Virtual Try-On Research

Study	Database Searched	Period Covered	Sample	Method/ Focus	Key Difference from the Present Study
Batool & Mou (2023), Cleaner Engineering and Technology	Scopus, Emerald, Springer, Wiley, Science Direct, ProQuest, IEEE Xplore	Jan 2005 - Feb 2023	80 studies	Systematic literature review categorising virtual fitting room studies by geography, research method and outcome variables	Qualitative/ descriptive synthesis, no citation, productivity or network analysis
Chen, Ni & Zhang (2024), Applied Sciences, 14(24), 11839	Scopus, Web of Science	Records screened from 930 initial hits; published Dec 2024	69 articles	PRISMA guided systematic review, content analysis building conceptual frameworks of consumer behaviour antecedents and consequences	Focused on psychological/ behavioural determinants of VTO adoption, not a bibliometric or science-mapping study
Present study	Scopus	1969 - 2025	1,265 documents	Bibliometric analysis (performance analysis and science mapping) using Biblioshiny/ Bibliometrix	Full-history, quantitative mapping of productivity, citation impact, thematic evolution and international collaboration networks across five decades

As Table 1 indicates, prior reviews of VTO research have relied on qualitative or content-analytic synthesis of a comparatively small, recent set of studies. The present study instead applies a quantitative bibliometric approach across the full available Scopus publication history, combining performance analysis and science mapping to characterise productivity, citation impact, thematic evolution and collaboration structure in a single, reproducible framework.

1. Methodology

Bibliometric analysis is a structured approach for mapping the knowledge base of a research domain using the quantitative tools (Kapoor et al., 2017). This study applied the approach to evaluate the research landscape of Virtual Try-On (VTO) technology, assisting in the assessment of publication trends, influential authors, research collaboration and thematic development within the field. The analysis was conducted using Biblioshiny, the web-based interface of Bibliometrix version 4.4.x and R version 4.5.x. Bibliometrix supports descriptive performance analysis and science-mapping procedures including source, author, country, citation, co-word and thematic analyses (Aria & Cuccurullo, 2017; Donthu et al., 2021). Data were retrieved from the Scopus database using the search string ("virtual tryon") OR ("virtual store"), applied to the Title, Abstract and Keywords fields. This initial search returned 1,265 documents, subsequently filtered by: (i) time period, 1969 to 2025; (ii) document type, comprising journal articles, conference proceedings, books, book chapters and reviews; (iii) language, English only; (iv) removal of duplicate records; and (v) Scopus subject category, limited to Social Sciences. All 1,265 documents met these criteria and were retained for analysis.

Virtual Try-On technology has procured substantial growth in the retail sector with reliable experience for consumers to try on clothes virtually in the event of in- store participation (Matiur et al., 2020). A proposed online optimisation module for OVITON for refining the appearance (Neuberger et al., 2020). Image-based VTO of a novel single- stage processing does not provide the essential VTO experience. Warped cloth learning is introduced to improve the quality and efficient functioning of VTO methods for users to experience realism in living in the virtual world (Pathak et al., 2024).

Social Sciences-only subject-category filter warrants a second look, since several of the most-cited documents in the dataset (e.g., Han et al., 2018, published at the IEEE Conference on Computer Vision and Pattern Recognition; Guan et al., 2012 and Pons-Moll et al., 2017, both in ACM Transactions on Graphics) are computer-science/ graphics venues that Scopus would not typically classify under Social Sciences. Please confirm whether this filter was in fact applied as shown in Fig. 1, or whether the category restriction should be corrected (e.g., to include Computer Science) so that the reported methodology matches the actual dataset.] The parameters of data collection are summarised in Fig. 1 below.

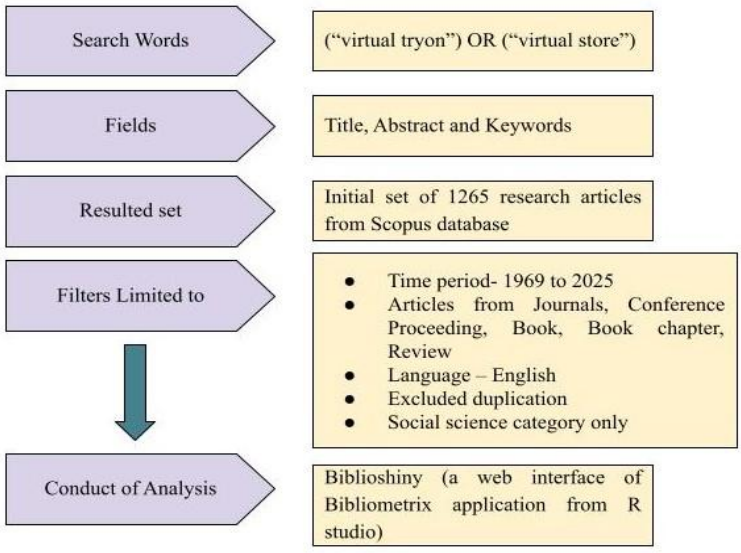

Fig.1. Methodology of the Study

1. Findings and Discussions

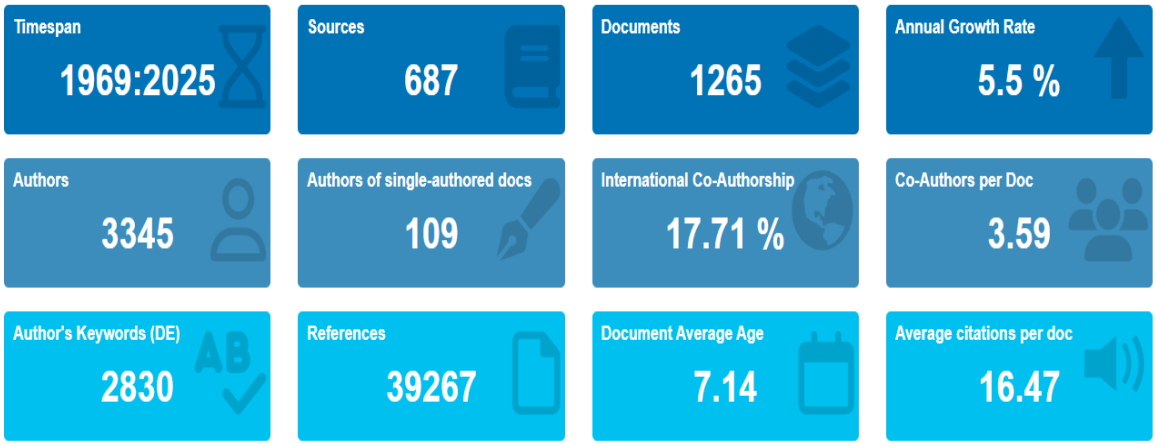

Fig.2. Main information about data

Fig. 2 summarises the descriptive profile of the dataset: the 1,265 documents were drawn from 687 sources, including journals, conference proceedings, books and book chapters, published between 1969 and 2025. The dataset reflects an annual growth rate of 5.5 percent, with contributions from 3,345 distinct authors, of whom 109 documents in the corpus are single-authored (the distinct proportion of authors who have published only one document in the dataset overall is reported separately under Lotka's Law, Section 2.1). International co-authorship accounts for 17.71 percent of papers, indicating a moderate level of global research partnership, with an average of 3.59 authors per document. The dataset includes 2,380 author keywords and 39,267 cited references. The average document age is 7.14 years, with a mean of 16.47 citations per document across the period examined.

