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From Virtual Trials to Real Sustainability: Augmented Reality as a Catalyst for Circular Consumption in Retail

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ABSTRACT

Growing consumer demand for ethical purchasing requires retailers to not only provide sustainable products but also create innovative tools that convert environmental intention into action. This study examines how Augmented Reality (AR) virtual trials can encourage circular consumption behaviors in retail. Based on the Unified Theory of Acceptance and Use of Technology (UTAUT), a conceptual model was developed linking key adoption factors—Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions—to sustainable outcomes. Using survey data analyzed through Structural Equation Modeling (SEM), results show that AR usage intention is strongly influenced by determinants such as Performance Expectancy and Social Influence, while Effort Expectancy plays a weaker role. Moreover, actual AR usage significantly contributes to lower return rates and greater reuse intentions, demonstrating AR's potential to support circular consumption. This study extends UTAUT into the sustainability domain and provides strategic insights for retailers seeking to leverage AR as a tool to promote environmentally responsible shopping behavior.

I.INTRODUCTION

The digital commerce landscape has witnessed a profound transformation with the integration of Augmented Reality (AR), positioning it as a central technology in elevating the consumer shopping journey. AR's ability to superimpose virtual elements onto real-world environments effectively bridges the long-standing "imagination gap" in online retail, enabling more informed and confident purchase decisions (Schultz & Kumar, 2024; Aslam & Davis, 2024). Industry applications strongly validate these benefits: IKEA's "IKEA Place" app allows users to visualize true-to-scale furniture at home, contributing to significant improvements in return reduction and purchase decisions (Appify Commerce, 2023), while Sephora's "Virtual Artist" tool has delivered millions of virtual try-ons and markedly enhanced conversion rates. In India, Lenskart's mobile AR functionality has similarly improved customer experiences by increasing conversion rates and reducing product returns (Product Monk, 2024). These outcomes underscore AR's ability to generate both hedonic and utilitarian consumer value, which subsequently shapes positive behavioral responses, including purchase intention, reuse intention, and brand engagement (Negm, 2025). Recent literature further highlights AR's expanding role across retail contexts—from enriching decision comfort (Jeganathan & Szymkowiak, 2025) and enhancing warm-glow effects toward green products (Lavoye et al., 2025) to reducing waste and returns through sustainable fashion practices (Karadayi-Usta,

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2024). As AR capabilities evolve, scholars emphasize its ethical landscape (Asif et al., 2025), cognitive impacts on product evaluation (Fan et al., 2020), and its broader influence on consumer engagement with sustainability initiatives (Nadeem et al., 2025), collectively establishing AR as a transformative driver in the future of digital commerce.

The exponential growth of e-commerce has introduced an urgent sustainability paradox: while digital sales reduce the need for physical retail spaces, they simultaneously fuel an increase in logistics and packaging waste, most critically manifesting in persistently high product return rates. Returns, particularly for items where fit or visual compatibility is uncertain (like apparel and furniture), represent a staggering environmental and economic burden, generating millions of tons of landfill waste and greenhouse gas emissions annually (PwC, 2025; Ellen MacArthur Foundation, 2024) The technological intervention of Augmented Reality (AR) represents a critical solution by enabling highly accurate virtual try-ons and spatial product visualization, directly mitigating the core uncertainty that drives these returns. Returns, particularly for items where fit or visual compatibility is uncertain (like apparel and furniture), represent a staggering environmental and economic burden, generating millions of tons of landfill waste and greenhouse gas emissions annually (PwC, 2025; Ellen MacArthur Foundation, 2024). By establishing a direct link between AR use and ecological outcomes, this study provides a novel, environmentally conscious framework for managerial investment, positioning AR not just as a revenue generator but as a vital tool for achieving both commercial success and sustainability mandates in the twenty-first-century retail environment.

2. LITERATURE REVIEW:

Title	Author(s) & Year	Objectives	Research Methodology	Key Findings	Keywords
ARvolution: Decoding consumer motivation and value dimensions in augmented reality	Schultz, C. D., & Kumar, H. (2024)	To identify the dimensions influencing AR usage by applying consumption value theory and integrating it into the Technology Acceptance Model (TAM).	Drawing on the S-O-R framework and Consumption Value Theory; analyzed 836 Gen Z consumers using PLS-SEM and multigroup analysis.	Both hedonic and utilitarian benefits significantly enhance perceived satisfaction, which mediates successful adoption intentions. Privacy concerns and technological anxiety dampen satisfaction.	Augmented reality marketing, Consumption value theory, Mobile marketing, Metaverse, Technology use behavior, Hedonic benefits, Utilitarian benefits.
Towards a theoretical framework for augmented reality marketing: A means-end chain perspective on retailing	Kumar, H., Rauschnabel, P. A., Agarwal, M. N., Singh, R. K., & Srivastava, R. (2024)	To develop a theoretical framework for AR marketing in retailing using the means-end chain theory to link AR features to consumer benefits and core values.	Theoretical framework development and application of Means-End Chain Theory.	AR features (e.g., interactivity, contextualization) drive benefits like risk reduction and better decision-making, contributing to consumer goals (e.g., self-confidence).	Augmented Reality, Retailing, Marketing, Means-end chain, Consumer behavior, Virtual try-on.

