AUGMENTED REALITY in E-COMMERCE: BOOSTING SALES and CUSTOMER SATISFACTION

Dr. Easubatham Armstrong Anand J[*1] Dr. Ande Hari Hara Nath Reddy[#2] Dr. Mekala P[#3] Dr. Jaishree S[#4]

**1 KPR College of Arts, Science and Research, India*
#2 KPR College of Arts, Science and Research, India
#3 Dr.N.G.P Institute of Technology, India
#4 PSG College of Arts & Science, India

***Abstract*--Augmented Reality (AR) has become a transformative force in e-commerce, providing immersive experiences that bridge the gap between online and in-store shopping. This article examines the impact of AR on e-commerce, particularly its capacity to enhance customer satisfaction and drive sales. Through case studies and industry data, we show how AR applications, such as virtual try-ons and interactive product visualizations, are reshaping consumer behavior and establishing new benchmarks for the online retail experience. The research employs both primary and secondary data sources. Primary data was gathered via a self-structured questionnaire using a convenient sampling method, resulting in <number> responses out of <number> distributed. Secondary data was sourced from a thorough review of articles, journals, books, and other relevant materials. The findings indicate that AR significantly improves product visualization, boosts customer engagement, and reduces return rates by facilitating more informed purchasing decisions. Furthermore, AR enhances overall customer satisfaction by delivering a more engaging and interactive shopping experience. This study highlights AR's potential to revolutionize e-commerce, providing valuable insights for retailers aiming to incorporate AR technologies into their online platforms to increase sales and improve customer satisfaction.**

Keywords --Augmented Reality, E-commerce, Online shopping, Customer Satisfaction, Sales, Shopping

I. INTRODUCTION

In the rapidly evolving landscape of e-commerce, businesses constantly seek innovative ways to captivate consumers and enhance their shopping experiences. Among the most transformative technologies reshaping this domain is Augmented Reality (AR). Augmented Reality is defined as “physical reality where users can also perceive virtual components” [4]. It integrates virtual and real-world elements and is both interactive and 3D registered. The applications of AR were vast and it is in almost all the domains from Healthcare, Gaming, Retail till interior designing, construction and military which proves the statement of [9] that is “Not just for online shoppers, Hari has outlined potential uses of augmented reality in retail.”. As In E-commerce, AR improves the purchasing experience by letting users see products in their actual settings. In the end, it results in increased conversion rates and lower return rates, which benefits both customers and retailers. It also lowers uncertainty, promotes engagement, and boosts confidence in purchasing decisions. When customers want to experience a product in an AR or VR environment, "virtually try before you buy" works effectively for both businesses and consumers [3].

Boosting sales in e-commerce is crucial for several reasons. Firstly, it directly impacts revenue, enabling businesses to grow, invest in new technologies, and expand their product offerings. Increased sales can lead to better economies of scale, reducing costs and improving profit margins. In a competitive market, higher sales volumes can strengthen a company's market position and brand recognition. Boosting sales in e-commerce is vital for numerous reasons, from revenue generation and market positioning to customer retention and operational efficiencies [5], [6], [7], [12] & [17]. These studies also prove that AR is revolutionizing online retail by bridging the gap between digital and physical shopping experiences. This interactive experience helps customers make better selections by reducing the uncertainty that is frequently connected to internet shopping. Augmented Reality (AR) provides a degree of interactivity that traditional e-commerce platforms cannot match, allowing users to preview furniture in their homes and try on virtual apparel and accessories.

Customer satisfaction on the other hand is the next important factor for any business, not only E-Commerce. Following are some of the importances of customer satisfaction in E-commerce such as repeat business, positive feedbacks $ referral, customer loyalty, competitive advantage, reduced costs, trust, credibility and improvements. By lowering consumer fear and raising customer satisfaction, the tools which incorporate AR contribute to a shorter sales cycle [14]. Experiences with AR not only mitigates the uncertainty often associated with online shopping but also empowers consumers to make more informed decisions. From trying on virtual clothes and accessories to previewing furniture in their homes, AR offers a level of interaction that traditional e-commerce platforms cannot match. Customer satisfaction in e-commerce hinges on several factors, including the ease of finding products, the accuracy of product information, and the overall shopping experience, which are resolved by AR.

Augmented Reality can offer several advantages that help boost sales in e-commerce by enhancing product visualization [19], improving customer engagement, reducing return rates, providing personalized shopping experiences, and offering a competitive advantage. It can also significantly boost customer satisfaction in e-commerce by enhancing product

visualization, improving engagement and experience, offering personalized shopping, reducing returns, and building trust and confidence. As AR technology continues to evolve, its impact on e-commerce sales is expected to grow, making it a vital tool for online retailers aiming to enhance customer experience and drive sales

By offering a detailed analysis of AR's customer perspectives, benefits and practical applications, this article aims to equip e-commerce businesses with the knowledge and tools necessary to stay competitive in an increasingly digital marketplace. As AR continues to evolve, its role in e-commerce is poised to expand, promising a future where online shopping is more interactive, personalized, and satisfying than ever before.