4.1 Virtual Try- On (VTO) - Research Trends and Thematic Developments

4.1.1 Eventual Research Growth

As shown in Fig.3 and Table 2, productivity has started to increase considerably from the year 2001, with fluctuating high to low for the next 5 years and has again shown greater productivity over the last 20 years (2007 to 2025). The tabular representation below, it shows expeditious growth from the past 10 years, as this current year starts with a steady escalation. This Annual Scientific Production indicates a notable increase in the rise in publications, mirroring growing interest in academics and industry.

Table 2. Annual Scientific Productivity

Year	Articles	Year	Articles
2016	40	2021	106
2017	39	2022	135
2018	40	2023	175
2019	72	2024	221
2020	76	2025	20

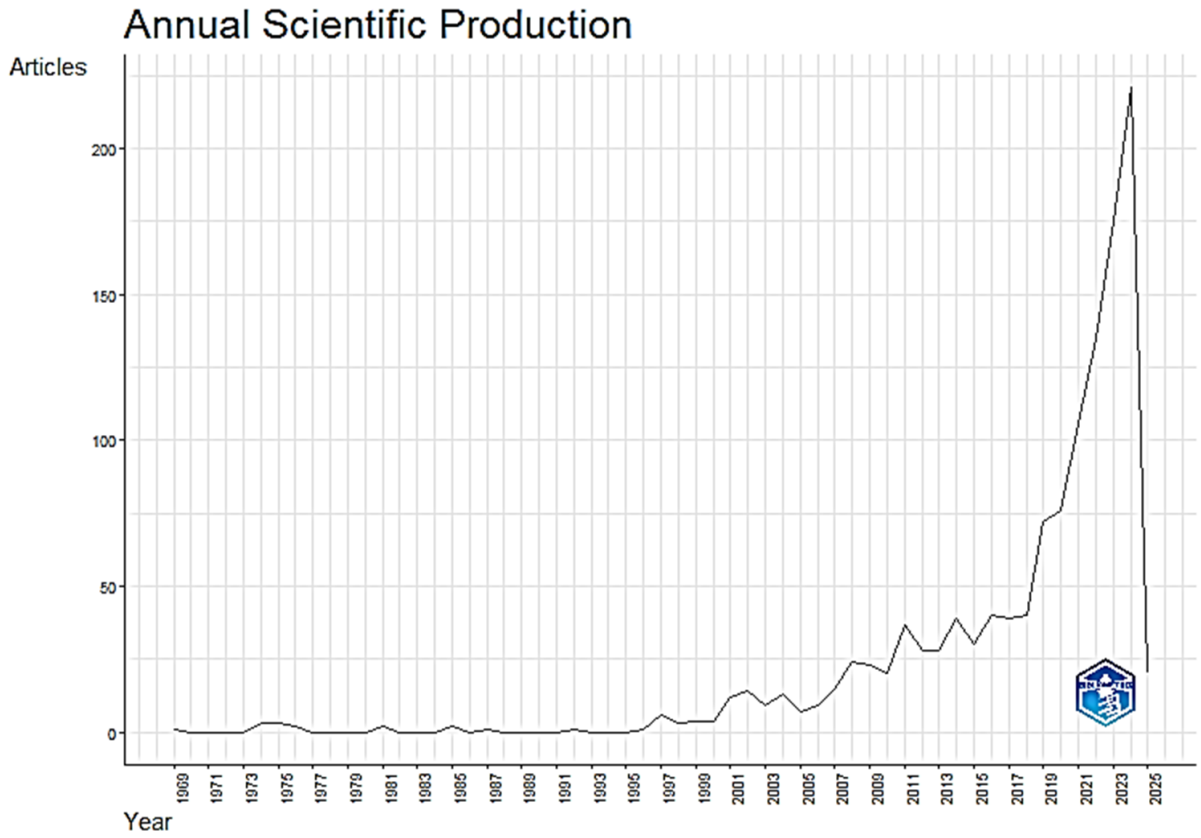

Fig. 3. Graphical Representation of Annual Scientific Productivity

4.1.2 Thematic Evolution and Trends

Research in VTO technology and related fields has evolved from early conceptual studies toward more applied, technologically integrated innovation in recent years. As shown in Fig. 4, the thematic evolution spans four periods. In the earliest period (1969-2015), foundational research centred on computer-aided design, virtual reality (VR), electronic commerce and general studies of human interaction with computer systems. The second period (2016-2021) shows a marked shift toward virtual try-on itself, alongside virtual reality, mobile applications, clothing and product design, as AR/VR applications began to integrate more directly with computer vision techniques to enable practical VTO experiences. The third period (2022-2023) reflects continued emphasis on virtual try-on, virtual stores and virtual reality, alongside emerging deep-learning applications and, notably, telemedicine, an unexpected co-occurrence that likely reflects overlapping AR/ VR terminology across health-technology and retail-technology literatures rather than a substantive convergence of the two fields. In the most recent period (2024-2025), virtual try-on remains dominant, now co-occurring with three-dimensional computer graphics, consumer behaviour, sales, consumption behaviour and animation, themes that mark VTO's growing association with consumer-behaviour and marketing outcomes; this reflects a co-occurrence pattern in the keyword data rather than a tested causal relationship between VTO adoption and sales performance.

The terms “Augmented Reality (AR)” and “Virtual Reality (VR)” have consequently diversified into more specific applied terms over time. Fig. 5 presents a word cloud of the most frequent terms in the dataset, in which “virtual try-on” is the most prominent term, followed by “augmented reality”, “virtual reality”, “deep learning”, “virtual store”, “computer vision”, “e-commerce”, “online shopping”, “image synthesis” and “generative adversarial networks”. Analysis of keyword co-occurrence further indicates that “e-commerce” and “virtual store” form a central thematic node within the network. Trend topics over time are visualised in Fig. 6 and summarised in Table 3 “Virtual try-on” (454 occurrences) and “virtual reality” (292 occurrences) show the highest term frequency, with “augmented reality” also showing sustained traction over the period.

