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The role of augmented reality in online shopping of apparels: A review of meaning, applications and user experience

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ABSTRACT

Purpose: The purpose of this paper is to review the role of augmented reality while purchasing apparels online by identifying and defining the role of AR, applications of AR that are relevant while purchasing garments online and to review users experience, who have tried AR technologies while purchasing clothing online.

Design/Methodology/ Approach – This paper is based on the review of research papers emphasizing the features and application of augmented reality in online shopping environment while purchasing apparels and focusing on papers to determine the users experience of using AR technologies.

Findings – Based on the previous literature, the paper presents synthesized definition of AR and its features. Furthermore, with the help of existing literature, the paper tries to identify the two major applications of AR in online shopping environment while purchasing apparels: Virtual Fittings and Try-on and 3D Visualizations. Finally, the paper tries to determine the user experiences using AR technologies while shopping online.

Originality/Value – This paper gives an overview of the application and utility of AR technology in the online shopping environment that has not yet been sufficiently reviewed. It outlines areas for future research and thus provides value for online retailers, online shoppers and researchers.

Keywords:
Augmented Reality, Virtual Fittings and Try-on, 3D Visualizations, Literature review

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1. INTRODUCTION

The technological advancements have led to the growth of online apparel retail market from US$382.8 billion in 2017 and is expected to reach US$821.83 billion at a Compound Annual Growth Rate of 13.58 by 2022.It is observed that the online platform of conducting business has become a promising future (Dwivedi et al., 2021)[1] of almost every company across the globe and this transition from brick & mortar format to online platform have led to the growth of apparel retail market (Reinartz et al., 2019)[2]. The benefits of buying online such as ease and comfort, access to variety of products has made the shopping experience more exciting in turn making consumers spend more money and time in making online purchases (Jiang et al., 2012)[3]. This has led to more emphasis on customized apparel and internet shopping across clothing and fashion retail sector. With this growing trend, the online vendors are trying to put more efforts in making the online shopping experience exciting by increasing their capital investments in creating more attractive (Constantinides, 2004)[4] website designs, easy navigation, offering the accessibility of various payment modes and also simplifying the procedures relating to return and refund. In addition to this, the online retailers are also working towards reducing the risks (Abuhashesh et al., 2019)[5] perceived by customers to shop online such as financial risks, privacy risks, and even the inconvenience that is faced by customers to shop apparels online without having the option to try the clothing before the final purchase. The physical separation between consumer and product in online shopping environment was always an obstacle affecting consumer purchase intentions. Thus, different strategies have been designed and implemented by online vendors to reduce risk factors associated while purchasing clothing online. Augmented Reality (AR) is one of several digital technologies that have paved ways to merge the elements of both traditional and digital stores (Caboni & Hagberg, 2019)[6]. The arrival of augmented reality is changing the shape of online environment (Flavian et al., 2019)[7] by integrating the objects of physical and online platforms at different levels. The physical separation between the consumer and products in the online shopping environment always resulted in uncertainty towards purchase decision. The consumer experience in this augmented world is being changed by the invasion of portable and highly interactive devices. Thus, AR modality has paved ways for individuals to have the feel of trying products as in real-time, thus establishing the rapport between the technology and their self-image (Huang et al., 2019)[8]. It was found that customers were happy as AR techniques (Baytar et al., 2020)[9] helped to provide finer details regarding the size, color, and fit of the garment and thus developing positive attitude and purchase intentions. Thus, AR embedded systems proved to have increased the efficiency of consumer purchase decisions (Wang et al., 2015)[10]. The demand analysis of Global Augmented Reality (AR) Market size & share revenue is estimated to grow to about USD 90.8 billion by 2028, at a CAGR of approximately 31.5% between 2022 and 2028. The way that consumer selects a retail channel, choose products and services and make purchase decisions are all influenced by the emerging forces and trends such as Augmented reality, Virtual reality, artificial intelligence and other internet of things (Grewal et al., 2017)[11]. Thus, understanding the impact of these technologies on consumer behaviour in online retail environment becomes very critical to make efficient business decisions and enhance consumer's experience (Flavian et al., 2019)[7]. Research studies relating to the applications of AR in online retailing and especially in the garment sector have increased rapidly in the recent times (Rahman & Kharb, 2018)[12]. This encompasses the need for the study of these emerging literatures. Thus, the purpose of this paper is to review the applications of AR in online platforms while shopping Apparels within business-oriented research. The paper addresses the following three research questions:

