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Adaptability of Augmented Reality (AR) and Virtual Reality (VR) in apparel industry with reference to Bangalore City

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Abstract

Bangalore, a city known for both technological advancements and a vast number of Apparel manufacturing industries, with the great innovation of augmented reality (AR) and virtual reality (VR) technologies, has significantly transformed the Apparel industries across the globe. This research study tried to explore the adaptability and its impact on Apparel industry with reference to Bangalore city, as it stands as a major hub for Apparel innovation in India. The technology has supported the manufacturing process and marketing of the product in the market through various activities like virtual prototyping, interactive product design, and finally better customer experiences with the help of advanced tools developed with the collaborative use of augmented reality (AR) and virtual reality (VR), which also helps customers make more accurate purchase decisions. This study focus on the various aspects of the adaptability of the AR and VR by Apparel Industry. This study has been conducted by using primary data collected through surveys and interviews with industry professionals and also supported by secondary data gathered from academic journals, industry reports and case studies that focused on global trends with respect to adaptability of augmented reality (AR) and virtual reality (VR) Technologies. This study examines the level of awareness, adoption rates, benefits and challenges faced by Apparel companies in implementing augmented reality (AR) and virtual reality (VR) Technologies. This study enables to also understand customers' perspectives towards purchasing preferences with the help of augmented reality (AR) and virtual reality (VR). The study concludes that the augmented reality (AR) is increasingly used for digital fabric sampling; virtual design simulations on the other hand virtual reality (VR) technology is used in employee training, virtual prototyping and immersive fashion shows. The industries in Bangalore are still aiming to reach the maximum potential of augmented reality (AR) and virtual reality (VR) by bringing in modern practices from overseas; however, the research also shows a few challenges, such as high costs of technology deployment, limited technical expertise, and lack of digital infrastructure to support the technology. On top of all these barriers, its been observed that Innovations are helping businesses reduce inventory costs, minimize product returns and enhances consumer engagement, ultimately leading to higher sales conversion rates and brand loyalty. By examining, its been concluded that augmented reality (AR) and virtual reality (VR) have a lot of scope and can become major key players in the Apparel industry. They also help in understanding more customer preferences and upcoming future trends. It makes the industry a more customer-friendly by giving customer's a vast array of custom-styled options.

In conclusion, we can understand that the adoption rate is currently moderate, but collaboration with augmented reality (AR) and virtual reality (VR) is surely a game changer in the industry that provides many advantages to both customers and manufacturers. Businesses that successfully incorporate augmented reality (AR) and virtual reality (VR) into their operations will have a major competitive advantage in both domestic and foreign markets. To fully realize the commercial benefits of augmented reality (AR) and virtual reality (VR) in Bangalore's Apparel industry, policy support, technology partnerships, and innovative business models are necessary.

Keywords: Bangalore, Apparel Industry, Augmented Reality (AR), Virtual Reality (VR), profitability, consumer engagement, market competitiveness

Introduction

The apparel industry is undergoing a significant transformation driven by the integration of Augmented Reality (AR) and Virtual Reality (VR) technologies. These immersive tools are revolutionizing traditional retail by enabling consumers to visualize and interact with garments in digital environments, offering a more personalized and engaging shopping experience.

AR applications, such as virtual try-ons, allow users to preview clothing and accessories on themselves in real time using mobile devices or smart mirrors, thereby enhancing decision-making and reducing product returns.

Meanwhile, VR technology is pushing the boundaries of fashion retail by offering fully immersive digital experiences. Brands are creating virtual showrooms and 3D fashion events that replicate physical stores or fashion shows, making them accessible from anywhere in the world. Luxury labels like Gucci and Balenciaga have pioneered the use of VR to conduct virtual runways and interactive storytelling that foster deeper emotional connections with consumers.

Despite the considerable potential, the adoption of AR and VR technologies in the apparel industry is not without challenges. High development costs, technical infrastructure requirements, and consumer accessibility remain key barriers to widespread implementation. However, research suggests that as digital literacy increases and hardware becomes more affordable, these immersive technologies will likely become more mainstream. Furthermore, studies show that AR and VR significantly influence consumer attitudes, brand loyalty, and purchasing behavior, positioning them as crucial tools for the future of fashion retail.

Literature Review

An *et al.*, 2021^[17], AR and VR have revolutionized how consumers interact with fashion products, primarily through virtual try-on (VTO) technologies. Smartphone-based AR applications, such as the real-time shoe try-on system “ARShoe”.

