

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/354751934>

# The rise of 3D E-Commerce: the online shopping gets real with virtual reality and augmented reality during COVID-19

Article in World Journal of Engineering · September 2021

DOI: 10.1108/WJE-06-2021-0338

CITATION

1

READS

729

6 authors, including:



**Sriram V.P.**

Acharya Bangalore B-School

26 PUBLICATIONS 135 CITATIONS

[SEE PROFILE](#)



**Sikandar M.A.**

Maulana Azad National Urdu University Hyderabad

18 PUBLICATIONS 4 CITATIONS

[SEE PROFILE](#)



**Kamal Gulati**

Amity University

46 PUBLICATIONS 127 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Gig Economy, sharing economy, Digital Platforms [View project](#)



Books and Reading [View project](#)

# The rise of 3D E-Commerce: the online shopping gets real with virtual reality and augmented reality during COVID-19

*Satish Rupraoji Billewar*

Department of Information Technology/Systems, Vivekananda Institute of Management Studies and Research, Mumbai, India

*Karuna Jadhav*

Neville Wadia Institute of Management Studies and Research, Savitribai Phule Pune University, Pune, India

*V.P. Sriram*

Acharya Bangalore B School, Bengaluru, India

*Dr. A. Arun*

Department of Management Studies, Sree Saraswathy Thyagaraja College, Coimbatore, India

*Sikandar Mohd Abdul*

School of Commerce and Business Management, Maulana Azad National Urdu University, Hyderabad, India

*Kamal Gulati*

Amity University, NOIDA, India and CSIT, Stratford University, Falls Church, Virginia, USA, and

*Dr Narinder Kumar Kumar Bhasin*

Amity University, NOIDA, India

## Abstract

**Purpose** – The COVID-19 virus outbreak began in December 2019 and rapidly spread to every continent on Earth. The analysts have predicted that COVID-19 and other similar pandemics will continue in the coming decade and badly affect offline businesses. As a result, the offline platform is also shifting to the online platform and online demands are increasing daily. The traditional two-dimensional E-Commerce websites are designed to provide simple, browser-based interfaces to allow users to access available products and services. Whilst virtual representations are an essential consideration in establishing trust, most virtual representation sites fall short in mimicking real-life human representation. This paper aims to focus on three-dimensional (3D) E-Commerce technology that presents how virtual reality (VR) and augmented reality (AR) can help deal with limitations and improve E-Commerce operations. It is built as an internet-only tool, a person-centred shopping assistant created following user-centred design principles to be used on various computing platforms, including desktop and mobile devices. The paper shows how VR and AR can offer more precise product information in 3D E-Commerce environments. The virtual store experience is also enhanced by an AR assistant that helps the users by giving them all the required information in audio form or using its avatar.

**Design/methodology/approach** – Implementation of VR and AR in E-Commerce will increase customer satisfaction. Sub hypothesis – to study the implementation of VR in E-Commerce. To study the implementation of AR in E-Commerce. To study the inclusion of E-Commerce sites in an open-world game. To study the customer satisfaction of users using VR stores.

**Findings** – The scope of work is concentrated on the urban Indian market especially targeting the country's youth who are already or ready to indulge in VR such as video games, cinema and other activities (Mattsson and Barkman, 2019). This demography is more open to learning and using VR. The primary segment of E-Commerce that we are concentrating upon is fashion. Here, the regular user needs to have more immersed knowledge about the product rather than just the written information like how would they look in a dress or will the size available on the website fit me or not.

**Originality/value** – A perfect system does not exist in the world. A terrible disease has landed on the planet. Very soon, it will be impossible to escape from this current situation. The effects of this plague have been felt in every sector of the world. The researchers also claim that physical stores will continue to exist. There will never be anything that replaces the ability to hold and use products or have personal face-to-face interactions with retail professionals. For the time being, brick-and-mortar retail is having a difficult time, but immersive technology is starting to be used to enhance the in-store experience. The good news is that this should help retailers increase their chances of survival. However, the melody of 3D E-Commerce is it would help out the in-store experience.