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Self-proximity in augmented reality enhances consumer's responses to green products through anticipated warm glow	Lavoye, V., Petit, O., Tarkiainen, A., & Sipilä, J. (2025)	To investigate how AR-enabled virtual try-on experiences influence consumer response to green products, focusing on the role of self-proximity and anticipated warm glow.	Empirical study using experimental design (likely survey/scenario-based).	Virtual try-on fosters self-proximity, which enhances the personal relevance of green products and increases the anticipated warm glow, leading to higher purchase intentions for green products.	Augmented reality, Green marketing, Virtual try-on, Self-proximity, Anticipated warm glow, Purchase intention.
Digital Product Passport with Augmented Reality: Predicting Consumer Reuse Intention in Brick-and-Mortar Retail	Chen, R., Wu, Y., Shi, J., & Yu, Y. (2025)	To examine the role of AR in integrating the Digital Product Passport (DPP) in physical retail settings and how this influences consumer reuse intention.	Empirical analysis (likely survey-based structural modeling).	AR integration of the DPP enhances consumer decision comfort and is a strong predictor of reuse intentions, thereby supporting the circular economy.	Digital Product Passport (DPP), Augmented reality, Circular economy, Reuse intention, Retail.
The temporal effects of augmented reality on consumer purchase intention: A habituation perspective	Kumar, H., Nanda, M., L., T., Dypvik Landmark, A., & Gupta, S. (2024)	To study how the influence of AR characteristics (usefulness vs. enjoyment) on consumer purchase intention changes over time due to habituation.	Empirical study examining usage over time.	Perceived usefulness is the key driver for first-time users, but enjoyment becomes the dominant factor for habitual users of AR.	Augmented reality, Habituation, Purchase intention, Perceived usefulness, Enjoyment, Temporal effects.
Role of artificial intelligence and augmented reality in fashion industry from consumer perspective: Sustainability through waste and return mitigation	Karadayi-Usta, S. (2024)	To explore how the combined use of AR and Artificial Intelligence (AI) can support sustainability goals in the fashion industry by mitigating waste and product returns.	Empirical study focusing on consumer behavior in fashion retail.	AR and AI can significantly support sustainability by reducing product return rates and minimizing waste in the supply chain.	Artificial intelligence, Augmented reality, Fashion industry, Sustainability, Waste mitigation, Return reduction.

AR plays a direct role in the circular economy by boosting consumer confidence to the extent that it significantly reduces product return rates, thereby mitigating supply chain waste (Karadayi-Usta, 2024). The use of AR to integrate Digital Product Passports (DPPs) into retail environments is also predicted to enhance decision comfort and promote consumer reuse intentions, solidifying AR's function as a catalyst for sustainable behavior (Chen et al., 2025).

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2.1 Conceptual Network Visualization

The conceptual network map was generated using VOSviewer based on the co-occurrence of keywords extracted from the full-text data of the 80 articles included in this review. The purpose of this visualization is to objectively illustrate the main thematic clusters, their interconnectedness, and the relative importance of concepts within the Augmented Reality and Circular Consumption research domain.

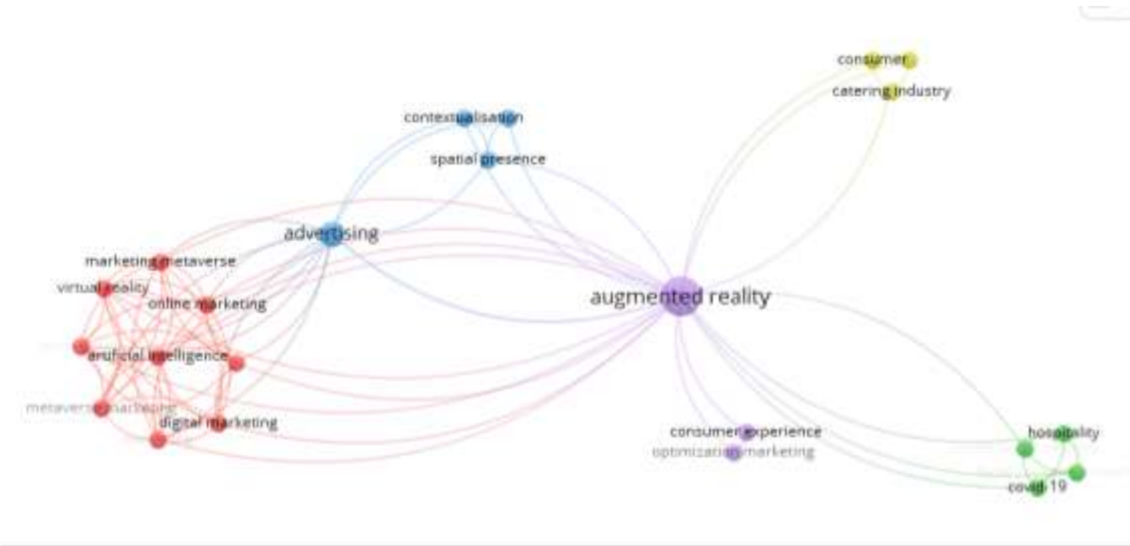

Figure-1

Source-Vos viewer (Author work)

The VOS Viewer keyword co-occurrence map shows that existing AR research is mainly concentrated on themes like technological innovation, digital marketing, and consumer experience, with limited overlap with sustainability. Keywords related to environmental awareness and green consumption appear in separate and weaker clusters, indicating that the connection between AR adoption and sustainable or circular consumption has not been sufficiently explored. While prior studies highlight AR's role in enhancing interactivity, realism, and consumer engagement, few investigate how these features can drive environmentally responsible decision-making. This gap highlights the need for integrating technology acceptance and behavioral theories to explain how AR can act as a digital catalyst for promoting eco-friendly and circular consumption in retail. This study addresses this gap by examining how AR usage can translate virtual product experiences into real-world sustainable purchasing behaviors.