- What is AR?
- What AR applications are relevant for online clothing retailers?
- To determine users experience adopting AR technologies while shopping online?

In the next section, the research paper describes the methodology in which the previous literatures have been identified, selected and screened. Next, the paper throws insights on the above research questions with the help of previous literatures. Firstly, an attempt is made to define the concept of AR according to different literatures. Secondly, an evaluation of AR applications which are relevant to online garment retailers are determined and thirdly the paper tries to examine user's experience adopting AR techniques while shopping in the online platforms.

2. METHODS AND MATERIALS

The reviews of literature were performed in four stages. The process began with identification and selection of literatures using keywords such as augmented reality, online retailing and then consumer behavior in online environment while purchasing clothing. Most of the literatures were selected from Scopus indexed Journals, as this would ensure the quality of research papers due to the inclusion of stringent peer review processes. In the next step, careful screening of identified literatures was carried out to make sure that only relevant literatures were considered for the review. The screened literatures were considered for initial assessment by reading the abstract of the literatures to determine the relevance of the paper to the topic considered. However, the selected literatures were analyzed based on the research questions of the study.

A detailed table was constructed by specifying the screened and selected literatures in the rows and considering the three research questions in the columns. The important findings of the research paper in accordance with the research questions were included in the respective cells. In addition to the above literatures, Industry reports, newspaper articles, related information from different internet sources were also recorded as this would help in determining the practical applications of the study under consideration. Further, the important findings and results of each of the selected literature is carefully analyzed and compiled and are presented in a highly structured and organized manner in order to provide clarity for the reader. Finally, the paper is concluded by including the practical and future implications of the study topic and even the limitations.

3. MEANING OF AR

Augmented reality is said to have integrated virtual reality (VR) setting with equipment's, physical materials and responses (Botden & Jakimowicz, 2008)[13]. The term 'Augmented Reality' was first used by Tom Caudell, a researcher at Boeing in 1990, when he was asked to upgrade the steep diagrams and marking instruments which were used to guide the workers on the factory floor (Zhang & Kwok, 2018)[14]. Augmented reality has the capability of bringing the real-world into virtual setting by incorporating various techniques thereby enhancing the perception and understanding of the real-world (Ushaa & Vishal, 2023)[15]. The adoption of augmented reality by online retail vendors has fasten the process of consumer decision making in online environment as it provides the combination of virtual and interactive real environment (Papanastasiou et al., 2018)[16]. Augmented reality involves adding up of virtual elements to the real scene which in turn poses a challenge to the customers to differentiate between the augmented reality and the actual environment. Augmented reality is the technology that combines virtual reality and reality, providing three dimensional images of the products and thereby providing a real-time interactive platform (Reaver, 2023)[17]. Augmented Reality has enabled the adoption and acceptance of Industry 4.0 at a very fast pace and is considered as the prominent technology in most of the engineering companies (Runji & Lin, 2020)[18]. The technology of augmented reality has led to the increase of confidence in consumers towards their purchase decisions and has positively impacted their engagement and brand recall while purchasing online (Urbas et al., 2019)[19].

4. WHAT AR APPLICATIONS ARE RELEVANT FOR ONLINE APPAREL RETAILERS?

Online apparel purchase has always taken a backseat compared to physical store purchase due various constraints and risks associated with the purchase. The online retailers especially in the fields of fashion, accessories and apparels have embedded various augmented and virtual reality technologies into their business platforms (Flavian et al., 2019)[7]. The most advanced technologies in the fields of online apparel retailing include 3D virtual models and virtual try-on systems being widely implemented.