Shrestha *et al.*, 2025^[18], 3D shoe reconstruction, exemplify how AR enhances consumer convenience and minimizes product returns in online shopping. These innovations support personalization and interactive engagement, both of which are critical for e-commerce competitiveness.

Jung *et al.* (2021)^[21] and Gonzalez *et al.* (2024)^[22], Studies done by them found that immersive product displays in VR settings can significantly increase consumers' purchase intentions and emotional attachment to brands.

Ahmed *et al.*, 2023^[44], Fashion retailers, particularly in the luxury sector, have begun hosting virtual fashion shows that amplify brand storytelling.

MDPI, 2023^[33], Furthermore, AR is proving popular among younger demographics, such as Gen Z, who value personalization and digital interaction.

Vogue Business (2023)^[23] and Time Magazine (2022)^[24], reveal that consumers appreciate the novelty and utility of AR features, which allow for virtual styling without visiting physical stores.

Sarakatsanos *et al.*, 2024^[27], in product design and development, VR tools are facilitating virtual garment creation and testing, thereby reducing the need for physical samples. Platforms like VR Designer allow designers to visualize how garments will fit and move in virtual spaces, streamlining the prototyping phase. This shift not only shortens development cycles but also aligns with sustainability efforts by minimizing material waste.

Ziae & Hamed, 2021^[28]; Anagnostopoulos *et al.*, 2023^[29], According to them AR is also advancing the digitalization of apparel manufacturing processes. Integrated with Industry 4.0, AR and VR applications support real-time factory monitoring, process visualization, and remote collaboration.

Science Direct 2022^[30], in a systematic review emphasizes the importance of immersive technologies in optimizing production and maintaining flexibility in rapidly evolving markets.

Fashion and Textiles, 2018^[32], virtual fashion stores, although still emerging, offer a sustainable alternative to physical retail by providing a rich sensory experience without the environmental cost.

Han *et al.* 2022^[40], AR also influences consumer behavior by shaping perceptions of product quality, store layout, and brand identity. For instance, demonstrated that the aesthetics of virtual stores such as opacity and space design can affect consumer trust and purchase decisions.

Kazmi *et al.* 2021^[39], similarly, research done by them showed that AR could positively shift consumer attitudes and reduce hesitation in high-involvement purchases.

El-Shamandi *et al.* 2023^[44], the integration of AR-enabled “magic mirrors” in service sectors, as studied by them, reveals how consumers associate digital try-ons with self-image and identity formation, leading to more emotionally driven purchases.

Joy *et al.*, 2022^[38], furthermore, the rise of digital fashion in the metaverse and the use of NFTs present new opportunities for brands to monetize virtual clothing and engage users in gamified ecosystems.

Harba, 2019^[43]; Vonkeman *et al.*, 2017^[46], Despite these benefits, adoption is not without limitations. Research highlights concerns such as high implementation costs, device compatibility issues, and a digital divide that hinders access for certain demographics. These challenges underscore the need for user-centered design and broader accessibility strategies in AR/VR development.

Objectives of the study

- To examine the level of awareness, adoption rates.
- To determine the benefits and challenges faced by Apparel companies in implementing augmented reality (AR) and virtual reality (VR) Technologies.
- To understand customers' perspectives towards purchasing preferences with the help of augmented reality (AR) and virtual reality (VR).
- To understand the implementation of AR and VR in Apparel industry.

Research Methodology

Type of Research

The exploratory research consisting of surveys and interviews with industry professionals and their customers has been conducted for analysing the adaptability of the AR and VR Technologies. A Structured questioners has been adopted and likert scale to measure it.

Secondary Data is obtained from various sources like articles, journals, websites, magazines.

Sample Size

This survey was conducted with respect to Bangalore City by collecting the primary data from various brand outlets from premium stores as well as locally grown stores that are based in Bangalore.

In numbers, we have approached more than 100 outlets and received genuine opinions and responses from 72 of them, which included brands like Mango, Armani Exchange, Mynta, Marks & Spencer, Ethinx by Raymond, The Bear House, Taruni, Diesel, Rareism, Louis Philippe, Calvin

Klein, Only, Soch, BIBA, Boss, American Eagle, Highlander, United Colors of Benetton, Indian Terrain, and more.

About the respondents

We have received survey responses from employees working in various roles in the company, such as owner/partner, manager, assistant manager, designer, marketing/sales, staff, senior and junior fashion consultant, fashion assistant, store visual merchandiser, high fashion stylist, senior sales executive, and customer relationship manager.