3. Research Objectives:

1. To examine how key UTAUT factors—Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions—influence consumers' intention to adopt Augmented Reality (AR) in retail.
2. To analyze the relationship between consumers' intention to use AR and their actual usage behavior.
3. To investigate the impact of actual AR usage on circular consumption behaviors, particularly reduction in product returns and increased intention to reuse.
4. To assess whether environmental consciousness strengthens the relationship between actual AR usage and circular consumption behavior.
5. To develop an empirically tested model linking consumer AR acceptance to measurable pro-environmental outcomes, providing a practical framework for retailers and sustainable marketers.

4.Theoretical Background: Unified Theory of Acceptance and Use of Technology (UTAUT)

The theoretical foundation of this research is rooted in the Unified Theory of Acceptance and Use of Technology (UTAUT) , which provides a comprehensive framework for understanding the factors that determine an individual's Behavioral Intention (BI) to use a technology and their eventual Use Behavior (Venkatesh, Morris, Davis, & Davis, 2003). By integrating and refining constructs from eight precursor models (including TAM and TRA), UTAUT is uniquely suited to analyze the complex factors influencing consumer adoption of modern retail technologies like Augmented Reality (AR).

In the context of virtual trials and circular consumption, the UTAUT model is applied to explain why consumers choose to integrate AR applications into their shopping journey, ultimately leading to more sustainable decisions. The model posits that Behavioral Intention is directly influenced by four core constructs:

I. Performance Expectancy (PE)

Performance Expectancy (PE) is defined as the degree to which an individual believes that using the system will help them achieve gains in performance (Venkatesh et al., 2003). In retail, this translates directly to the utilitarian value a consumer expects to gain from the AR application (Schultz & Kumar, 2024).

II. Effort Expectancy (EE)

Effort Expectancy (EE) is the degree of ease associated with using the technology (Venkatesh et al., 2003). If an AR application is perceived as difficult to use, cumbersome, or buggy, adoption will be hindered.

III. Social Influence (SI)

Social Influence (SI) is the degree to which an individual perceives that important others (peers, family, social media influencers) believe he or she should use the new system (Venkatesh et al., 2003).

IV. Facilitating Conditions (FC)

Facilitating Conditions (FC) is the degree to which an individual believes that an organizational and technical infrastructure exists to support system use (Venkatesh et al., 2003).

For AR adoption to translate into sustained usage, consumers must have access to the necessary infrastructure (compatible devices, reliable network, and in-store support). If consumers face technological anxieties or barriers (Schultz & Kumar, 2024), the lack of facilitating conditions will prevent the successful activation of sustainable behaviors, regardless of their positive intentions.

By using UTAUT, this paper frames AR adoption as a pathway where the expectations of performance (reducing returns and waste), ease of use, social validation, and technical support all converge to form a strong Behavioral Intention. This intention then predicts the actual use of AR, which, as an innovative tool, serves as the mechanism through which abstract sustainable goals (like the Anticipated Warm Glow and Reuse Intention) are made tangible and actionable for the consumer (Lavoye et al., 2025; Chen et al., 2025).

5.Conceptual Framework”

The conceptual model synthesizes established technology acceptance theory (UTAUT) with the imperatives of circular consumption. It posits that consumer intention to use AR is driven by its perceived utility, which in turn acts as a crucial lever for influencing sustainable behaviors like reducing product returns and increasing reuse intention.