II. REVIEW OF LITERATURE

Augmented reality in E-commerce have discussed by various authors during various period of time which are reviewed and presented below the gist from which the research is inspired. Augmented Reality offers a live view of the actual world, enriched by computer-generated sensory elements such as audiovisual, designs, or Global Positioning System information [11]. AR technology aims to expand and electronically blend the consumer's world or actual surroundings in real time by incorporating layers of electronic data. [1]. When you combine AR/VR E-Commerce with physical storefronts, you get mixed commerce [13]. Research from the University of Texas demonstrates that a high-quality shopping experience is positively correlated with consumer satisfaction [18]. The virtual reality architecture can be modified by including AR, in which when a customer enters the virtual showroom where they can search for the things they need and they will be supported by the AI character [20]. Augmented Reality (AR) lets customers visualize products like furniture and clothing in their real environment, reducing uncertainty and increasing purchase likelihood [2]. AR applications in e-commerce create immersive, interactive experiences that captivate customers, enhance engagement, and drive increased product exploration and purchases [15]. AR reduces e-commerce return rates by providing accurate product representations, helping customers make more informed purchase decisions and better understand product features and suitability [10]. AR enhances personalization by using customer data to recommend tailored clothing sizes and styles, boosting satisfaction and conversion rates [16]. Incorporating AR into e-commerce can differentiate a brand as innovative and customer-focused, attracting tech-savvy consumers and creating a competitive edge [8].

III. RESEARCH METHODOLOGY

Design and method: For this study, the responses from the respondents using online platforms for shopping and platform users in which AR incorporated. Using a convenient sampling method, a sample size of 230 out of 300 responses have been used for the study.

***Sampling size*:** In total 300 responses were collected for this analysis from E-commerce platform users that are facilitated with AR, from which 230 have been selected using convenient sampling methods and analysis have been performed.

Data Collection: Primary and secondary data are both used in which the responses to a structured questionnaire comprise primary data, while secondary data is obtained from publications, websites, periodicals, and books to bolster the research.

***Tools and Technologies Used*:** Primary data has been collected using Google Forms. Data analysis and visualization have been done using Microsoft Power BI and Excel. In this work, the independent sample T-test for hypothesis testing and percentage analysis for exploratory data analysis were employed.

***Questionnaire Design*:** The questions were designed in a way which identifies the respondents view on augmented reality incorporated E-commerce platforms and its impact in purchasing and finding the right products. The questions are also addressing the customer's satisfaction too. In total 17 questions with appropriate choices have been designed and used

IV. DATA ANALYSIS

The data (Primary) for the analysis have been collected through Google forms. As the aim is to analyze the impact for AR in boosting sales and customer satisfaction, the responses of the respondents who do not know AR and its features have been removed. Therefore, in total 230 out of 300 responses have been used for the further analysis. The responses were selected in a way that there are an equal number of responses for the respondents using AR and not using AR during their shopping. Checked for the missing values and handled with the mean and mode values.

Figure 1 depicts the demographic distribution of the respondents in age, occupation, marital status, occupation and gender. Male respondents are greater than the female respondents in taking this survey. Majority of the customers are under the age group 19-25 years old age group and 15-18 years old age group has the least respondents. There are 138 married and 92 unmarried respondents who have responded to this survey. Majority of the population are under employed, followed by Home-makers and students. Most of the respondents are in the 30001 - 50000 rupees salary range followed by 0 who are students, 50001 - 70000, 10001 - 30000 and below 10000 respectively. This indicates that salary range creates an impact on purchasing products online.

Figure 2 pictures the distribution of responses on AR and its features. From the survey it is clear that most of the respondents are aware of AR and its features (154 - yes, 44 - Maybe and 32 - No). 150 respondents are purchasing products online monthly followed by occasionally (48) and weekly (32). 106 out 230 respondents stated that they have completed a product purchase in the last six months from the E-Commerce platforms incorporated AR. 186 out of 230 respondents stated that they are influenced by AR and its features during their product purchase in the E-Commerce platform.