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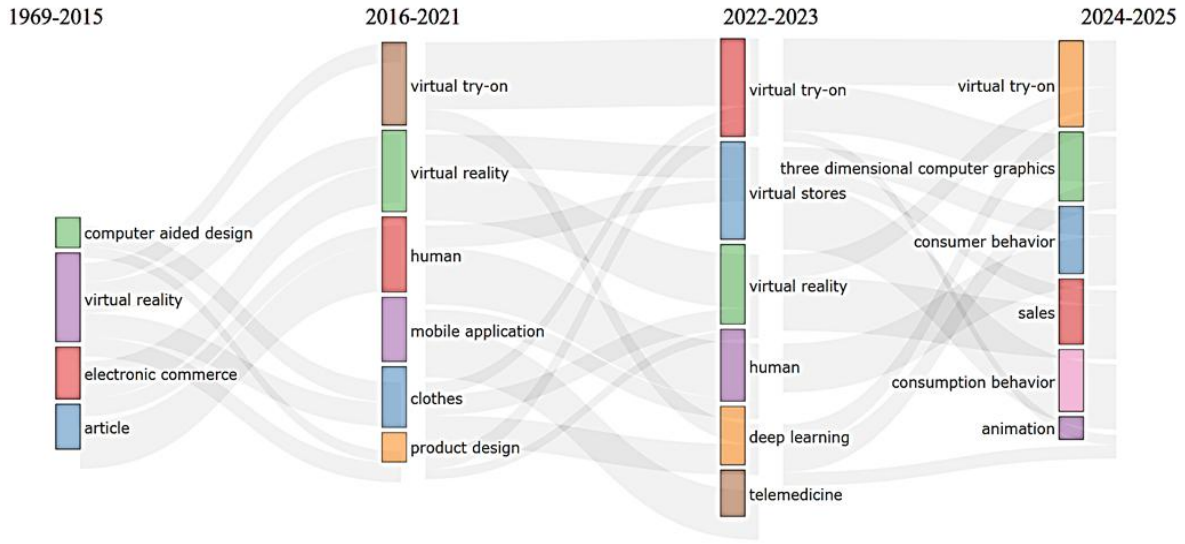

Fig.4. Thematic Evolution

From Fig. 4, the early phase from 1969 to 2015 had foundational research exploring the areas of computer graphics and its aided designs, virtual reality (VR), e-commerce and articles studying humans, followed by the next phase from 2016 to 2021, when research significantly shifted towards AR applications that integrated with computer visual techniques, enabling the experience of Virtual Try-On technology. From the period of 2022 to the present (2025) indication of growing emphasis on VTO applications, AI-driven personalisation and deep learning in various fields, trying to enhance consumers' consumption behaviour, which leads to sales growth. The terms "Augmented Reality (AR)" and "Virtual Reality (VR)" have evolved into various terms, giving birth to new forms, as represented in the below Fig. 5. of Word Frequency over Time, which currently places trending words that are "Virtual Try-On", "Virtual Reality", "Augmented Reality" and "Computer Vision". Analysing the network of keywords, "e-commerce" and "virtual store" have a central theme. Trending topics are visualised in Fig.6 and Table 2. The table particularly selected the period from 2015 to 2025, which describes the frequency of topics evolved around these periods, where "Virtual Try-On" (455 occurrences), "Virtual Reality" (292 occurrences) and "Augmented Reality" had their traction over the years with high term frequency.

Fig.5. WordCloud

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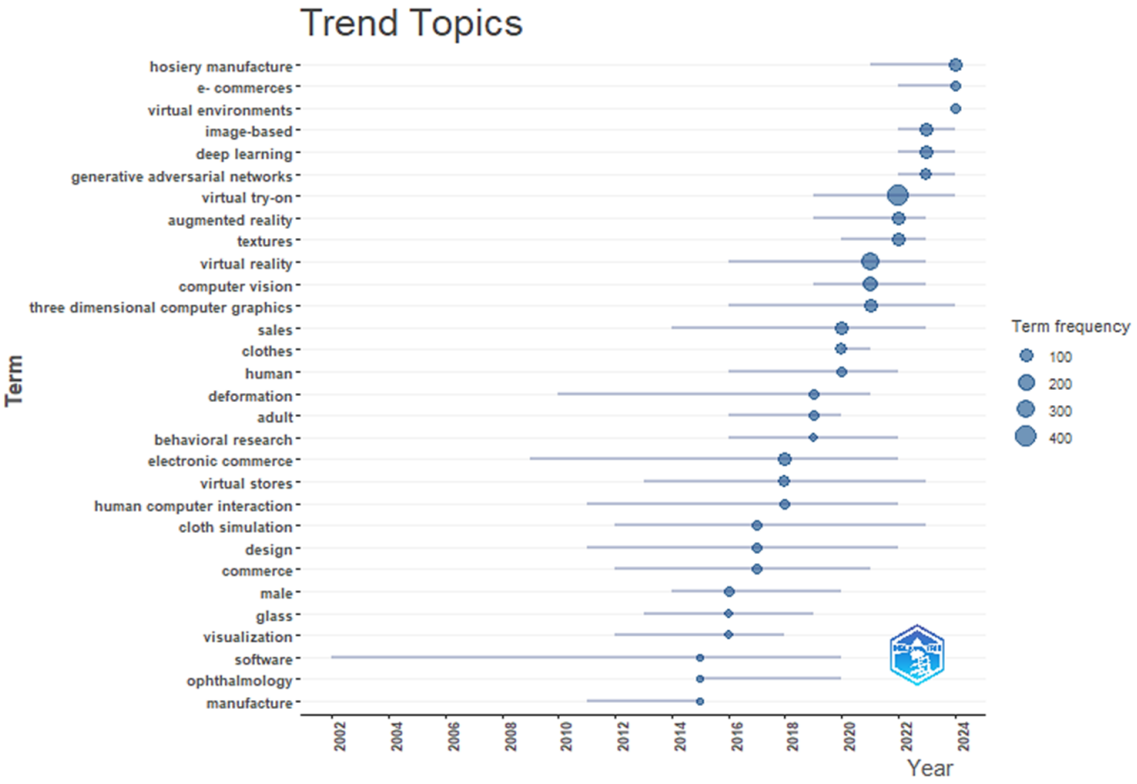