This helped us in understanding the opinion of apparel industry professionals on adapting AR and VR. The collected opinions were from the professionals who had more than 5 years of experience, which were 51.4%; then

29% were above 6 to 10 years, and the remaining were ones who had more than 11 years or below a year.

Utilization of VR and AR

The major segments that were covered are marketing and retail with 59.7%, then 33% were into apparel designing, and the remaining were into manufacturing and footwear manufacturing. Surprisingly, 72% of the respondents were aware of the rise of AR and VR in the industry, and 59% have adopted any AR or VR technologies in their operations.

The areas in which they have utilized the benefits of AR and VR mainly were in employee training, with a 42% response; then digital fabric sampling, virtual fashion shows, virtual prototyping, and interactive product design are respectively arranged according to the utilization of technology.

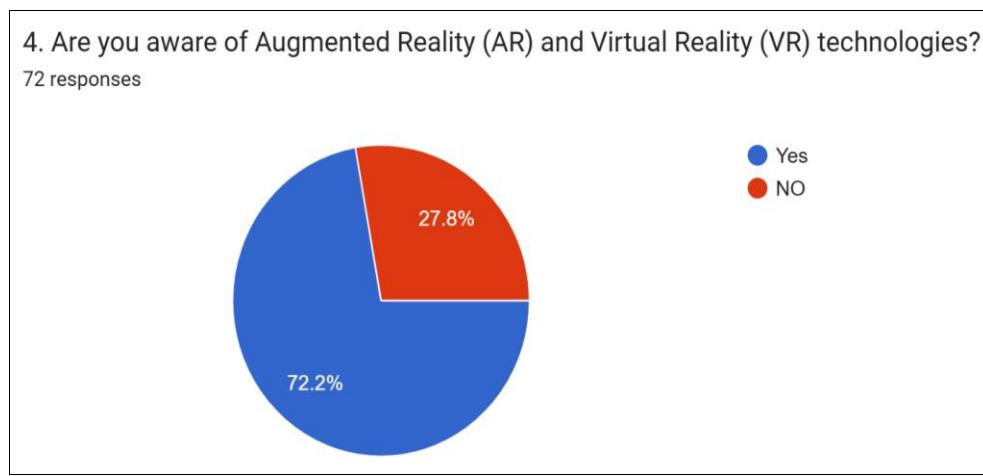


Fig 1: Utilization of AR and VR across functional areas of the apparel industry

AR and VR in customer approach and manufacturing

Towards the customer perspective, 8.3% and 33% suggested that it was extremely and very effective in customer engagement, 21% suggested it was moderately effective, and the remaining stood with slightly effective and not

effective. Also, 45% believed it would significantly impact a company's sales and marketing strategies, and another 45% mentioned it was moderately beneficial, and only 5.6% suggested it would negatively impact.

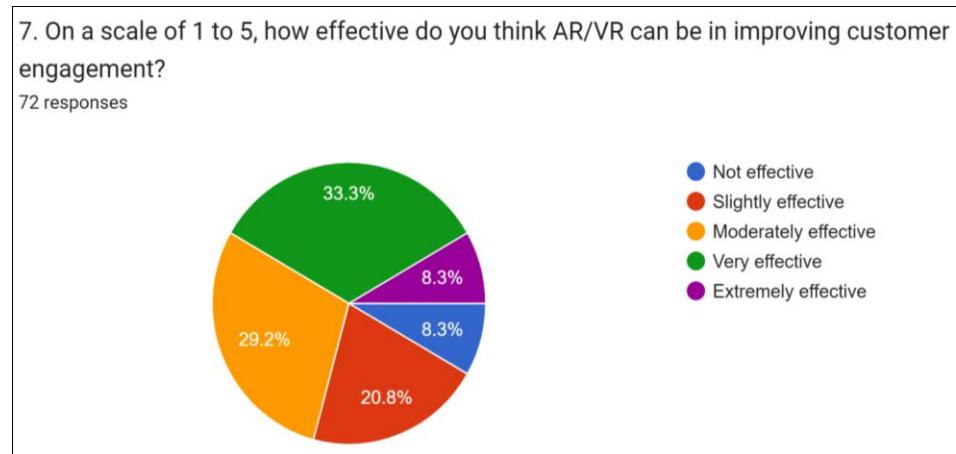


Fig 2: Effectiveness of AR and VR in customer engagement and sales impact

AR/VR technologies help customers make better and more informed purchasing decisions were strongly agreed by 31.9%, agreed by 48.6% and 18% were on the neutral end, but only 1.4% disagreed.