4.1 Virtual try-on technology

The Virtual Try-on technology enables customers to experience the reality in virtual settings through enhanced device cameras. The VTO technology was found to have huge impact on consumer's perceived benefits and perceived risks associated with online shopping environment. The gender and age of the customers were found to have no difference when it comes to adopting of VTO while making online purchase decisions (Huang et al., 2019)[8]. The VTO systems are considered to be one of the most reliable technologies as it provides more realistic experience and thus considering it to be the most implemented technology among e-retailers. The factors such as "innovativeness" and "optimism" were considered to be the most important determinants of customer's intentions of adopting and using VTO (Qasem, 2021)[20]. Consumer inspiration was considered to be the prominent factor impacting customer's intention of using and adopting VTO while making exploratory shopping (Tawira & Ivanov, 2022)[21]. The stereoscopic virtual reality provides for a three-dimensional view of the objects in the virtual world and is considered to enhance consumer's hedonic shopping experiences (Lau & Lee, 2018)[22]. The research study argues that the adoption of the Virtual Try-on system is still not completely matured and thus it was found that the dimensions of apparels are not coherent and customers not feel comfortable while shopping. The online vendors adopting VTO must put efforts towards increasing the perceived resemblance of consumers in virtual reality settings (Plotkina & Saurel, 2019)[23]. The virtual fitting rooms allow consumers to check the products for its size, fitting and even colors. This aspect of VTO has resulted in the development of favorable attitude and positive perception which in turn is impacting customers purchase intentions (Yawan, 2022)[24]. The inception and implementation of virtual fitting rooms have led the brick and mortar stores to crisis and there is a drastic shift of customers towards online shopping (Syahidi et al., 2021)[25]. The consumer's private data shared while using VTO systems when shopping online is also a growing concern among online shoppers, impacting the adoption of the technology (Berkemeier et al., 2019)[26]. The adoption of the technology depends upon the compatibility and the degree of ease with which one can learn and use it (Pustynski, 2022)[27]. The VTO systems have offered consumers with functional benefits by allowing them to try on products. (Kim & Forsythe, 2007)[28]

4.2 3D VIRTUAL MODELS

The use of augmented and virtual reality provides customers with a reality experience by displaying graphical and interactive representation of the product. It was found the hedonic motivations had greater impact on consumer's decision to use 3D image view while shopping (Nakayama, 2019)[29] as it was perceived to have greater entertainment value. Among various Sensory Enabling Technologies such as 2D larger view, 3D rotation view and virtual try-on, the 3D rotation view was considered to score highest with respect to perceived ease-of use. Mere exchange of product information with customers would not provide entertainment and fun while shopping online. This has led to the origin of the most interactive technology called 3D virtual models that would provide the real experience of the products, the customers desire to buy (Vlahović & Djurovic, 2020)[30]. The comfort and the degree of ease associated with the usage of 3D view, made the technology popular among the online shoppers. The 3D view model helped consumers by providing 360-degree view of the products and thus reducing the perceived risk associated with the purchase (Shim et al., 2016)[31]. The 3D environment is expected to provide the three-dimensional virtual systems provide in-depth view and interactive experience to the customers with high quality and visual richness images of the products thus enhancing enjoyment and fun among consumers shopping online (Li et al., 2010)[32]. The customer's attitude and the online shopping enjoyment are influenced by the store layouts of the 3D embedded online stores (Krasonikolakis et al., 2018)[33]. The 3D virtual models will considerably reduce the risk associated with apparel fit when the virtual model bodies represent the consumer's actual body size (Shim et al., 2016)[31]. The entertainment value was the major determinant of customer's decision towards adoption of virtual 3D model while making online purchase (Shamlikashvili, 2015)[34].

