Study on AI-Powered Body Scanning and 3D Avatar Creation for Personalized Virtual Shopping Experiences

Yogesh Sonvane; Amol Pannaswar; Harish Limje
Dept. of Master in Computer Application, GHRCEM, Nagpur, India

Abstract: The fashion and retail industries are undergoing significant transformation due to the rapid growth of artificial intelligence (AI), especially with the advent of 3D body scanning and avatar creation technology. By enabling customers to see how clothes fits their virtual self, these solutions enhance customization, increase fit precision, and lower the number of returns for products. The virtual shopping experience is further improved by combining the use of AI with augmented reality (AR) and virtual reality (VR), allowing for interactive, real-time try-ons. According to recent study, there is a lot of interest in using AI for virtual fashion. Systems that offer contact-free measurements, realistic avatar creation, and mobile-based scanning are available. On the basis of unique body data, generative AI also helps designers create personalized ensembles. While customers and fashion designers alike gain from these developments, problems including data privacy, scanner precision, and system cost continue to prevent widespread application. Despite these problems, the technology has revolutionary potential. It supports sustainable fashion methods, improves client involvement, and fits completely with new digital commerce models like the Metaverse. Overall, by developing more intelligent, engaging, and user-friendly retail experiences, AI-driven body scanning and avatar technologies are pushing the path of personalized online shopping.

Keywords: Artificial Intelligence, 3D body scanning, 3D avatars, virtual try-on, personalized shopping, virtual fitting rooms, e-commerce innovation, augmented reality, extended reality, generative AI, digital twin technology, anthropometric measurement, smart wearables, customer experience, online fashion retail, real-time avatar generation, body measurement accuracy, fit personalization, consumer behavior, impulse buying.

1. Introduction

The digital transformation in multiple industries, including fashion and retail, has been greatly impacted by the quick development of Artificial Intelligence (AI) technologies. Among these developments, 3D avatar creation and AI-powered body scanning have grown into revolutionary instruments in the quest for customized online purchasing experiences [1], [2]. By allowing users to see clothes on virtual versions of themselves, these technologies boost customer happiness and fit accuracy while decreasing returns [4], [10].

A more interactive and dynamic shopping experience can be made possible by combining AI with augmented reality (AR) and virtual reality (VR) technologies, which allow for the real-time depiction of clothing on 3D avatars [3], [9], and [15]. Customers can create their avatars with just their smartphone cameras thanks to mobile-based 3D body scanning apps, which further simplify the process and enhance accessibility and convenience [5], [10].

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DOI: https://doi.org/10.5281/zenodo.15526424

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2. Literature Survey

In recent years, there has been a lot of excitement in the application of artificial intelligence (AI) to improve customized online shopping. To enhance online shopping experiences, a number of researchers have looked into merging AI with technologies like virtual avatars, 3D body scanning, and augmented/virtual reality (AR/VR).

An extensive examination of AI-powered metaverse applications was given by Soliman et al. [1], who highlighted how these applications provide immersive digital experiences through intelligent circumstances and virtual avatars. Similar to this, Nong and Sun [3] completed a thorough analysis of how AI is working together with AR and VR technologies to enable real-time user engagement and visualization, one of the key elements of virtual try-on systems.

AI is changing personalization and design in the fashion business. By facilitating automated clothing customisation, improved user experience, and eliminating the need for physical trials, generative AI is revolutionizing the fashion business, according to Maheswari et al. [2]. Additionally, Evangelista [7] showed how AI-powered solutions are impacting the fashion ecosystem's operational procedures and consumer behavior.

Researchers are using 3D body scanning technology to solve the issue of incorrect apparel fits in online retail. A 3D approach that goes beyond conventional sizing and improves fit accuracy and personalization in online clothing buying was put out by Jain et al. [4]. Idrees et al. [5] evaluated a number of mobile-based AI body scanning apps and highlighted how easy and contact-free they are. These developments make taking measurements of the body easier, particularly at home.

However, concerns around privacy remain a barrier to wider adoption. Youn et al. [6] explored the “privacy paradox” associated with 3D body scanning apps. While users show interest in virtual try-on experiences, they often hesitate due to data security concerns.

Several researchers have focused on developing avatars and try-on systems. Habermann et al. [10] introduced an approach to generate volumetric 3D avatars using phone scans, offering realistic visualizations of user bodies. Manikandan and Anjaneyulu [9] proposed a virtual apparel try-on model based on augmented reality, allowing users to preview clothing in real-time. Heo et al. [15] went a step further by implementing a personalized avatar-based AR system for interactive virtual try-ons.

Fashion designers are also benefiting from the use of AI. Jeon and Kim [13] investigated how generative AI assists designers come up with innovative ideas. Butteddi and Butteddi [12] shown how AI uses a data-driven to provide customized clothing design and fitting.