Fig .6. Trend Topics

Table 3. Tabular representation of Trend Topics

Term	Frequency	Year (Q1)	Year (Median)	Year (Q3)
electronic commerce	103	2009	2018	2022
sales	92	2014	2020	2023
virtual reality	292	2016	2021	2023
computer vision	124	2019	2021	2023
three-dimensional computer graphics	93	2016	2021	2024
virtual try-on	454	2019	2022	2024
augmented reality	106	2019	2022	2023
textures	83	2020	2022	2023
image-based	87	2022	2023	2024
hosiery manufacture	113	2021	2024	2024

4.2 Influential Authors Work- Global Impacts

4.2.1 Influential Authors

Bradford's Law ranks journals by the number of articles they publish on a given subject, sorting sources into three zones: Zone 1 comprises a small number of highly productive core journals, Zone 2 a moderate tier of journals and Zone 3 a large number of journals each publishing relatively few relevant papers (peripheral journals) (Desai et al., 2018). As shown in Fig. 7 below, Lecture Notes in Computer Science, ACM International Conference Proceedings and Proceedings of the IEEE Conference rank as the top three core journals by output. Proceedings of the IEEE Computer Society Conference recorded 1,829 citations and the highest H-index (15), followed by Lecture Notes in Computer Science (77 articles) and ACM International Conference Proceedings (29 articles).

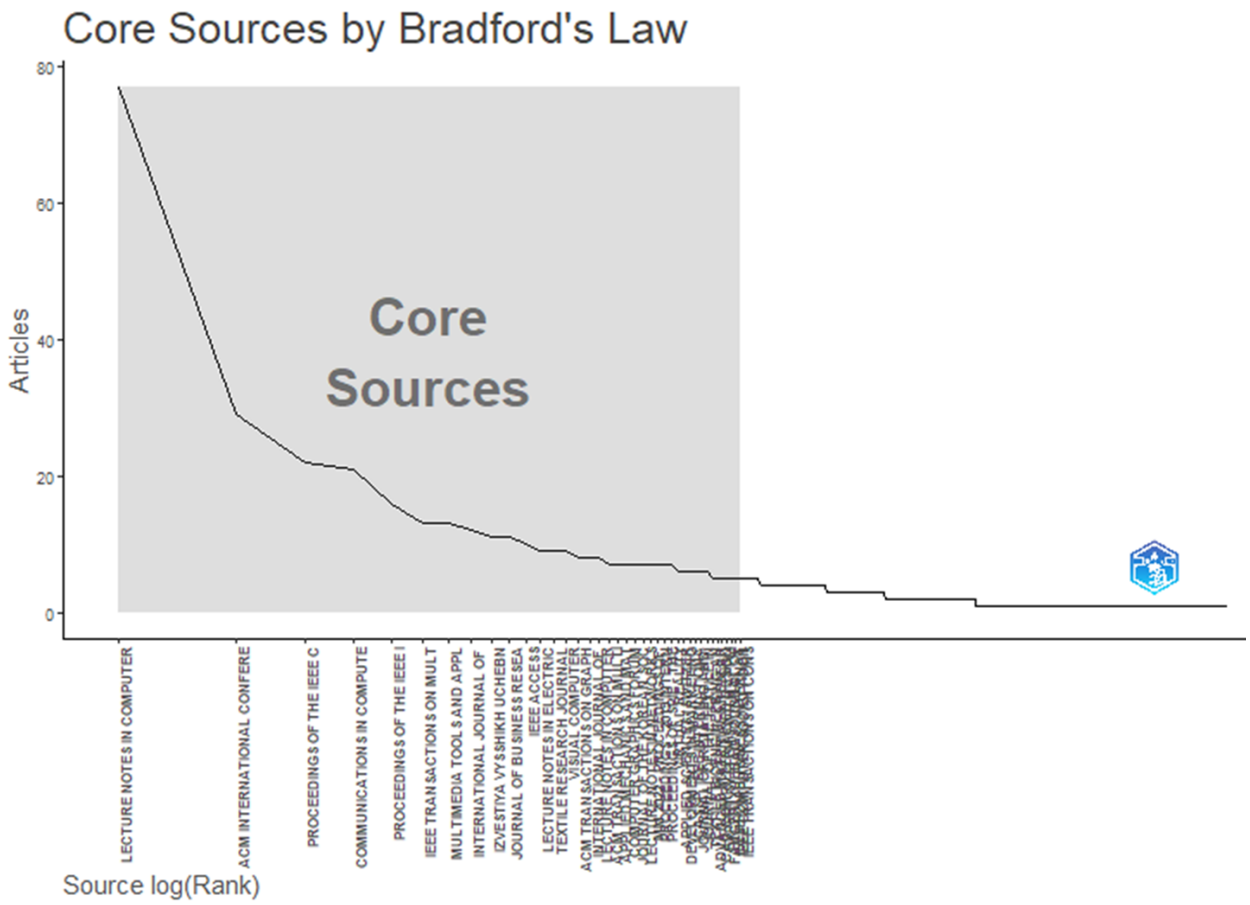

Fig.7. Visualisation of Bradford's Law

Table 4. Most Relevant Authors

Authors	Articles	Articles Fractionalized
HU, XINRONG	23	3.4297619
PENG, TAO	22	3.28690476
JIANG, MINGHUA	15	2.20238095

KUZMICHEV, V.E.	15	6.83333333
BRUNIAUX, PASCAL	13	2.91785714
LIU, CHENG-LI	12	7.33333333
YU, FENG	12	1.69047619
ZHONG, YUEQI	12	4.9
DU, CHENGHU	11	2.46190476
LIU, KAIXUAN	10	1.96904762

From Table 4, the top 10 most influential authors have contributed substantially to VTO and related technologies. Hu Xinrong, Peng Tao, Jiang Minghua, Kuzmichev V.E. and Bruniaux Pascal play a particularly prominent role, working across deep learning, interactive AR systems and computer vision and advancing VTO development through high-productivity contributions. Consistent with Lotka's Law, 82 percent of authors in the dataset have published only a single paper, a pattern typical of scientific author-productivity distributions.