**Keywords** Augmented reality, Virtual reality, 3D E-Commerce, COVID-19, Pandemic, Online shopping

**Paper type** Research paper

---

The current issue and full text archive of this journal is available on Emerald  
Insight at: <https://www.emerald.com/insight/1708-5284.htm>



World Journal of Engineering  
© Emerald Publishing Limited [ISSN 1708-5284]  
[DOI 10.1108/WJE-06-2021-0338]

---

Received 14 June 2021  
Revised 13 August 2021  
Accepted 2 September 2021

## 1. Introduction

The COVID-19 outbreak is changing the world rapidly. The traditional offline business structure is not sufficient to cope up with the changes. The distribution supply chain is disrupted because of the lockdowns. In a time of crisis, the government has to implement several preventive measures. Unfortunately, the situation is deteriorating. Restrictions on the people and businesses within the lockdown exist as well. Many people and businesses are in a difficult position due to the current circumstances. The economy has taken a massive hit since the lockdown, but many new opportunities have arisen during the pandemic (Grubaugh *et al.*, 2020).

During complete lockdowns, E-Commerce companies are permitted to take orders for the necessary goods. However, this was aided by the fact that Indian companies accepted the challenge of E-Commerce, which facilitated their participation. Most E-Commerce companies implement additional safety measures and follow all government guidelines in times of crisis. The people flocked to online shopping when the Indian Government implemented social distancing, lockdown and working from home. Other industries are surprised that E-Commerce businesses are doing so well. They are making money with their business-to-business and business-to-consumer companies. There has been a significant shift in the way of doing business because of increased online sales.

According to a recently released forecast, the Indian internet user population is predicted to grow from 186.4 million to 666.4 million by 2023. As the Indian economic growth depends on the increase in sales and profits from the E-Commerce industry, growth will depend on E-Commerce sales and profits. Both businesses and consumers will benefit. There are no adverse health effects due to technological advancements; instead, E-Commerce companies are increasingly using them to increase delivery speed and reduce the need for physical contact with the product and customers.

Over the next 20 years, the Indian E-Commerce industry is expected to overtake the US and become the world's second-largest. E-Commerce is getting an additional boost from online retailers, including Amazon and Facebook-Reliance, placing investments in the space. Other employment and additional revenues are anticipated as a result of this new development. Retail volume may have topped past years high due to the lockdown and customers' beliefs that online retailers are more reliable and more accessible than offline marketplaces (van Herpen *et al.*, 2016).

Amazon uses multiple offices around the country to constantly check out new strategies for acquiring customers, thus keeping smaller retail stores in one location. Whilst many local E-Commerce stores use SEO to target clients with geographical areas and foster networking relationships custom to the local market, the largest online stores also focus on building relationships in this way. Their strategy will be focussed on various key differentiators that set them apart from competitors with larger-volume operations. Also, there is a rising trend in marketing automation in more and more organisations daily activities. The automation will help small online stores increase their conversion rates by using email sequences, remarketing and lead nurturing automation (Wydict, 2008).

E-Commerce plays a vital role in the vast array of products and services that online customers access. Order your product whenever you would like and have it shipped to you. Despite this, businesses are constantly working to keep up with customer demands daily. Because of this, many companies are now affected by the virus effect (Mishra and Rastogi, 2012). The product returns range from 20% to 40%, with most returns being made because of how the product looks in the real world versus how it appears on the retailer's website.

Marketing in a complex, omnichannel world helps forge strong brand connections. This world is filled with sights to see: People are visually oriented. According to MIT neuroscientists, the human brain processes visual information almost instantly and images are identified after a mere 13 milliseconds. University of Texas research confirms that customer satisfaction is associated with their high-quality shopping experience (Van Kerrebroeck *et al.*, 2017). The three-dimensional (3D) E-Commerce allows for an exciting range of interactions such as customers can use touch, swipe or drag facilities to interact with products (Nassiri, 2008).