Table 1. Virtual applications supported by companies and online platforms: A comparative overview

Type of Application	Brand	Short description
Virtual Try –on	○ Myntra ○ Flipkart ○ Amazon ○ Ajio	• Try me • Shopping virtual • Virtual dressing room • Virtual fitting rooms
3D View modeling	○ Sketchfab ○ ZARA ○ OptiTex ○ Levis ○ Nike	• TriMirror • Zara Interior 3D Model • Real-to-Life 3D simulation • Levi's Tailor shop • Nike By You

Source: Author's data elaboration as per industry reports, newspaper articles and company website.

5. TO DETERMINE USERS EXPERIENCE ADOPTING AR TECHNOLOGY WHILE SHOPPING ONLINE

The applications of augmented technologies by online retailers to provide realistic experiences to online shoppers in a virtual environment was found to have considerable impact on consumer decisions while purchasing through online platforms (Fan et al., 2020)[35]. The AR technologies are found to have fascinating features that enhance consumer's engagement in online environment. It was also found that there exists user's acceptance of the AR technologies but still there is hindrance by the online retailers in its full-fledged implementation (Akman & Mishra, 2017)[36]. In apparel shopping environment, it was found that comparative study has been done to determine consumer response to

AR- based and Traditional web-based product presentations. An important revelation shows that most of the consumers having unfavorable perception about their own body image found AR based presentations more attractive (Yim & Park, 2019)[37]. The young generation needs more data especially while shopping for fashion accessories and apparels. They want to check if the apparels have a proper fit on to their bodies and want to determine whether the color of the cloth match them exactly or not (Billewar et al., 2021)[38] and this has resulted in the growth of AR technology adoptions. The relative advantage and user compatibility of AR technologies were found to have major impact on user's attitude towards adoption of AR systems (Iqbal & Sidhu, 2021)[39]. There is limited adoption of AR technologies among online shoppers despite positive perception and favorable attitude among online shoppers (Shim et al., 2016)[31]. The unique features and interactivity aspects of the novel technology determine the rate at which the users adopt and use the system (Huang et al., 2019)[8]. The technological developments in the area of online shopping are offering consumers the benefit of fun and entertainment as customers not only use the VTO and 3D view to evaluate the virtual fit but also to mix and match their apparels and share those photos to their friends and relatives (Imran et al., 2022)[40]. The perceived value and the visibility of the technology determines the consumer adoption intentions of the new technology (Kranthi & Ahmed, 2018)[41]. These novel technologies are adding up to the social values as consumers are able to take opinion from their friends by displaying the selected outfits on to the customized models (Chuah et al., 2016)[42]. The return rate of products bought online stands at 35 to 40 percent even after the implementation of these advanced technologies due to the measurement risk resulting misfit between the actual size and the virtual fit (Lebermann, 2021)[43].

6. CONCLUDING DISCUSSION

The purpose of this paper was to conduct a review of AR in retailing within business-oriented research. An attempt is made to review most relevant research papers to determine the meaning of AR and its utility to the online retailers and online customers. The most advanced technologies under AR including Virtual Try-On and 3D virtual models are reviewed considering the most relevant research studies to determine its implications on customer's buying intentions and decision making while purchasing apparels online. The beneficiaries and their experience while using the above technologies in AR created virtual environment are reviewed to determine the impact on customer attitude and motivations while shopping online. From the review, it is evident that AR has created a great opportunity for online retailers by enabling them to provide more realistic environment to their customers, enhancing their store experience and involvement while shopping online (B.V.D, 2023)[44]. The advanced technologies in AR have become a boon for every online apparel retailer and customer as it provides for more sophisticated ways to try the products before purchase. Thus, increased interest in the fields of AR is likely to continue amongst online vendors, online customers, and researchers. The implementation and utility of AR is still in the budding stage and is assured to have great scope for further development.