4.2.2 Productive Trends- Authors Impact and Citations

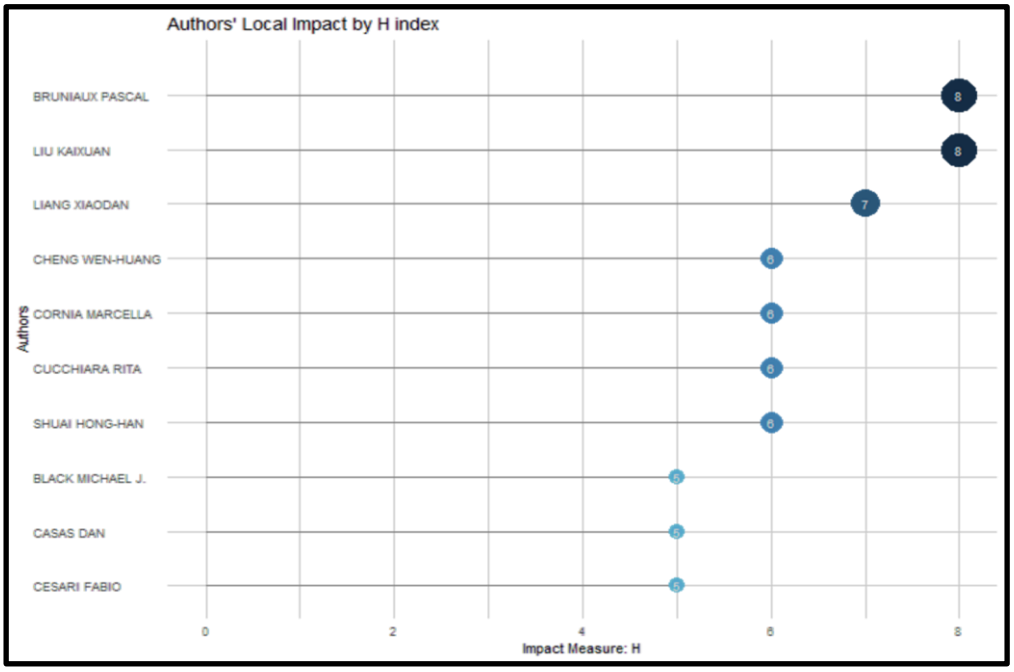

Fig.8. Visualization of Local Impact Pattern

Fig.8. shows that Bruniaux Pascal, Liu Kaixuan and Liang Xioudon record the highest local H-index values. Pascal, with a local H-index of 8 and 278 total citations, focuses on 3D modelling and virtual fitting using computational approaches, Liu Kaixuan has contributed substantially to the area of AR-based VTO experiences. The sustained citation activity around their work reflects ongoing scholarly interest in realistic virtual experiences, user interaction and the underlying computational foundations

4.3 Citation Patterns and Networked Collaborations

By analyzing most cited global documents, researchers recognise the most impactful and influential research within the area, pinpointing significant understanding of a term or topic revealing its importance by

identification of trends (Rodríguez-Navarro & Brito, 2024).

4.3.1 Underlying Studies and Most Cited Papers

Fig. 9 illustrates the most globally cited documents in the dataset. The most-cited paper, published in the Journal of Business Research by Eroglu, Machleit and Davis (2001) on "Atmospheric qualities of online retailing: A conceptual model and implications," has accumulated 1,007 total citations (40.28 citations per year; normalised citation score of 10.55), examining how atmospheric cues shape shoppers' affective and cognitive reactions. The second most cited paper is by Chen, Gillenson and Sherrell (2002), "Enticing online consumers having an extended technology acceptance perspective," published in Information & Management, has 914 total citations (38.08 citations per year, normalised score of 7.79). This analyses consumer behaviour in virtual stores through the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT). Arthur Burke (2002) contributes the third most cited paper, examining digital consumer engagement in the context of VTO adoption in retail, with 619 citations. While Han, Wu, Wu, Yu and Davis (2018) contributed the fourth most cited paper, with 468 citations, presenting an image-based VTO system built on deep learning. These four studies collectively serve as foundational building blocks for subsequent innovation in the field. Table 5 extends this list to the ten most-cited documents globally in the dataset.

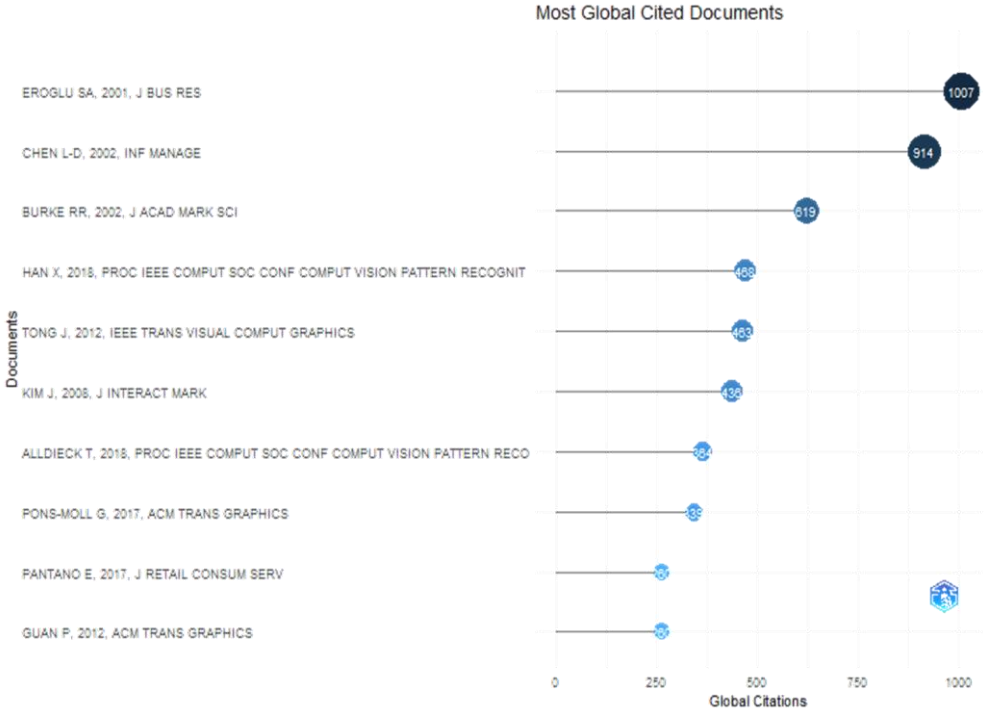

Fig.9. Global Cited Documents

Table 5. Ten Most Globally Cited Documents in the Dataset

Rank	Author(s) & Year	Source	Total Citations
1	Eroglu, Machleit & Davis (2001)	Journal of Business Research	1,007
2	Chen, Gillenson & Sherrell (2002)	Information & Management	914
3	Burke (2002)	Journal of the Academy of Marketing	619

		Science	
4	Han, Wu, Wu, Yu & Davis (2018)	Proc. IEEE Conference on Computer Vision and Pattern Recognition	468
5	Tong (2012)	IEEE Transactions on Visualization and Computer Graphics	463
6	Kim (2008)	Journal of Interactive Marketing	438
7	Alldieck (2018)	Proc. IEEE Conference on Computer Vision and Pattern Recognition	384
8	Pons-Moll (2017)	ACM Transactions on Graphics	339
9	Pantano (2017)	Journal of Retailing and Consumer Services	Approx. 285*
10	Guan (2012)	ACM Transactions on Graphics	Approx. 285*

*Exact citation count could not be verified with full precision from the Fig. 9 chart.