The 3D E-Commerce is a model based on the combination of virtual reality (VR) and augmented reality (AR) on websites and mobile apps to visualise high-quality 3D graphics with all interactive supports to users. The other terms used for 3D E-Commerce are immersive commerce, 3D modelling commerce and 3D commerce (Guo, 2013).

The 3D E-Commerce provides the highest quality images and allows customers to see the specifications, eliminate the problem of returns and reduce returns. The emergence of the highest quality analytics helps provide better visual search features to higher product match rates. However, the traditional two-dimensional E-Commerce does not provide enough specific product information and operating capabilities to online customers.

The main reason 3D E-Commerce has come to dominate online retail is that customers demand it. Customers prefer a wide variety of choices and convenience. They often want to be entertained. Sometimes customers want to feel strongly connected to the brand. A unique and extraordinary online shopping experience can have numerous consequences for customers (Lee and Chung, 2008).

VR is considered to be the technology that will be used very extensively. The implementation of VR is to give the customer a more real-world shopping experience without having to go outside. It also makes shopping online more attractive and reliable. The user can have the store experience by looking for the items from the isles and having a better experience in evaluating the things by picking them up like in actual stores (Glazer *et al.*, 2010).

As per the 2019 Global E-Commerce Foundation Report prepared by SAP, using AR and VR to see and feel products in the real world does not have to be as expensive as one might think (11. IAMA Report, 2019). Both consumers and businesses gain from "virtually try before you buy" for customers who want to see the product in the AR or VR setting; AR and VR tools work well. The tools help shorten the sales cycle by reducing customer anxiety and increasing customer satisfaction (Nasser Nassiri, 2008). You get mixed commerce when combining AR/VR E-Commerce with brick-and-mortar stores (Lin-Hendel, 2017).

The researchers are doing research on how to make physical products such as models for online catalogues, mobile AR and virtual showrooms will be the focus. For many years, creating 3D content for games and visual effects specialists were the main applications for 3D technology. However, it is now inevitable that catalogue marketers and online marketing specialists will interact with the customers before purchasing (Mattsson and Barkman, 2019; Zhu et al., 2004).

One primary advantage of having a virtual store is plugin the store in different games targeting the virtual video game players. They could be more interested in the idea of buying products even whilst playing their favourite game and could order their merchandise from an E-Commerce store within the game.

In highly competitive markets, companies will begin advertising their products even before production has started. The traditional system cannot provide this service. The 3D rendering and modelling can vary skin and hair colour, texture, patterns and many other features to give a high-level buying experience. The satisfaction from the virtual immersion is enormous. Everything can be customised according to the user such as crowd, products and the joy of interaction during shopping can be given without any hassle (IBEF Report, 2020).

## 2. Literature review

An online method for a user to shop in a 3D VR setting requires a shopping server to display a specific store (Lin-Hendel, 2017). It directs the user's computer to view the location using a web browser in an interactive simulation to experience what it is like to shop in the real place for themselves. Immersion, interactivity and presence are three essential characteristics of VR. The degree to which the subject's senses are cut off from the real world and fed with virtual simulation is referred to as immersion. Interactivity describes the level to which users can take part in the design and content of VR environments simultaneously (Steuer, 1992). According to Steuer (1995), "telepresence" is a more accurate term for talking about how one feels in the mediated environment. The balance between interactivity, immersion and presence depends mainly on a website.

The programmers feature specific VR shopping experiences using the components found in shopping cart software, media data and optionally 3D virtualisation software. One such idea is when someone superposes an item from the shopping cart into the Audio/Visual Virtual Tour Software, thus providing the shopper with an immersive virtual tour experience of that item in the store. If the chopper hovers over the item and looks at additional images and descriptive text, as well as pricing data, he or she is permitted to "pick up" the product and then ask a clerk about it (Chandra and Kumar, 2018).