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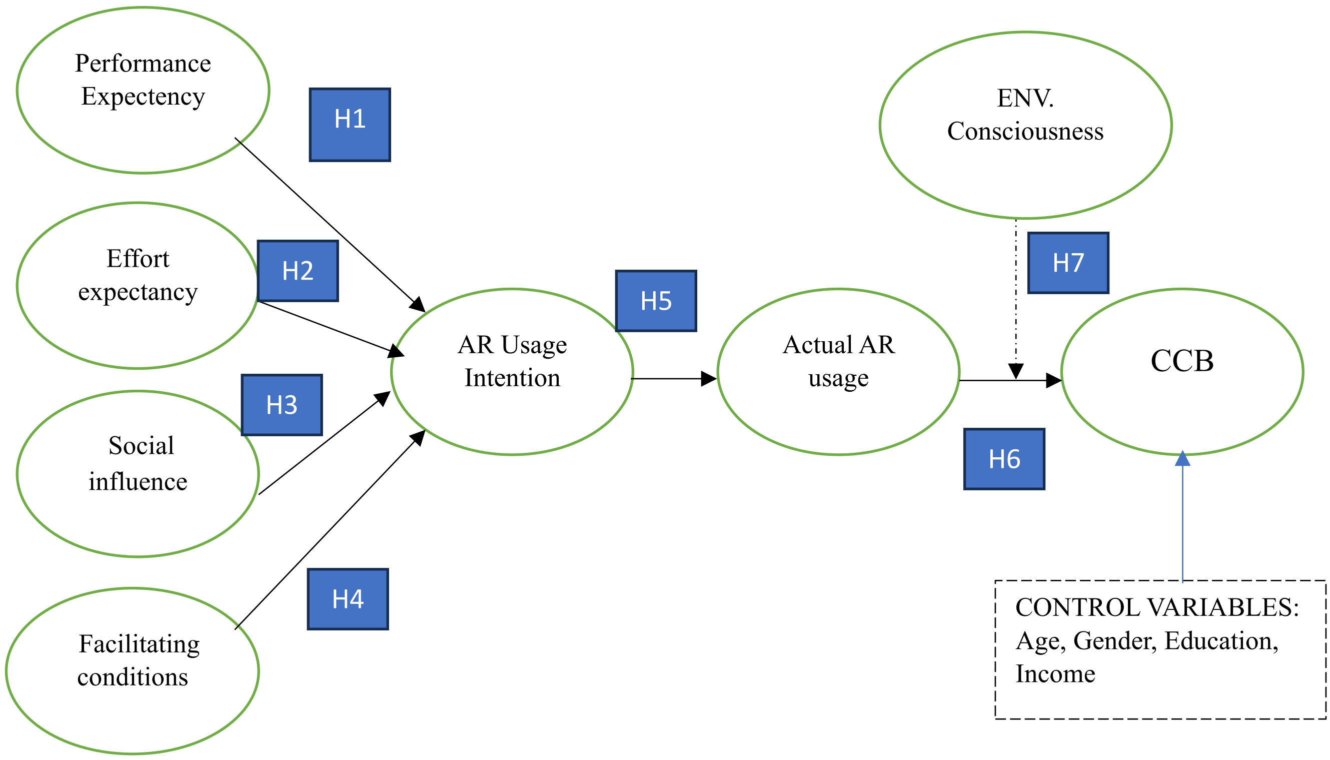

Figure-2-UTAUT (Unified Theory of Acceptance and Use of Technology) Model

Source-Author work

6.Hypotheses Development

i. Performance Expectancy

Performance Expectancy represents consumers' belief that AR will improve their shopping effectiveness, reduce product trial effort, and enhance environmentally responsible decisions. Prior studies show that AR strengthens decision comfort, improves product comprehension, and reduces wasteful product returns—key drivers of performance value (Attri et al., 2024; Karadayi-Usta, 2024; Jeganathan & Szymkowiak, 2025). When consumers perceive AR as useful for understanding product quality, longevity, and sustainability claims, their intention to interact with AR applications increases (Aslam & Davis, 2024).

H1: *Performance Expectancy has a positive effect on Augmented Reality usages Intention.*

ii. Effort Expectancy

Effort Expectancy refers to the perceived ease and simplicity of using AR tools. Evidence shows that user-friendly interfaces, intuitive gestures, and seamless mobile integration increase consumers' willingness to adopt AR in retail (Fan et al., 2020; Palaniappan et al., 2025). When AR applications minimize cognitive effort, consumers experience smoother interactions that encourage frequent and meaningful engagement with circular and sustainable shopping tools (Naveen et al., 2025).

H2: *Effort Expectancy positively influences Augmented Reality usages Intention.*

iii. Social Influence

Social Influence reflects how peers, social norms, influencers, and retail communities shape technology adoption. Research shows that social endorsement increases AR adoption, especially when AR is associated with sustainability awareness or green-product visualization (Lavoye et al., 2025; Schultz & Kumar, 2024). As sustainable consumption becomes socially desirable, recommendations from peer networks enhance intention to use AR for eco-conscious product evaluation (Ngo et al., 2025).

H3: *Social Influence positively affects Augmented Reality usages Intention.*

iv.Facilitating Conditions

Facilitating Conditions include technological support, device readiness, and availability of AR-enabled retail environments. When consumers have access to reliable AR features, supporting infrastructure, and guidance, they are significantly more willing to use AR applications (Kumar, 2021; Li & Lev, 2026). Smooth platform performance and retailer-provided support increase consumers' confidence and usages intentions (Kumar et al., 2024).

H4: *Facilitating Conditions positively influence Augmented Reality Interaction Intention.*

v. AR Usages Intention

AR usages Intention captures consumers' willingness to engage with AR tools during the consumption journey. Studies indicate that AR increases awareness of environmental impacts, encourages product longevity considerations, and supports reuse and repair decisions (Asif et al., 2025; Nadeem et al., 2025). AR-enabled virtual trials and product passports provide richer information that motivates consumers to take circular consumption actions such as choosing refurbished items, evaluating durability, or reducing unnecessary purchases (Jeganathan & Szymkowiak, 2025; Söderström et al., 2024).

H5: *Augmented Reality usages Intention positively influences Actual AR usages.*

vi. Actual AR Usages

It is a critical outcome variable in the UTAUT model, representing the physical adoption of the AR application, which is directly and strongly predicted by the user's Behavioral Intention (Venkatesh et al., 2003).

H6: A*ctual AR Usage positively affects Circular Consumption Behavior.*

vii. Environmental Consciousness

Environmental Concern represents consumers' awareness and personal relevance of ecological issues. Extant literature shows that higher environmental concern amplifies sustainable consumption patterns, especially when supported by AR's immersive green cues (Nadeem et al., 2025; Lavoye et al., 2025). Consumers with strong ecological values are more likely to translate sustainable actions into long-term circular behaviours.