4.3.2 Countries Productivity and Global Interactive Network

Table 6. Most Productive Countries by Scientific Production

Region	Frequency
CHINA	1537
USA	404
INDIA	361
SOUTH KOREA	207
SPAIN	152
JAPAN	146
UK	145
BRAZIL	131
GERMANY	125
FRANCE	111

Table 6 depicts the top 10 countries of scientific production (documents associated with at least one author affiliated with that country) in VTO and related technologies. China, the USA, India, South Korea and Japan are the top five producers of research. China's contributing well ahead of the USA and other countries, positioning China as a major technology hub for VTO development, particularly in retail and e-commerce applications. The institutions contributing the highest publication counts are Wuhan Textile University and Donghua University indicates that the country, with 145 and 103 articles respectively. This pattern is consistent with a close relationship between government and industry funding and technologies associated with Virtual Try-On and its

related fields, including Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI) and fashion technology more broadly.

Table 7. Most Cited Countries

Country	Total Citations	Average Article Citations
USA	3941	54
CHINA	3203	10.5
UNITED KINGDOM	795	34.6
KOREA	541	10.4
FRANCE	513	28.5
SPAIN	416	17.3
GREECE	328	41
NEW ZEALAND	287	57.4
INDIA	271	4.6
HONG KONG	269	22.4

Citation impact across countries is led by the USA, with total citations of 3,941 exceeding China's 3,203, despite China's substantially higher publication volume. This suggests that USA based VTO research is mostly associated with AI-driven applications and attracts disproportionately higher citation attention relative to output. The United Kingdom, having 795 total citations, ranked third, reflecting a foundational research contribution behind the USA and China (Table 7). The collaborative world map of research under Virtual Try-On from Fig. 10 depicts China and the USA dominating other countries. China acts as the most active contributor and the USA acts as the global connector in research. China has 27 collaborative research projects with the USA, Hong Kong has 17, France and Singapore have 13 collaborations each and the United Kingdom has 12. China also has an Intra-Asian network as the country collaborated with Korea, Japan, Malaysia and New Zealand with 3 collaborations each. Next, the USA has strong connectivity by having significant collaborations with China (27), Korea (9), India (6), Germany (5) and Singapore (4), actively working with European and Asian countries, forming a broad research network.

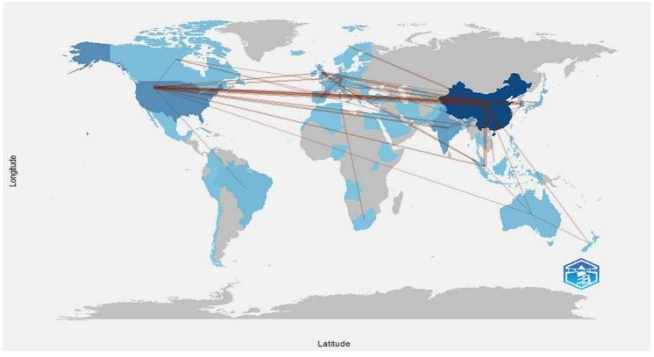

Fig. 10. Collaboration of Countries in World Map

The USA's leadership position affords it substantial leverage in collaborations that drive innovation in cutting-edge VTO technology. The United Kingdom acts as a European hub, bridging European, Asian and American countries in research. France, as a key European contributor, collaborates with Canada and Romania (3 collaborations each) and maintains a strong partnership with China (13), reflecting a balanced mix of collaborative patterns across European and Asian countries. India is increasingly active in VTO research, engaging in collaboration with the USA, Japan, the UK and Korea.

4.4 Visualisations from the Three-Field plot

Fig. 11 represents the association between countries (AU_CO), keywords (DE) and authors (AU) in VTO research. China leads significantly in research volume compared to other countries, including India, the USA, Korea, Spain, Nigeria, the UK, France, Germany and Brazil, which contribute at comparatively lower levels. China's position reflects its dominance in AI-driven and AR/VR advancement within fashion technology. The research topics most closely associated with VTO are Augmented Reality (AR), Virtual Reality, image synthesis, appearance flow and deep learning. Authors such as Liu Chenghu and Liu Chengli have made notable contributions within this thematic space.

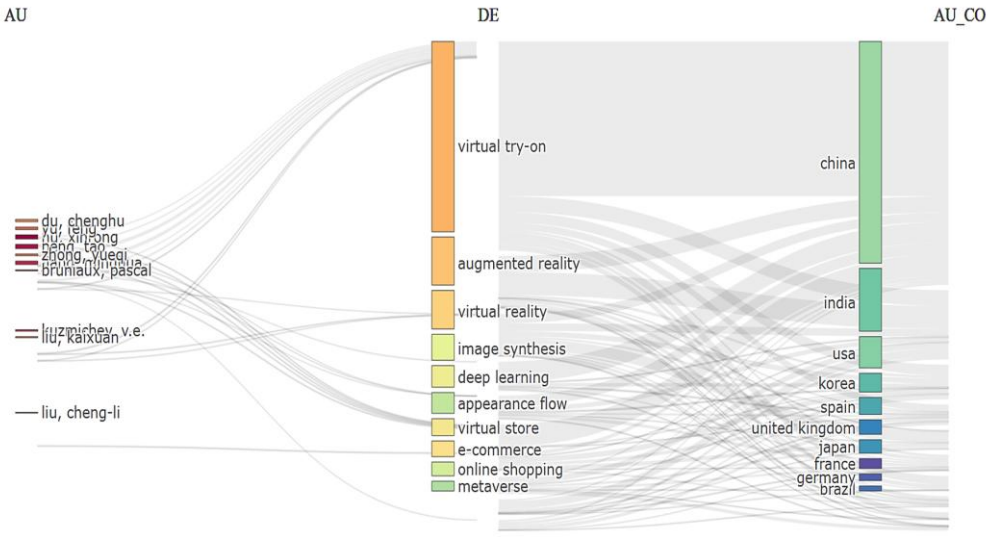

Fig.11. Visualisation of Three-Fields Plot

Topic areas like E-Commerce, online shopping, virtual store and metaverse indicate a strong link associated with the VTO and digital transformation in the retail sector.