In this application, AR enhances the human perception of reality by enhancing the meaning and value of natural objects and adding virtual complements to contextualise individual objects found in the real world. The tablet's display outputs a modified image of the camera's original vision. In this example, a marker is used to enhance the visibility of one of the company's products, thus changing the image's overall appearance to provide an AR representation of that product. Dynamic contextualisation can be achieved by using AR

technology. E-Commerce systems that deliver both passive and active information are better (Future of virtual reality, 2020).

One-third of purchasing decisions are made in the store. Then, of course, an E-Commerce system should be able to invoke impulsive decisions like a spur-of-the-moment purchase. AR uses dynamic contextualisation to offer three-dimensional visualisations of products that are both registered to their proper places in the store and are currently in use by customers. The dynamic contextualisation can be blended with previous consumption situations to help customers envision how they would use it. AR technologies enable dynamic contextualisation, real-time modification of context (Yi-Cheon Yim et al., 2017).

At E-Commerce companies, they are currently experimenting with using AR's rich media and enhanced intuitive interfaces to provide customers with a more engaging and enriching experience, consequently leading to a new model in the industry of E-Commerce.

AR is expected to eliminate the greatest obstacle to E-Commerce customers, allowing potential customers to have a conversation about whether or not they want to buy the product before purchasing and determining if the product is appropriate for them. This research aims to look at how AR can be used in E-Commerce due to the enormous potential of this immersive technology in creating a retail in-store shopping experience no matter where the customer is located.

Customers will interact with digital models from the comfort of their own homes by superimposing 3D objects in various spaces (Schnack et al., 2019). Companies such as IKEA and Converse use AR to help people see virtual furniture models in their homes or feet in their shoes in real-time. AR technology is much more complex and innovative than the other technologies that have been used with E-Commerce, especially when it comes to getting the best possible results whilst incorporating into E-Commerce. E-Commerce firms must dramatically increase marketing and sales efforts for the technologies to be relevant to the needs of online shoppers. In 2016, Chen described A lot of support is required from the organisation's top managers. Because of this, AR adoption in E-Commerce businesses will be effective. For example, as Apple is acquiring AR startups, it has put AR software in a significant number of mobile devices with the recent release of iOS 11 by adding AR capability to iOS devices such as the iPhone and iPad. As a result, Apple could almost instantly create a growing market for AR developers to serve, resulting in more widespread AR adoption within the company.

Based on the analysis, the technological competence and relative advantage and organisational support for the chief executive officer are key factors influencing E-Commerce firms' intent to adopt AR technology. Despite the considerable anticipation regarding the delivery of value through AR technology and increasing use cases, there is still room for growth in mainstream AR adoption in retail. Business literature from customers' perspective in the past suggests that whether a new technology is believed to be valuable and easy to use is vital for its adoption. However, whilst an organisation may still play a role in an individual's decision to adopt AR technology, environmental and inter-organisational factors also contribute to adopting this technology (Vincent and Stefano, 2007).



Although India is the second-largest user base globally, E-Commerce penetration is comparatively low, as is shown by markets such as the USA or France. On the other hand, India is experiencing rapid growth, as demonstrated by the country's recent addition of around 6 million new E-Commerce users each month. To perceive VR, you will either need a pair of gloves or a helmet with a screen built-in. It is a significant game-changer with instantaneous, real-time and real-life access from anywhere globally with a headset for retailers. Growth enabler has predicted that the VR industry will expand by 76% in the next five years (Grubaugh *et al.*, 2020).

In addition, the report focusses on E-Commerce integration into video games (Mattsson and Barkman, 2019; Statista Report, 2020). Since at least the late 90s, in-game purchases have been an integral part of video games. When microtransactions first became available, they paved the way for the Freemium model, which allowed players to play games without paying anything. Instead, they made use of game in-app purchases as the primary source of revenue. Free-to-play games rely on microtransactions, in-game purchases of extra items for real money. Over \$108bn was generated by the global video game market in 2017, with 75% of this revenue generated by purchases in free-to-play games (according to Superdata, 2018a). Around 50% of all income is earned through mobile games. Riot Games' game, League of Legends, generated most of all gaming revenue in 2017, making \$2.1bn (Superdata Research, 2018b). The virtual goods that are money or objects that can only be used online are commonly referred to as microtransactions. Most online game developers' primary source of income is payments from customers.