Figure 1 Demographic Split-up

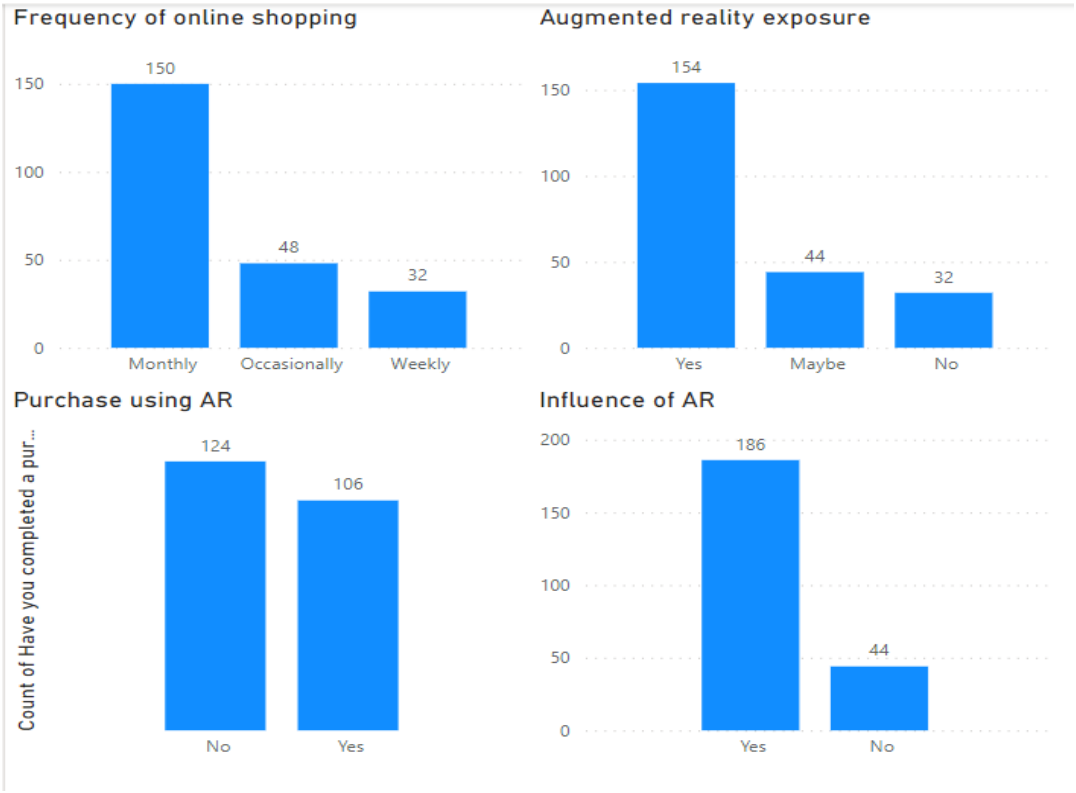

Figure 2 Augmented Reality aspects

t-Test: Paired Two Sample for Means

	Recommend platform with AR	*Recommend platform without AR*
Mean	4.104347826	3.426086957
Variance	0.620594966	0.387032799
Observati	115	115
Pearson C	0.194860417	
Hypothesi	0	
df	114	
t Stat	8.048842123	
P(T<=t) or	4.43037E-13	
t Critical o	1.658329969	
P(T<=t) tw	8.86073E-13	
t Critical t	1.980992298	

Figure 3 AR incorporated platform recommendation

t-Test: Paired Two Sample for Means

	Return Rating (Platform with AR)	*Return Rating (Platform without AR)*
Mean	4.252173913	3.217391304
Variance	0.313043478	0.311975591
Observations	115	115
Pearson Correlation	0.159873311	
Hypothesized Mean Difference	0	
df	114	
t Stat	15.31365844	
P(T<=t) one-tail	9.84399E-30	
t Critical one-tail	1.658329969	
P(T<=t) two-tail	1.9688E-29	
t Critical two-tail	1.980992298	

Figure 4 Product return rating

t-Test: Paired Two Sample for Means

	Rating for platform with AR	*Rating for platform without AR*
Mean	4.234782609	2.530434783
Variance	0.60228833	0.865293669
Observations	115	115
Pearson Correlation	0.652243257	
Hypothesized Mean Difference	0	
df	114	
t Stat	25.20419654	
P(T<=t) one-tail	9.91924E-49	
t Critical one-tail	1.658329969	
P(T<=t) two-tail	1.98385E-48	
t Critical two-tail	1.980992298	

Figure 5 Customer Rating

A. Hypothesis 1: Augmented Reality Increases Conversion Rates

H0 (Null Hypothesis): There is no significant increase in conversion rates when augmented reality is implemented in e-commerce platforms.

H1 (Alternative Hypothesis): There is a significant increase in conversion rates when augmented reality is implemented in e-commerce platforms.