5. Synthesis: Integrating the Findings

Altogether, these results indicate that VTO research has matured along two related but distinct axes. First, productivity is concentrated in China, driven substantially by textile and engineering oriented institutions such as Wuhan Textile University and Donghua University. This consistently reflects China's broader manufacturing and technology base in textiles and AI. Secondly, citation influence is concentrated in the USA, where foundational, highly cited work in marketing and information systems (Eroglu et al., 2001; Chen et al., 2002; Burke, 2002) established the conceptual groundwork later drawn upon by more recent computer-vision and deep-learning contributions (Han et al., 2018; Guan et al., 2012; Pons-Moll et al., 2017). This divergence between where VTO research is produced and where it is most heavily cited suggests that Chinese institutions are driving the volume of technical development, while foundational theoretical and marketing frameworks, disproportionately cited across the field, largely originate from the USA.

The thematic evolution traced in Section 1.2 reinforces this picture: the field has moved from general computer-graphics and virtual-reality foundations (pre-2016) through applied AR/VTO systems (2016–2021) toward

integration with deep learning, virtual retail and, most recently, consumer-behaviour and sales-related outcomes (2022–2025). Read alongside the collaboration network (Fig. 10), in which China and the USA anchor the two most active poles of international collaboration, this suggests that VTO scholarship is consolidating around a technology-to-market pipeline, in which computer-vision advances developed largely in China and East Asia are increasingly evaluated against consumer-behaviour and retail-outcome frameworks developed largely in North America and Europe. This synthesis directly addresses RQ1–RQ4 by linking productivity and citation leadership (RQ1) to collaboration structure (RQ2), thematic evolution (RQ3) and keyword association patterns (RQ4) within a single explanatory account, rather than treating each bibliometric indicator in isolation.

6. Conclusion

This bibliometric analysis of 1,265 documents retrieved from Scopus using the search terms "virtual tryon" and "virtual store" maps the research landscape of Virtual Try-On (VTO) technology and its integration with Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR) and deep learning, alongside its strong ties to e-commerce, online shopping and the metaverse. In relation to the study's four research questions, China leads the field in publication volume, driven substantially by textile- and engineering-focused institutions, while authors such as Hu Xinrong and Peng Tao have made particularly influential contributions at the intersection of VTO and machine learning (RQ1). Citation impact, by contrast, is led by the USA, whose foundational marketing and information-systems literature continues to be widely cited despite lower publication volume than China (RQ1). International collaboration remains moderate, at 17.71% of papers, with China and the USA anchoring the two most active poles of the collaboration network and the UK, France and other countries occupying more peripheral, bridging positions (RQ2). Thematically, VTO research has evolved from early computer-graphics and virtual-reality foundations toward integration with deep learning, virtual retail and, most recently, consumer-behaviour and sales-related outcomes (RQ3), with "virtual try-on," "augmented reality" and "virtual reality" remaining the most persistent keywords across the period, closely associated with "e-commerce" and "virtual store" (RQ4). Theoretically, the study contributes a consolidated, multi-indicator bibliometric account of VTO scholarship spanning more than five decades, complementing the narrower systematic reviews discussed in Section 2.4. Methodologically, it demonstrates the value of combining performance analysis and science mapping within a single Biblioshiny-based workflow to track a fast-growing, interdisciplinary technology field.

References:

[1] Akhtar, W. H., Watanabe, C., Tou, Y., & Neittaanmäki, P. (2022). A new perspective on the textile and apparel industry in the digital transformation era. Textiles, 2(4), 633–656. https://doi.org/10.3390/textiles2040037

[2] Aria, M., & Cuccurullo, C. (2017). bibliometrix : An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

[3] Briedis, H., Kronschnabl, A., Rodriguez, A., & Ungerman, K. (2020, May 14). Adapting to the next normal in retail: The customer experience imperative. McKinsey & Company. https://www.mckinsey.com/industries/retail/our-insights/adapting-to-the-next-normal-in-retail-the-customer-experience-imperative

[4] Burke, R. R. (2002). Technology and the customer interface: what consumers want in the physical and virtual store. Journal of the Academy of Marketing Science, 30(4), 411–432. https://doi.org/10.1177/009207002236914

[5] Ceschin, F., Vezzoli, C., & Zhang, J. (2010). Trends and tradition: Negotiating different cultural models in relation to sustainable craft and artisan production - UAL Research Online. https://ualresearchonline.arts.ac.uk/id/eprint/4615

[6] Chen, L., Gillenson, M. L., & Sherrell, D. L. (2002). Enticing online consumers: an extended technology acceptance perspective. Information & Management, 39(8), 705–719. https://doi.org/10.1016/s0378-7206(01)00127-6

[7] Cipresso, P., Giglioli, I. a. C., Raya, M. A., & Riva, G. (2018). The Past, Present, and Future of Virtual and Augmented Reality Research: A network and cluster analysis of the literature. Frontiers in Psychology, 9. https://doi.org/10.3389/fpsyg.2018.02086

[8] Desai, N., Veras, L., & Gosain, A. (2018). Using Bradford's law of scattering to identify the core journals of pediatric surgery. Journal of Surgical Research, 229, 90–95. https://doi.org/10.1016/j.jss.2018.03.062

[9] Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2001). Atmospheric qualities of online retailing. Journal of Business Research, 54(2), 177–184. https://doi.org/10.1016/s0148-2963(99)00087-9

[10] Ghodhbani, H., Neji, M., Razzak, I., & Alimi, A. M. (2022). You can try without visiting: a comprehensive survey on virtually try-on outfits. Multimedia Tools and Applications, 81(14), 19967–19998. https://doi.org/10.1007/s11042-022-12802-6

[11] Gu, X., Gao, F., Tan, M., & Peng, P. (2020). Fashion analysis and understanding with artificial intelligence. Information Processing & Management, 57(5), 102276. https://doi.org/10.1016/j.ipm.2020.102276

[12] Guan, P., Reiss, L., Hirshberg, D. A., Weiss, A., & Black, M. J. (2012). DRAPE. ACM Transactions on Graphics, 31(4), 1–10. https://doi.org/10.1145/2185520.2185531

[13] Häfiger, U., Stasinakis, A., Chatzilari, E., Nikolopoulos, S., & Pugliese, M. (2021) eTryon - the user requirements. Zenodo.