H7: *Environmental Consciousness strengthens the positive relationship between Actual AR Usage and Circular Consumption Behavior.*

viii. Circular Consumption Behaviour

Circular Consumption Actions reflect direct sustainability-driven decisions, such as selecting eco-friendly options, repairing instead of replacing, or reusing products. These actions often spill over into broader circular consumption behaviours (Wang & Escobar, 2025). AR facilitates transparent sustainability cues, which convert specific actions into habitual sustainable behaviours (Lavoye et al., 2025).

7.Research Methodology

Aspect	Details
Sample Size	200 Individual Consumers
SampleSize Determination	Minimum Necessary Sample Size: 200 (See Figure No. 3 for details)
Sampling Method	Non-Random Purposive Sampling
Data Collection	Primary and Secondary Data
Statistical Technique	Structural Equation Model (SEM)

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Aspect	Details
Statistical Tool	SMART-PLS

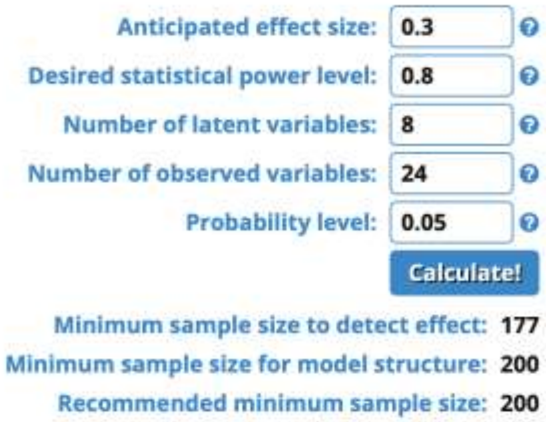

Figure No: 3 A-priori SEM sample Size Calculator

Using the a-priori SEM sample size calculation with an anticipated effect size of 0.30, desired statistical power of 0.80, and significance level of 0.05, the minimum required sample size for the model is approximately 200 respondents.

8. Data Analysis and Interpretation:

i. Measurement Model Result-

A.Indicator reliability -all items are above 0.70 indicating indicator reliability

Table No. 1-Indicator reliability

Outer loadings - Matrix

	ACT	AR_INT	CCB	EE	ENV	FC	PE	SI	ENV x ACT
ACT1	0.944								
ACT2	0.952								
ACT3	0.957								
AR_INT1		0.951							
AR_INT2		0.947							
AR_INT3		0.946							
CCB1			0.969						
CCB2			0.968						
CCB3			0.962						
EE1				0.965					
EE2				0.963					
EE3				0.966					
ENV1					0.959				
ENV2					0.965				
ENV3					0.960				
FC1						0.979			
FC2						0.914			

Outer Loadings Table (Indicator Reliability)

Outer loadings indicate how strongly each item measures its assigned construct.

The table no. 1 shows that all items have strong loadings, meaning every indicator reliably measures the construct it belongs to.

ii. Internal Consistency Reliability

Reliability of the measurement model was assessed using Cronbach's alpha and Composite Reliability (CR). As presented in Table 2, all constructs achieved Cronbach's alpha values between **0.94 and 0.95** and CR values ranging from **0.85 to**

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0.88, which exceed the recommended threshold of 0.70 (Hair et al., 2022). This confirms that all constructs exhibit satisfactory internal consistency.

Moreover, all Average Variance Extracted (AVE) values were above **0.50**, demonstrating convergent validity of the latent constructs. Therefore, the measurement model exhibits both **internal consistency reliability** and **convergent validity**.

Table No: 2 Reliability and validity

Construct reliability and validity - Overview

	Cronbach's alpha	Composite reliability (rh...	Composite reliability (rh...	Average variance extrac...
ACT	0.947	0.947	0.966	0.904
AR_INT	0.943	0.945	0.964	0.898
CCB	0.965	0.967	0.977	0.934
EE	0.963	0.974	0.976	0.931
ENV	0.959	0.966	0.973	0.924
FC	0.958	-0.927	0.929	0.814
PE	0.954	0.956	0.970	0.916
SI	0.958	0.982	0.973	0.923

iii. Discriminant Validity (Fornell–Larcker Criterion)

Discriminant validity was assessed using the **Fornell–Larcker criterion** (Fornell & Larcker, 1981). As presented in Table 3, the square root of the **Average Variance Extracted (AVE)** for each construct **greater than its correlations with other constructs**.This confirms that each construct shares more variance with its own indicators than with other constructs, thereby establishing discriminant validity.

The Fornell–Larcker criterion results demonstrate that all constructs satisfy the discriminant validity condition, as the square roots of their AVE values are higher than the inter-construct correlations.

Table No: 3 Discriminant validity

Discriminant validity - Fornell-Larcker criterion

	ACT	AR_INT	CCB	EE	ENV	FC	PE	SI
ACT	0.951							
AR_INT	0.539	0.948						
CCB	0.366	0.282	0.966					
EE	0.053	0.216	0.151	0.965				
ENV	0.047	0.080	0.435	0.083	0.961			
FC	0.382	0.054	0.169	0.038	0.000	0.902		
PE	0.298	0.498	0.166	-0.009	0.004	-0.067	0.957	
SI	0.155	0.340	0.018	0.045	0.073	-0.023	0.001	0.961

The diagonal values (√AVE) are higher than the correlations with other constructs,

confirming that each construct is distinct, supporting discriminant validity.