In terms of performance, Hassan et al. [8] enhanced the realism and responsiveness of avatars by proposing the AVATAR system for real-time 3D action analysis. The

DOI: https://doi.org/10.5281/zenodo.15526424

"Smart Body" concept, initially offered by Cimolin et al. [11], showed the precision and flexibility of 3D avatars in a variety of industries, including retail, wellness, and health. Last but not the least, Kim and Kim [14] emphasized how 3D scanning is growing more and more relevant in applications that are focused on individuals, making it an essential tool for online retail systems of the future.

With AI, 3D scanning, and avatar creation at its core, the literature currently in publication shows a growing movement toward intelligent and immersive purchasing systems. While existing methods show commitment, more study must be done to tackle ethical and technical issues.

3. Methodology

This study examines the use of AI-powered body scanning and 3D avatar development in the context of customised virtual shopping using a multi-phase exploratory and qualitative methodology. System designs, technology evaluations, and existing literature became the foundation for the methodology's creation.

1. Technology Mapping and Literature Review

To fully understand the current state of technology, the first step entails a thorough analysis of the body of accessible literature. The impact of generative AI in fashion [2], the integration of AI in virtual worlds [1], and the merging of AI with AR/VR technologies [3] are all part of this. Finding key technologies, unfulfilled research needs, and useful applications in body scanning and avatar development is the aim.

2. Research on 3D Body Scanning Devices

This stage examines a number of 3D body scanning techniques, from sophisticated camera systems to mobile-based scanning. Studies like Kim & Kim [14] and Idrees et al. [5] shed light on contact-free body measurement methods and their human-centered uses. The correctness and feasibility of 3D reconstructions, as highlighted by Cimolin et al. [11], are alsoevaluated.

3. The Creation and Realism of Avatars

The transformation of scanned data into 3D avatars is the main topic of the third stage. Analysis is done on real-time action-based avatar creation systems like AVATAR [8] and advanced geometric modeling from phone scans, as demonstrated by Habermann et al. [10]. These studies aid to evaluate how well avatars can replicate the bodies and motions of users, improving their online try-on experience.

4. AI Integration for Customized Fitting

This stage explores the use of AI algorithms to suggest customized apparel styles and sizes. A foundation for comprehending AI's function in evaluating user preferences, body kinds, and producing customized fashion opportunities is provided by the system architecture covered in Jain et al. [4] and the generative design methodologies provided by Butteddi et al. [12] and Jeon & Kim [13].

5. Systems for Virtual Try-Ons

At this point, virtual try-on options that facilitate in-the-moment avatar interaction are examined. Systems like those in Heo et al. [15] and Manikandan et al. [9] that use AR/VR for immersive shopping have been taken into consideration. These technologies simulate real-world try-on experiences by enabling users to communicate with clothing on customized avatars.

6. Privacy and Ethical Issues for Users

This stage looks into user adoption patterns and security concerns because data privacy remains a crucial consideration in scanning-based systems. To address how privacy impacts the way users interact with

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such technologies, the "privacy paradox" as defined by Youn et al. [6] is examined.

7. Conceptual Framework Proposals

A conceptual framework for a specific virtual shopping system powered by AI is put forth, take into account the outcomes of all earlier stages. Using knowledge from Soliman et al. [1], Evangelista [7], and Maheswari et al. [2], this contains modules for 3D scanning, avatar creation, customization engine, virtual try-on interface, and secure data handling techniques.

4. Applications and Benefits

By providing personalized and enjoyable user experiences, AI-powered body scanning and 3D avatar creation have transformed the online retail and fashion industries. With the use of these technologies, users can produce realistic virtual bodies that can be used to virtually try on clothing, enhancing fit and increasing customer satisfaction while making purchases online [4], [5]. Virtual try-ons are now more realistic and interactive because to utilize the combination of augmented reality and artificial intelligence, which improves user engagement and lowers return rates for online stores [3], [9], and [15]. These developments are also helping the Metaverse, as powered by AI avatars are becoming into indispensable resources for online purchasing, online communication, and even monitoring their health [1]. In order to boost creativity and optimize production, fashion designers are using generative AI to speed up the design process and provide personalized clothing according to specific body dimensions [2], [12], and [13]. Furthermore, these characteristics are now more readily accessible thanks to mobile-based 3D scanning apps, which let users to scan their bodies with just a smartphone, providing ease and inclusivity to the digital fashion industry [5, 10]. In the field of health and wellness, where precise body measurements and avatars are used to track physical modifications and support telemedicine applications, benefits go beyond fashion [11], [14]. Research indicates that good virtual try-on experiences might lessen users' fears and encourage wider consumption, despite privacy concerns with body scanning techniques [6]. All things considered, the combination of AI, AR, and 3D modeling technologies offers a potent mix that improves personalization, increases trust among consumers, and transforms the world of online buying [7], [8].