[14] Han, X., Wu, Z., Wu, Z., Yu, R., & Davis, L. S. (2017). VITON: an image-based virtual try-on network. arXiv (Cornell University). https://doi.org/10.48550/arxiv.1711.08447

[15] Hilken, T., De Ruyter, K., Chylinski, M., Mahr, D., & Keeling, D. I. (2017). Augmenting the eye of the beholder: exploring the strategic potential of augmented reality to enhance online service experiences. Journal of the Academy of Marketing Science, 45(6), 884–905. https://doi.org/10.1007/s11747-017-0541-x

[16] Islam, T., Miron, A., Liu, X., & Li, Y. (2024). Deep Learning in Virtual Try-On: A Comprehensive survey. IEEE Access, 12, 29475–29502. https://doi.org/10.1109/access.2024.3368612

[17] Kapoor, K. K., Tamilmani, K., Rana, N. P., Patil, P., Dwivedi, Y. K., & Nerur, S. (2017). Advances in social Media Research: past, present and future. Information Systems Frontiers, 20(3), 531–558. https://doi.org/10.1007/s10796-017-9810-y

[18] Kim, J., & Forsythe, S. (2008). Adoption of Virtual Try-on technology for online apparel shopping. Journal of Interactive Marketing, 22(2), 45–59. https://doi.org/10.1002/dir.20113

[19] Kim, S. Y., Park, J., Choi, H., Loeser, M., Ryu, H., & Seo, K. (2023). Digital marker for early screening of mild cognitive impairment through hand and eye Movement analysis in Virtual Reality using Machine Learning: First Validation study. Journal of Medical Internet Research, 25, e48093. https://doi.org/10.2196/48093

[20] Lee, K. M. (2004). Presence, explicated. Communication Theory, 14(1), 27–50. https://doi.org/10.1111/j.1468-2885.2004.tb00302.x

[21] Matiur Rahman Minar, Thai Thanh Tuan, Heejune Ahn, Paul Rosin, and Yu-Kun Lai, "Cp-vton+: Clothing shape and texture preserving image-based virtual try-on," in CVPR Workshops, 2020, vol. 3, pp. 10–14.

[22] Morotti, E., Stacchio, L., Donatiello, L., Roccetti, M., Tarabelli, J., & Marfia, G. (2021). Exploiting fashion x-commerce through the empowerment of voice in the fashion virtual reality arena. Virtual Reality, 26(3), 871–884. https://doi.org/10.1007/s10055-021-00602-6

[23] Neuberger, A., Borenstein, E., Hilleli, B., Oks, E., & Alpert, S. (2020). Image based Virtual Try-On network from unpaired data. 2022 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR). https://doi.org/10.1109/cvpr42600.2020.00523

[24] Oikonomou, K., Chatzilari, E., Nikolopoulos, S., Kompatsiaris, I., Gavilan, D., & Downing, J. (2021b). Snapwear: A Snapchat AR filter for the virtual tryon of real clothes. 2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), 46–51. https://doi.org/10.1109/ismar-adjunct54149.2021.00019

[25] Ostrom, A. L., Parasuraman, A., Bowen, D. E., Patrício, L., & Voss, C. A. (2015). Service research priorities in a rapidly changing context. Journal of Service Research, 18(2), 127–159. https://doi.org/10.1177/1094670515576315

[26] Pantano, E., Rese, A., & Baier, D. (2017). Enhancing the online decision-making process by using augmented reality: A two country comparison of youth markets. Journal of Retailing and Consumer Services, 38, 81–95. https://doi.org/10.1016/j.jretconser.2017.05.011

[27] Pathak, S., Kaushik, V., & Lall, B. (2024). Single stage warped cloth learning and Semantic-Contextual attention feature fusion for virtual Tryon. 2022 IEEE International Conference on Multimedia and Expo (ICME), 1–6. https://doi.org/10.1109/icme57554.2024.10687502

[28] Ricci, M. (2022). Exploiting virtual reality for enhancing the shopping experience in the fashion industry: between interaction and perception. 2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), 9, 938–941. https://doi.org/10.1109/ismar-adjunct57072.2022.00210

[29] Richins, M. L. (1991). Social comparison and the idealized images of advertising. Journal of Consumer Research, 18(1), 71. https://doi.org/10.1086/209242

[30] Rodríguez-Navarro, A., & Brito, R. (2024). Rank analysis of most cited publications, a new approach for research assessments. Journal of Informetrics, 18(2), 101503. https://doi.org/10.1016/j.joi.2024.101503

[31] Särmäkari, N. (2021). Digital 3D fashion designers: cases of Atacac and the Fabricant. Fashion Theory, 27(1), 85–114. https://doi.org/10.1080/1362704x.2021.1981657

[32] Seo, Y., Kim, M., Jung, Y., & Lee, D. (2016). Avatar face recognition and self-presence. Computers in Human Behavior, 69, 120–127. https://doi.org/10.1016/j.chb.2016.12.020

[33] Spajić, J., Mitrović, K., Lalić, D., Milić, B., Bošković, D., & University of Novi Sad, Faculty of Technical Sciences. (2022). Personalized brand experience in metaverse. In 10th International Conference on Mass Customization and Personalization – Community of Europe (MCP-CE 2022) (p. 158). https://mcp-ce.org/wp-content/uploads/2022/10/25.pdf

[34] Tong, J., Zhou, J., Liu, L., Pan, Z., & Yan, H. (2012). Scanning 3D full human bodies using kinects. IEEE Transactions on Visualization and Computer Graphics, 18(4), 643–650. https://doi.org/10.1109/tvcg.2012.56

[35] Virginie, L. (2022). Les débats des humanistes sur la finalité de l'art. Svět Literatury, XXXII(SI), 160–172. https://doi.org/10.14712/23366729.2022.3.11

[36] Vonkeman, C., Verhagen, T., & Van Dolen, W. (2017). Role of local presence in online impulse buying. Information & Management, 54(8), 1038–1048. https://doi.org/10.1016/j.im.2017.02.008

[37] Wang, P., Ali, N. M., & Sarker, M. R. (2024). A Bibliometric Analysis Exploring the Acceptance of Virtual Reality among Older Adults: A Review. Computers, 13(10), 262. https://doi.org/10.3390/computers13100262

[38] X. Han, Z. Wu, Z. Wu, R. Yu and L. S. Davis, "VITON: An Image-Based Virtual Try-on Network," 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition, Salt Lake City, UT, USA, 2018, pp. 7543-7552. https://doi.org/10.1109/CVPR.2018.00787