45.8% chose "YES" that AR/VR could reduce inventory costs or product returns in an apparel business; the

remaining 40.3% chose "Maybe," and 13.9% chose to go with "NO." AR/VR technologies could enhance the design and development process in the apparel industry, where strong agreement was agreed upon by 72.2%, and the remaining stood neutral, as no one disagreed.

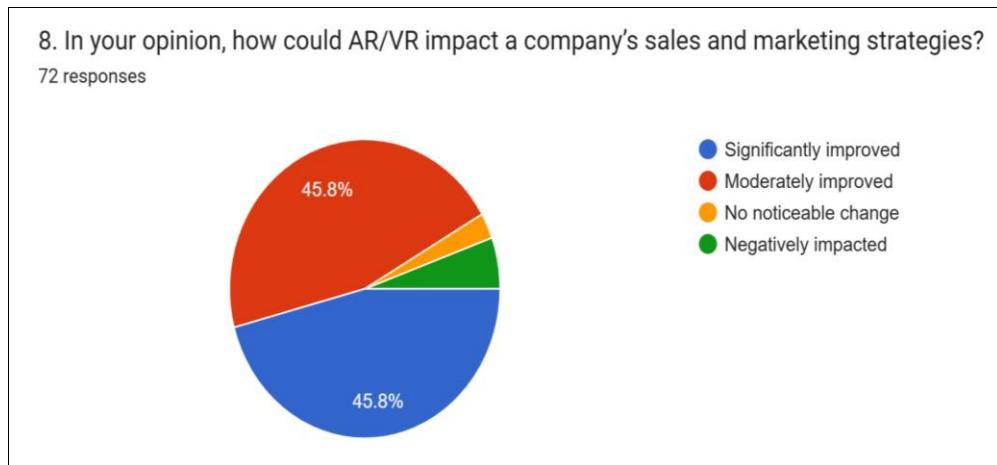


Fig 3: Perceived benefits of AR and VR in purchasing decisions and operational efficiency

Implementation and Challenges

The major challenges of AR and VR were mostly voted High cost of technology (51%), lack of technical expertise (30.6%), resistance to change (26.4%), poor digital infrastructure (16.7%), no challenges faced (12.5%), and unclear return on investment (6.9%) were respectively voted

by the respondents.

Their opinion on difficulty level is to train employees to use AR/VR tools; 51.4% of them mentioned that it's very easy or easy to train employees, 44.4% conveyed that the difficulty is just moderate, and only 4.2% mentioned that it's difficult.

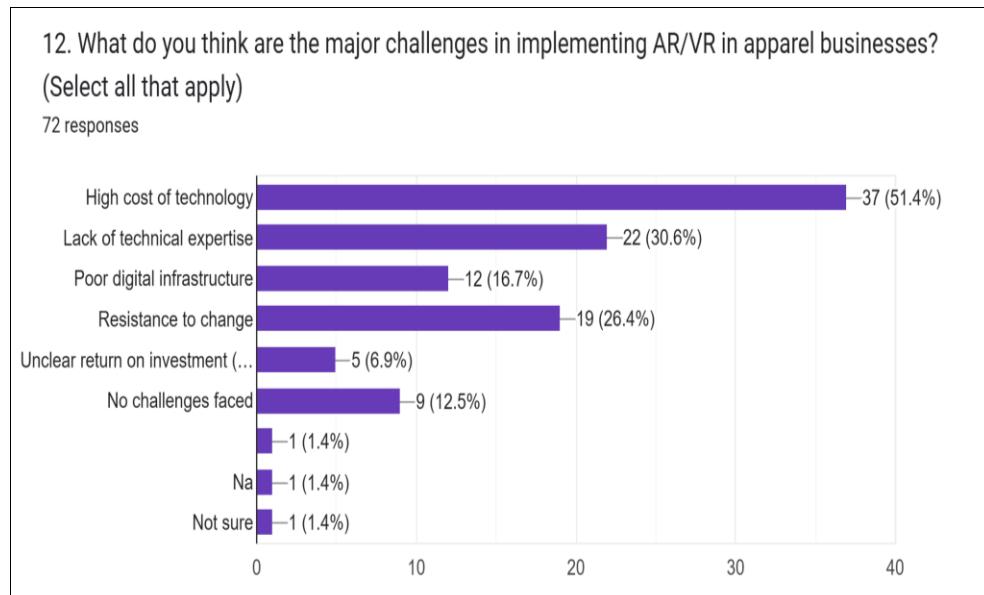


Fig 4: Challenges and training difficulty associated with AR and VR implementation

Future and Adaptability of AR and VR

43.1% of the respondents mentioned that the company receives support (technical/financial/policy) for implementing AR/VR. Also mentioned that 52% of them mentioned that they would be likely to invest in AR/VR technologies in the next 2 years.