Interpretation: From Figure 3, it is found that the T - test critical value for both one - tail and two - tail tests for customer recommending AR incorporated platforms to friends and families are greater than the conventional significance level which are 1.6583 and 1.9809 respectively. Therefore rejected null hypothesis which indicates that there is a significant increase in conversion rates when augmented reality is implemented in e-commerce platforms.

B. Hypothesis 2: Augmented Reality Reduces Return Rates

H0 (Null Hypothesis): The implementation of augmented reality does not significantly reduce the return rates of products in e-commerce.

H1 (Alternative Hypothesis): The implementation of augmented reality significantly reduces the return rates of E-commerce products.

Interpretation: From Figure 4, it is found that the T - test critical value for both one - tail and two - tail tests for customers rating on returning the product purchased are greater than the conventional significance level which are 1.6583 and 1.9809 respectively. Therefore, rejected null hypothesis which indicates that the AR implementation significantly reduces the return rates of E-commerce products. The mean of the rating values is higher for platforms with AR than platforms without AR which also indicates that the product return is less for the product purchased from AR incorporated E-commerce platform than platforms without AR.

C. Hypothesis 3: Augmented Reality Enhances Customer Satisfaction

H0 (Null Hypothesis): Augmented reality features do not significantly enhance customer satisfaction in e-commerce.

H1 (Alternative Hypothesis): Augmented reality features significantly enhance customer satisfaction in e-commerce.

Interpretation: From Figure 5, it is found that the T - test critical value for both one - tail and two - tail tests for customers satisfaction rating on E-commerce platforms are greater than the conventional significance level which are 1.6583 and 1.9809 respectively. Therefore, rejected the null hypothesis which indicates that augmented reality features significantly enhance customer satisfaction in e-commerce.

V. RESULTS AND DDISCUSSION

The above analysis gives a detailed view on the AR and its features, impact of AR in boosting sales and customer satisfaction on the AR incorporated E-commerce platforms. The exploratory data analysis on the collected data indicates that most of the population are aware of AR and its features and also, they are much influenced by them during their purchase. It is also found that the customers are getting more satisfied with the platforms incorporated AR than the platforms without AR. The trend on the recommendation of AR empowered E-commerce platforms is increasing gradually results in increasing conversion rates thereby increasing the sales.

From the result of hypothesis 1, it is found that the mean of the recommendation rating values are higher for platforms with AR than platforms without AR which also indicated that the customers are recommending platforms incorporated AR more than with the platforms without AI. From the result of hypothesis 2, it is found that the mean of the rating values are higher for platforms with AR than platforms without AR which also indicates that the product return is less for the product purchased from

AR incorporated E-commerce platform than platforms without AR. from the result of hypothesis 1, it is found that the mean of the Satisfaction Rating values are higher for platforms with AR than platforms without AR which also indicates that customers are satisfied with the platforms incorporated AR than platforms without AR. Therefore, from the analysis it is seen that AR and its features are helping customers more during their purchases. Benefits under certain domains are as follows.

AR enables customers to visualize products in their intended environment. For instance, furniture retailers like IKEA have developed AR apps that allow customers to see how a piece of furniture would look and fit in their home. This level of interactivity reduces uncertainty and enhances confidence in purchase decisions. For apparel and accessories, virtual try-ons have become a game-changer. Brands like Warby Parker and Sephora use AR to let customers try on glasses or makeup virtually. This not only increases engagement but also reduces the likelihood of returns, as before completing the purchase, consumers can check the way goods appear on them. By providing a realistic representation of products, AR reduces the gap between online and offline shopping experiences. This realistic visualization can lead to higher conversion rates, as customers feel more confident in their purchases. It helps mitigate product return issues by allowing customers to make more informed decisions. For example, virtual fitting rooms reduce the likelihood of clothing returns due to size or fit issues.

VI. CONCLUSION

The transformative potential of Augmented Reality is depicted in this study. From the analysis on the impact of AR and its features on boosting sales and customer satisfaction, it is clear that AR is playing an important and centric role in boosting sales by increasing convention rates and reducing return rates. It also helps in customer satisfaction through improved product visualization, virtual try-ons, and engaging shopping experiences. It addresses common pain points in online shopping and sets new standards for customer interaction. AR transforms the online shopping experience from a passive activity to an engaging one. Interactive AR features can guide customers through product features, benefits, and usage, providing a richer and more informative shopping experience. This engagement can lead to higher customer satisfaction and loyalty. As the technology continues to evolve, its adoption in e-commerce is expected to grow, offering even more innovative ways to connect with customers and transform the shopping experience. In conclusion adopting augmented reality in E-Commerce platform will definitely boost sales and customer satisfaction

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CONFLICT OF INTEREST

The authors confirm no conflicts of interest. They have all approved the final version of the manuscript and have contributed equally to its creation

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