In addition to being functional, advertising products and selling them on the same platform can help sell more. The approximate number of 2- to 17-year-olds in the US who are playing video games in a given minute is 1.6 million. In total, 74.4% of all users and an average of 345 min per usage day for every usage day in the fourth quarter of 2006 used the console heavily. Although projected advertising revenue from in-game advertising to hit \$260m by 2008, it was predicted that by 2008, advertisements in video games would account for over \$260m in total advertising revenue. IG Worldwide predicts that the in-game advertising market will be worth \$800m by 2009. Video games do not just show static advertisements; instead, they provide dynamic, interactive features because of the interactivity potential that video games present.

New ideas and approaches are given by introducing interactivity to the advertising campaign. Advertising and promotional campaigns can be more memorable and successful when companies can use interactivity to their advantage. In addition to watching an advertisement, the target market may become active participants in the ad and form a relationship with the previously unknown brand. Environmental features such as billboards, mega posters and trackside hoardings are used in gameplay locations. Game genre and game backgrounds determine what kinds of gameplay areas are feasible (www.igawordwide.com, May 2008). Most respondents felt that in-game advertisements could be acceptable as long as they were placed in the right game genre.

According to a report from CyberMedia Research, the Indian E-Commerce market could increase nearly fourfold to US\$150bn by 2022, driven by rising incomes and the increase in internet users (Statista Report, 2020). New users are being added every month in India at 10 million people per day, which is higher than any other country globally, helping to support the E-Commerce industry. India is estimated to have 220 million online shoppers by 2025 (IBEF Report, 2020).

### 3. Motivations and objectives

#### 3.1 Research motivation

The motivation for the paper came from a movie named Ready Player One, directed by Steven Spielberg, which is based on a fictional virtual world showing applications of VR. The film has one scene where the protagonist could order products for his real-world use in the virtual world. The scene triggered a thought that this can be done and VR Store for 1-to-1 E-Commerce VR interface over a familiar E-Commerce interface. It talks about how few VR features can help in increasing customer experience.

The number of users of VR is increasing tremendously over the years. The target market that uses VR and is comfortable doing micro-transaction, i.e. young adults who would find it easier to understand the technology, can be a good entry point with the development in VR peripherals over the years and the increase in commercial availability of peripherals

#### 3.2 Problem statement

One of the primary advantages of VR is its high level of immersion. The study focusses on how VR and AR can be implemented to improve E-Commerce. The secondary focusses of the research are to the unification of E-Commerce in open-world games, increasing customer satisfaction of customer using VR store (Maas and Hughes, 2020).

#### 3.3 Hypothesis

*Implementation of VR and AR in E-Commerce will increase customer satisfaction.*

*Sub hypothesis:*

*3.3.1 To study the implementation of virtual reality in E-Commerce*

*3.3.2 To study the implementation of augmented reality in E-Commerce*

*3.3.3 To study the inclusion of E-Commerce sites in an open-world game*

*3.3.4 To study the customer satisfaction of users using virtual reality stores*

#### 3.4 Scope of work

The scope of work is concentrated on the urban Indian market especially targeting the country's youth who are already or ready to indulge in VR such as video games, cinema and other activities (Mattsson and Barkman, 2019). This demography is more open to learning and using VR. The primary segment of E-Commerce that we are concentrating upon is fashion. Here, the regular user needs to have more immersed knowledge about the product rather than just the written information like how

would they look in a dress or will the size available on the website fit me or not.