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Discriminant validity - Heterotrait-monotrait ratio (HTMT) - Matrix

	ACT	AR_INT	CCB	EE	ENV	FC	PE	SI	ENV x ACT
ACT									
AR_INT	0.570								
CCB	0.382	0.295							
EE	0.061	0.225	0.157						
ENV	0.059	0.081	0.449	0.084					
FC	0.395	0.029	0.118	0.036	0.034				
PE	0.314	0.523	0.174	0.016	0.026	0.120			
SI	0.161	0.349	0.028	0.051	0.070	0.049	0.040		
ENV x ACT	0.035	0.048	0.224	0.119	0.107	0.054	0.064	0.118	

Table No.4 HTMT MATRIX

All HTMT values are below 0.90, meaning each construct is unique and does not overlap with other constructs. This ensures good discriminant validity.

9. Hypothesis testing

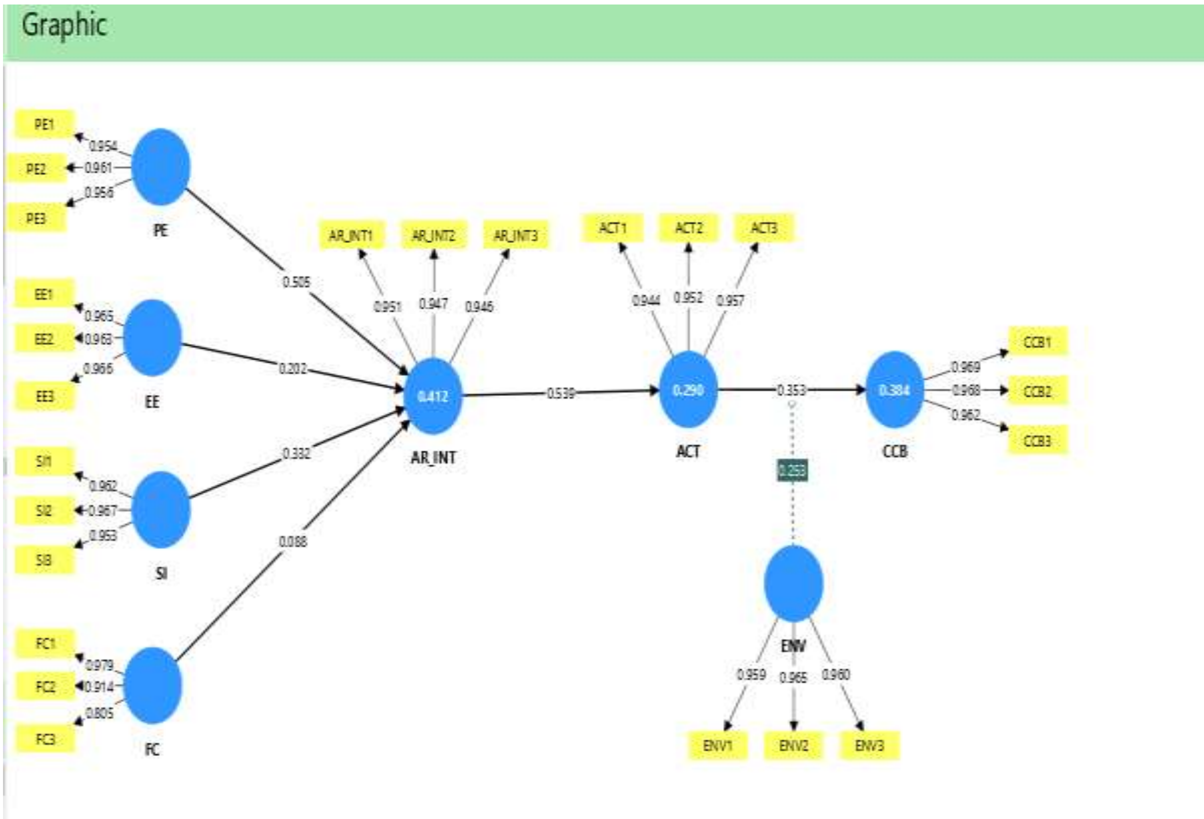

Figure-4
Source-Author work(SmartPLS)

Path coefficients - Mean, STDEV, T values, p values

	Original sample (O)	Sample mean (M)	Standard deviation (ST...	T statistics (|O/STDEV|)	P values
ACT -> CCB	0.353	0.351	0.062	5.734	0.000
AR_INT -> ACT	0.539	0.540	0.055	9.761	0.000
EE -> AR_INT	0.202	0.206	0.060	3.358	0.001
ENV -> CCB	0.447	0.448	0.055	8.080	0.000
ENV x ACT -> CCB	0.253	0.248	0.053	4.739	0.000
FC -> AR_INT	0.088	0.082	0.070	1.255	0.210
PE -> AR_INT	0.505	0.506	0.062	8.086	0.000
SI -> AR_INT	0.332	0.334	0.061	5.458	0.000

Table-5 PATH COFFICIENTS

The path analysis results indicate that most hypothesized relationships in the model are significant, confirming that Augmented Reality effectively drives circular consumption behavior. Performance Expectancy, Effort Expectancy, and Social Influence significantly increase consumers' intention to adopt AR, while AR intention strongly predicts actual usage. Furthermore, both environmental concern and actual AR usage positively influence circular consumption behavior, with environmental concern also strengthening this effect through a significant moderating role. The only relationship found to be non-significant was between Facilitating Conditions and AR adoption intention (FC → AR_INT), with a p-value of 0.210 highlighted in red by SmartPLS. As the value exceeds the 0.05 threshold, the hypothesis was not supported, indicating that users may already have sufficient technological access and support, making infrastructural factors less influential in their adoption decisions. This result reinforces that perceived usefulness, ease of use, social influence, and environmental concern are the key drivers shaping AR-enabled sustainable and circular consumption behavior in retail settings.