5. Challenges and Limitations

The broad use of AI-powered body scanning and 3D avatar technology is hampered by a number of obstacles and restrictions, despite the encouraging developments. Users often feel reluctant to give sensitive body measurements or 3D scans because they fear data misuse or surveillance, making data privacy and security one of the main issues [6]. Furthermore, the reliability of virtual try-on experiences is impacted by technological constraints including inconsistent smartphone scanning accuracy and device compatibility [5, 10]. Lack of uniformity in body measurement techniques is a further major issue that can result in disparities in how clothing fits on various platforms and brands [4], [11]. High processing capacity is required from a development standpoint to produce hyper-realistic avatars and assure real-time rendering. which not all developers or users may be able to access [1], [3].

Furthermore, without human refinement, generative AI technologies employed in fashion design can still produce repetitive or impractical patterns [2], [12], and [13]. Fashion industry experts also face adoption difficulties, since some designers are reluctant to use AI extensively because they fear losing creative control [13]. Lastly, for startups and small merchants entering into

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this market, cost-related concerns including software licensing, hardware investment, and system integration might be a major obstacle [7], [9], and [15]. These difficulties show that in order to fully realize the endless possibilities of AI-driven virtual selling experiences, ongoing innovation, user education, and regulation development are required.

6. Result

Several significant insights about the efficacy of the technology, user experience, personalization, and useful applications in virtual shopping are revealed by the examination of existing systems and literature in the area of AI-powered scanning of bodies and 3D avatar development.

1. Precise and Effective Body Analysis

According to studies, 3D scanning technology based on AI can use depth-sensing cameras or mobile devices to acquire incredibly precise body measurements. In the creation of body models avoiding physical contact, methods such as contact-free scanning, as covered by Idrees et al. [5], demonstrate favorable results. Furthermore, studies by Cimolin et al. [11] show that 3D reconstruction produces highly precise body measurements, which makes them appropriate for customized retail applications.

2. Realistic 3D Avatars for Virtual Try-On

Habermann et al. [10] demonstrated that avatars created from phone scans are both visually appealing and volumetrically accurate. Customers may now electronically try on clothes in a manner that closely mimics the fit and appearance of real-world items. Furthermore, Hassan et al.'s AVATAR system [8] improves the authenticity and interactivity of virtual avatars through the use of motion analysis and real-time interaction.

3. More Customization in Fashion Stores

When it comes to customizing clothes design and fit according to consumer preferences and body types, generative AI is important. Butteddi et al. [12] emphasize how AI models could enhance customer satisfaction by making personalized apparel recommendations. According to Jain et al. [4], AI-driven fit prediction operates better than traditional size charts and resolves size mismatch problems in online buying.

4. Good User Experience with AR-Based Virtual Try-On

It has been demonstrated that AR-based virtual try-on platforms significantly boost consumer engagement. According to Heo et al. [15], customized avatars in augmented reality settings offer an engaging buying experience. In a similar vein, Manikandan et al.'s AVATAR model [9] increases users' trust in their purchase by making it simpler for them to see how clothing would look on their digital twin.

5. Retail Ecosystems' Integration of AI

AI-powered systems are said to be an essential component of the metaverse and smart retail ecosystems, as reported by Soliman et al. [1] and Maheswari et al. [2]. These integrations create smooth digital experiences by fusing e-commerce, AI, and AR/VR into a single virtual purchasing paradigm.

6. Privacy and Ethical Issues

Privacy concerns continue to impact user acceptance in spite of technology developments. Youn et al. [6] discovered that although consumers are drawn to 3D virtual try-ons, app downloads and interest may be constrained by worries about disclosing personal data. It is imperative that this privacy dilemma be resolved if body scanning technologies are to be widely used.

7. Growing Uptake among Customers And Designers

DOI: https://doi.org/10.5281/zenodo.15526424

AI-driven tools are growing more and more popular among designers and consumers, according to Evangelista [7] and Jeon & Kim [13]. AI is being used by designers for creating innovative ideas, and consumers are enjoying personalized, technologically advanced purchasing experiences.

7. Conclusion

Customers' views on online purchasing platforms are being entirely transformed by the use of AI-powered body scanning and 3D avatar creation technology. It is clear from this study that these developments significantly enhance user pleasure, fitting accuracy, and personalization in online shopping experiences. These solutions are easily accessible and scalable because to the utilization of advanced computer vision and machine learning algorithms, which enable the creation of lifelike avatars and accurate body measurements, even from mobile devices [5, 10, 11].