These are the major future applications of AR/VR that they were most interested in for their business

- Virtual fitting rooms (61.6%)
- AI-integrated virtual design (37.5%)
- Augmented showrooms (31.9%)
- Predictive fashion trend visualization (30.6%)

66.7% of them agreed that AR/VR will become a standard practice in the apparel industry within the next 5 years, and the remaining stood as neutral; only 5.6% disagreed and strongly disagreed.

The implementation of AR/VR gives a competitive edge in both domestic and international apparel markets, which was strongly agreed to by 62.5%; 34.7% believed it to be neutral, and only 2.8% disagreed with it. Their openness to partnerships with technology providers to integrate AR/VR in operations was 37.5% "yes" and 47.2% "maybe."

63.9% of the respondents strongly agreed and agreed that AR/VR technologies are essential for the future growth and innovation of the apparel industry.

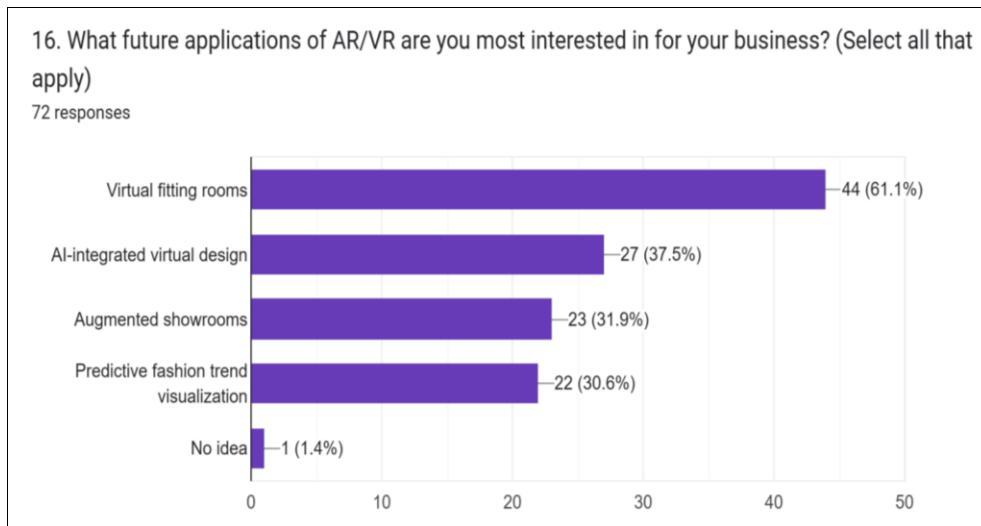


Fig 5: Future adoption potential and strategic importance of AR and VR

Findings

- The utilisation of AR and VR-72% of the respondents were aware of the rise of AR and VR in the industry, and 59% have adopted any AR or VR technologies in their operations. The areas in which they have utilized the benefits of AR and VR mainly were in employee training, with a 42% response; then digital fabric sampling, virtual fashion shows, virtual prototyping, and interactive product design are respectively arranged according to the utilization of technology.
- AR And VR in customer approach and manufacturing. The response from customer side reveals that 33% suggested that AR and VR is an effective approach in customer engagement and on the manufacturing forefront 45.8% said it will could reduce inventory costs or product returns in an apparel business
- 51% of the respondents agreed that Technology costs are on the higher end in implementing AR and VR.
- Virtual Fitting rooms holds the highest in future application of AR and VR in Apparel Industry

Suggestions

- The Industry needs to be supported by the government through various financial schemes to support the High cost of the technology.
- It is required that in today's curriculum AR and VR should be a subject to be included and taught at graduate and undergraduate level.
- The existing employees in the industry should be provided with crash courses and training in the use of AR and VR.
- The employees should also be informed about the benefits of the use of AR and VR to avoid resistance to change.

Conclusion

On observation, 94.5% of the industry professionals rated that Bangalore is slightly ready, moderately ready, mostly ready, and fully ready, and 5.6% rated that Bangalore is not yet ready.

The study points out that there is a lot of interest among professionals in exploring and adapting AR and VR technologies in their operations. Also, at the same time, we

can see some drawbacks: Cost, training, and infrastructure. But the majority of the respondents affirm that it has enormous potential in terms of design, market competitiveness, and customer engagement. Bangalore's clothing industry is well-positioned to lead the way in tech-integrated fashion design and retail with better policy support, training, and collaborations.

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