10.Theoretical Implications

The findings of this study contribute significant theoretical advances to technology adoption and sustainability behavior literature by integrating UTAUT-based constructs with environmental variables and behavioral outcomes. First, the strong predictive effects of performance expectancy, social influence, and effort expectancy on anxiety/risk interpretation extend existing UTAUT theories by demonstrating that cognitive and social drivers not only influence intention directly but also shape individuals' affective risk perceptions, highlighting an expanded psychological pathway within technology adoption. Second, the significant role of environmental concern and its interaction with adoption behavior in predicting consumer citizenship behavior underscores the importance of embedding pro-environmental psychology into behavioral models, thereby bridging sustainability theory with technology-use frameworks. Third, the mediating effect of adoption behavior between antecedents and citizenship outcomes emphasizes the centrality of actual behavioral engagement, aligning with recent theoretical calls to move beyond intention-based models toward behavior-driven research. Finally, the non-significant influence of facilitating conditions on anxiety/risk interpretation challenges prevailing assumptions in UTAUT, suggesting that infrastructural support may not meaningfully reduce perceived risk in contexts involving sustainability or ethical consumption. Together, these insights enrich theoretical understanding by offering a more holistic, multi-layered explanation of how cognitive, emotional, and environmental factors jointly shape sustainable behavioral outcomes.

11. Managerial Implications

The results offer several actionable insights for managers aiming to enhance adoption and sustainability-related consumer behaviors. Since performance expectancy and social influence significantly shape risk perceptions, organizations should prioritize clear communication of functional benefits, demonstrate effectiveness through testimonials, and leverage opinion leaders to build trust and reduce consumer uncertainty. The strong impact of environmental concern on citizenship behavior highlights the need for firms to embed sustainability values in branding, product design, and customer engagement strategies, as environmentally conscious consumers are more likely to support responsible business practices. Given the significant mediating role of adoption behavior, managers should focus on creating seamless user experiences,

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simplifying onboarding processes, and offering personalized support to convert intention into actual behavior that ultimately stimulates citizenship actions such as advocacy and responsible usage. Additionally, the non-significant role of facilitating conditions suggests that infrastructure alone is insufficient; instead, managers must address psychological barriers by offering transparency, risk-reduction mechanisms, and credible assurance programs. By integrating these findings into marketing, product development, and sustainability initiatives, managers can cultivate stronger consumer engagement, enhance responsible consumption, and strengthen long-term customer–brand relationships.

12. Conclusion

This study advances understanding of how augmented reality (AR) technology shapes sustainable and circular consumption behaviors in retail by empirically validating a model that integrates technology adoption factors, environmental concern, and consumer citizenship behavior. The findings demonstrate that performance expectancy, effort expectancy, and social influence significantly enhance consumers' risk interpretation toward AR, which in turn strongly predicts actual AR usage. Moreover, AR-driven adoption behavior emerges as a critical mechanism that translates consumer perceptions into responsible and sustainability-oriented actions. Environmental concern further strengthens this relationship by positively influencing both adoption behavior and citizenship behavior, highlighting its central role in fostering circular consumption. Overall, the study provides robust evidence that AR can function as a transformative tool for promoting environmentally responsible consumer decisions, offering retailers a pathway to align digital innovation with sustainability goals. By bridging virtual product experiences with real-world sustainable outcomes, the research contributes meaningful theoretical insights and practical directions for leveraging AR as a catalyst for circular retail consumption.

13. Scope for Further Study

Future research can extend this study by exploring additional psychological and contextual variables—such as digital self-efficacy, privacy concerns, and perceived enjoyment—that may further influence AR adoption and sustainable consumption. Longitudinal studies could offer deeper insights into how consumer perceptions evolve with repeated AR usage and whether sustained engagement leads to stronger circular consumption behaviors over time. Comparative analyses across retail sectors (e.g., fashion, electronics, home décor) and cultural contexts would allow researchers to examine whether the model holds universally or varies across markets. Additionally, future studies may integrate objective behavioral data from retailers' AR platforms to complement self-reported responses and enhance predictive accuracy. Given the rapid evolution of immersive technologies, examining the role of AI-driven personalization, virtual try-on accuracy, and mixed-reality environments could further advance understanding of how emerging technologies influence sustainable retail ecosystems. These directions provide fertile ground for expanding theoretical insights and strengthening the empirical foundation of AR-enabled sustainable consumption research.