7. RESEARCH LIMITATIONS AND FUTURE RESEARCH

While this paper contributes an overview of a relatively recent but rapidly emerging theme that has so far not been sufficiently reviewed, the limitations should also be acknowledged. The Augmented Reality is relatively new and emerging technology being implemented in the online environment.

Table 2. Comparative analysis of meaning, applications, and user experience across various literature sources

Augmented reality		Relevant literatures
meaning		(Botden et al.,(2009)); (Mekni et al., (2014)); (Carmigniani et al.,(2011)); (Pantano et al.,(2017)); (Silva et al.,(2019)); (Reinwald et al.,(2014)); (Urbas et al., (2019)); (Brengman et al.,(2018))
applications	virtual try-on technology	(Zhang et al.,(2017)); (Qasem (2021)); (Tawira et al., (2021)); (Lau et al., (2019)); (Ghodbani et al.,(2022)); (Merle, (2020)); (Liaw et al., (2013)); (Kramer, (2011)); (Belanger, (2011));(Imbert et al., (2013));(Kim et al.,(2008))
	3d virtual models	(Forsythe (2007)); (Kim et al., (2008)); (Poon et al., (2014)); (Shim et al., (2011)); (Papagiannidis et al.,(2013)); (Krasonikolakis,(2018)); (Shim et al., (2011)); (Sahai et al.,(2021))
user experience		(Fan et al.,(2020)); (Nanda Kumar et al., (2016)); (Yim et al., (2019)); (Billewar et al., (2021)); (Liao et al.,(2008)); (Han et al., (2020)); (Huang, (2003)); (Pachoulakis and Kapetanakis, (2012)); (Chuah, (2016)); (Kang and Johnson (2013)); (Dennis, (2017)).

The present research paper has just tried to review the important features and meaning of AR with the help of few previous research studies. However, there is no in-depth understanding and exploration of details and information on the implementation of these features in the online retail environment. An attempt was made to determine the most widely used applications of augmented reality environment. Virtual Try-On technology and 3D technologies are assessed to determine its impact on customer's perception and attitude towards online shopping environment. The literatures have proved that there is lot of scope for its implementation and execution. The present literatures were insufficient to analyze the application and its usage by the online retailers in detail. Further, literature survey aims at determining the user's experience while using the advanced technologies of AR in the virtual environment. It was discovered that most of the customers of online platform were unaware of these technologies and few of the customers were not flexible using the above technologies. This proved to be a major constraint in order to determine customer's experience of using AR technologies. The large implementation and usage of AR technologies among consumer segments will prove to be fruitful arenas to further explore the above discussed areas. These further research studies are expected to throw lights on the implications of the AR technologies on online retailing and the value it provides to the customers and retailers. Secondly, the present research focuses on the AR technologies used in the areas of online apparel retailing whereas, the further research can extend its wings to combine other streams of online businesses and even execute cross-cultural studies. These studies would allow generalizing upon various technologies of AR being implemented in the areas of online businesses. In the coming years, AR is expected to become an integral part of online business platform. This would call for in-depth investigation of literatures involving additional features, the various technologies under AR as well as the detailed analysis of understanding customer's experience using AR technologies.

8. PRACTICAL IMPLICATIONS

Several practical implications can be drawn from this literature review on augmented technology in online retail area. Firstly, AR is a technology interface system that becomes part of the consumers' body and enhances consumer's online shopping experience (Huang et al., 2019)[8]. Thus, marketing managers can use the AR technologies to explore digital promotional strategies to enhance customer's experiences. Secondly, the Virtual Try-on and 3D technologies help consumers integrate technology and their physical self in a merging of body and technology so as to augment and create online brand experiences (Huisman & Hannink, 2023)[45]. The usage of AR applications proved to have impact on customer's emotions, beliefs, preferences and psychological responses before, during and after use of a system (Tsai & Huang, 2018)[46]. Therefore, a thorough assessment of various aspects of AR is necessary to identify those elements of impacting customer experience in the virtual environment and to use them as a roadmap for AR standards.

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