AI and AR/VR technologies work together to produce realistic and interactive virtual try-on experiences that replicate in-store shopping settings [3], [9], and [15]. These developments are in line with the metaverse's and digital commerce's larger shift, where intelligent and customized digital experiences are becoming commonplace [1]. By enabling automated clothing design and customized fashion recommendations, generative AI further helps by speeding the process for both designers and consumers [2], [12], and [13].

Despite the advantages, the report also notes drawbacks, including user privacy issues, a lack of uniformity, and adoption hesitation in certain fashion business sectors [6], [7]. However, continued research and technical refinement are likely to overcome these hurdles.

In conclusion, individualized online shopping has a bright future thanks to AI-powered 3D body scanning and avatar technology. By providing more inclusive, effective, and fulfilling user experiences, these systems have the potential to completely change the online fashion retail market as they develop [4], [8], and [14].

8. Reference

[1]M. M. Soliman, E. Ahmed, A. Darwish, and A. E. Hassanien, "Artificial intelligence powered Metaverse: analysis, challenges and future perspectives," *Artificial Intelligence Review*, vol. 57, pp. 4107–4144, 2023.

[2]U. Maheswari, G. Painguzhali, V. Ananth, D. Kavitha, and R. Sujatha, "How Artificial Intelligence and Generative AI Is Revolutionizing the Fashion Industry," in *Trends, Applications, and Challenges of Generative Artificial Intelligence in Smart Industries*, IGI Global, pp. 115–133, Feb. 2025.

[3]Y. Nong and J.-Q. Sun, "A Systematic Survey on the Integration of Artificial Intelligence with Augmented and Virtual Reality Technologies," *MK Science Set*, vol. 1, no. 1, pp. 1–11, 2025.

[4]R. Jain, N. Patel, and G. J. Mathew, "Beyond Standard Sizing: A 3D Revolution in Online Apparel Retail for Personalized and Precise Fit," *Kuwait Journal of Engineering*, vol. 14, no. 2, 2023.

[5]S. Idrees, S. Gill, and G. Vignali, "Mobile 3D body scanning applications: a review of contact-free AI body measuring solutions for apparel," *Journal of the Textile Institute*, vol. 114, no. 6, pp. 915–928, 2023.

[6]S.-Y. Youn, J. Hwang, L. Zhao, and J.-B. Kim, "Privacy paradox in 3D body scanning technology: the effect of 3D virtual try-on experience in the relationship between privacy concerns and mobile app adoption intention," *Humanities and Social Sciences Communications*, vol. 10, no. 1, 2023.

[7]P. N. Evangelista, "Artificial Intelligence in Fashion: How Consumers and the Fashion System Are Being Impacted by

DOI: https://doi.org/10.5281/zenodo.15526424

AI-powered Technologies," MSc. thesis, Politecnico di Milano, AY 2019/2020.

[8] M. Hassan, A. Rehman, and Z. Huang, "AVATAR: AI Vision Analysis for Three-dimensional Action in Real-time," bioRxiv, 2022.

[9] R. Manikandan and K. S. R. Anjaneyulu, "Advanced Virtual Apparel Try Using Augmented Reality (AVATAR)," *International Journal of Scientific and Technology Research*, vol. 9, no. 4, pp. 1033–1036, 2020.

[10] M. Habermann et al., "Authentic volumetric avatars from a phone scan," in *ACM Transactions on Graphics (TOG)*, vol. 41, no. 4, 2022.

[11] V. Cimolin, I. T. Paraskevopoulos, M. Sala, M. Tarabini, and M. Galli, "The smart body concept as a demonstration of the overarching utility and benefits of 3D avatars in retail, health and wellbeing: an accuracy study of body measures from 3D reconstruction," Scientific Reports, vol. 12, no. 1, pp. 1–12, 2022.

[12] R. K. Butteddi and S. Butteddi, "Revolutionizing Fashion: A Generative AI Approach to Personalized Apparel Design and Custom Fitting," International Journal of Computer Engineering and Technology (IJCET), vol. 15, no. 4, pp. 702–710, 2024.

[13] E. Jeon and S.-W. Kim, "Understanding Fashion Designers' Behavior Using Generative AI for Design Ideation," Archives of Design Research, vol. 36, no. 1, pp. 5–17, 2023.

[14] J. Kim and D. Kim, "Emerging Roles of 3D Body Scanning in Human-Centric Applications," Technologies, vol. 13, no. 4, Art. no. 126, Apr. 2025.

[15] J.-P. Heo, S.-H. Baek, and M. H. Kim, "An Interactive AR-Based Virtual Try-on System Using Personalized Avatars," International Journal on Advances in Systems and Measurements, vol. 14, no. 1–2, pp. 55–64, 2021.

DOI: https://doi.org/10.5281/zenodo.15526424