REFERENCES

- Asif, M., Fazel, H., & Alghamdi, F. S. (2025). The ethical landscape of immersive marketing: virtual and augmented reality in advertising. *Marketing Intelligence & Planning, 43*(7), 1515–1533. https://doi.org/10.1108/MIP-07-2024-0519.
- Aslam, U., & Davis, L. (2024). Analyzing consumer expectations and experiences of Augmented Reality (AR) apps in the fashion retail sector. *Journal of Retailing and Consumer Services, 76*, 103577. https://doi.org/10.1016/j.jretconser.2023.103577.
- Attri, R., Roy, S., & Choudhary, S. (2024). In-store augmented reality experiences and its effect on consumer perceptions and behaviour. *Journal of Services Marketing, 38*(7), 892–910. https://doi.org/10.1108/JSM-01-2024-0005.
- Fan, X., Chai, Z., Deng, N., & Dong, X. (2020). Adoption of augmented reality in online retailing and consumers' product attitude: A cognitive perspective. *Journal of Retailing and Consumer Services, 53*, 101986. https://doi.org/10.1016/j.jretconser.2019.101986.
- Jeganathan, K., & Szymkowiak, A. (2025). Bridging Digital Product Passports and in-store experiences: How augmented reality enhances decision comfort and reuse intentions. *Journal of Retailing and Consumer Services, 84*, 104242. https://doi.org/10.1016/j.jretconser.2025.104242.

- Karadayi-Usta, S. (2024). Role of artificial intelligence and augmented reality in fashion industry from consumer perspective: Sustainability through waste and return mitigation. *Engineering Applications of Artificial Intelligence, 133*(Part A), 108114. https://doi.org/10.1016/j.engappai.2024.108114.
- Kumar, H. (2021). Augmented reality in online retailing: a systematic review and research agenda. *International Journal of Retail & Distribution Management, 50*(4), 537–559. https://doi.org/10.1108/IJRDM-06-2021-0287.
- Kumar, H., Rauschnabel, P. A., Agarwal, M. N., Singh, R. K., & Srivastava, R. (2024). Towards a theoretical framework for augmented reality marketing: A means-end chain perspective on retailing. *Information & Management, 61*(2), 103910. https://doi.org/10.1016/j.im.2023.103910.
- Lavoye, V., Petit, O., Tarkiainen, A., & Sipilä, J. (2025). Self-proximity in augmented reality enhances consumer's responses to green products through anticipated warm glow. *Journal of Business Research, 196*, 115403. https://doi.org/10.1016/j.jbusres.2025.115403.
- Li, Z., & Lev, B. (2026). Integrating the physical and digital strategies for supplier: the role of offline showroom and augmented reality experiences. *Computers & Operations Research, 185*, 107294. https://doi.org/10.1016/j.cor.2025.107294.
- Nadeem, W., Ashraf, A. R., & Kumar, V. (2025). Fostering consumer engagement with sustainability marketing using augmented reality (SMART): A climate change response. *Journal of Business Research, 192*, 115289. https://doi.org/10.1016/j.jbusres.2025.115289.
- Negm, E. (2025). The impact of augmented reality on consumer behavior: a focus on value development, leading to brand engagement and purchase intention. *Management & Sustainability: An Arab Review, 4*(2), 320–341. https://doi.org/10.1108/MSAR-08-2023-0044
- Naveen, L., Khan, M. I., Saleh, M. A., & Subudhi, R. N. (2025). The influence of mobile augmented reality on consumer behavior: Insights into affective, cognitive, and behavioral responses. *Computers in Human Behavior, 165*, 108558. https://doi.org/10.1016/j.chb.2025.108558.
- Ngo, T. T. A., Tran, T. T., An, G. K., & Nguyen, P. T. (2025). Investigating the influence of augmented reality marketing application on consumer purchase intentions: A study in the E-commerce sector. *Computers in Human Behavior Reports, 18*, 100648. https://doi.org/10.1016/j.chbr.2025.100648.
- Palaniappan, U., Vilma G, A., & Booshnam, D. (2025). The digital interface effect: how mobile augmented reality (MAR) app quality shape purchase decisions. *Journal of Systems and Information Technology, 27*(4), 705–728. https://doi.org/10.1108/JSIT-06-2024-0228.
- Schultz, C. D., & Kumar, H. (2024). ARvolution: Decoding consumer motivation and value dimensions in augmented reality. *Journal of Retailing and Consumer Services, 78*, 103701. https://doi.org/10.1016/j.jretconser.2023.103701.
- Söderström, C., Mikalef, P., Landmark, A. D., & Gupta, S. (2024). Augmented reality (AR) marketing and consumer responses: A study of cue-utilization and habituation. *Journal of Business Research, 182*, 114813. https://doi.org/10.1016/j.jbusres.2024.114813.
- Wang, Q. J., & Escobar, F. B. (2025). Immersive Technologies for Food Consumer Science-Virtual and Augmented Reality. In *Reference Module in Food Science*. Elsevier. https://doi.org/10.1016/B978-0-443-29139-5.00002-1.
- Xu, L., Qin, H., Meah, M. R., & Hughes, J. (2025). A novel application of flow theory to mobile augmented reality. *Technological Forecasting and Social Change, 221*, 124359. https://doi.org/10.1016/j.techfore.2025.124359.
- Appify Commerce. (2023, April 25). *Real-world success stories: Brands leveraging AR for eCommerce growth* [Blog post]. Appify Commerce. https://www.appifycommerce.com/blog/augmented-reality-ecommerce-success-stories/
- Product Monk. (2024, May 27). *Boost customer retention: Learn from … a brand ruling online eyewear shopping*. Product Monk. https://www.productmonk.io/p/how-did-lenskart-manage-customer-retention