## 4. Methodology

### 4.1 Existing system

The existing system is mainly based on the browser. The internet shopper visits a standard internet store or shopping cart. The shopper takes the audio/visual virtual tour to see the item's availability on the shelf of the store. Then the shopper picks up an item, examines it by viewing additional images. The shopper checks the textual descriptions, pricing data and can even ask a specific question. Finally, if desired, place the item into their shopping cart.

Figure 1 is a representation of VR shopping. The essential component of the system is the software. All of the media and shopping cart functionalities are merged to give the shopper the physical store, crowd, roads, the complete atmosphere of an actual store and its surrounding area. A user can experience a shopper walking on the store's street, entering the store by strolling up and down the aisles, examining the products on the shelves and placing them into the shopping cart.

The essential component of the system infrastructure is the network (i.e. internet), so there is a need for high-speed internet and connects the shopper's point via his respective computer and Internet web browser and the media, shopping cart and VR shopping software. The media content can be significant to move across the network or internet; therefore, the higher the throughput and bandwidth of both the network or internet itself and the Internet connection, the better or more complete the VR shopping experience will be (Glazer et al., 2010; Jiang and Benbasat, 2005). There must be a computer. The only constraints for the shopper's computer will be a connection to the internet to connect to the virtual store.

The computer internet browser is any standard commercially available Internet web browser. Examples are Microsoft internet explorer (IE), Netscape web browser or Firefox web browser. A further restriction is that the web browser can either

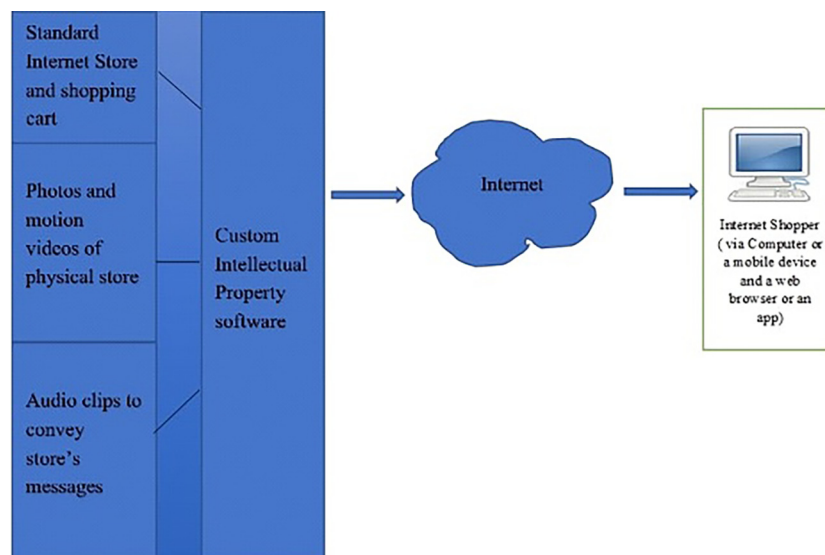
be natively or through a publicly available "plugin" to support standard internet media formats such as jpeg and gif picture formats and flash. Examples of such plugins to a web browser are Macro media's flash player, real network player and Microsoft media player. This web browser and media players tools allow the VR shopping experience to be displayed to the shopper at his/her computer connected to the internet (Van Kerrebroeck et al., 2017).

Shopping experience is photos of physical store location, the video clip of the store and store location and audio clips. The minimum requirement to create the VR store is only the photos of the physical store location. All other media are present to enhance the experience giving a complete VR of the physical store. A full array of photos and video is essential – the more images of the physical store, the better the VR experience. For example, pictures from various angles and every store's location will enable the VR shopping software to better "recreate" the store on the shopper's computer and Internet Web Browser (Jiang and Benbasat, 2005).

Audio clips and video clips of store and store location include a broader scope of video information beyond that of the photo record of the physical store. It also has people (i.e. the store owner, employees, clerks and customers) to provide the complete atmosphere of the store. After all, what a person experiences when physically shopping in a specific store includes all aspects of the store, its physical decoration, atmosphere and the quality and politeness of the store owner, clerks and other customers. This added value media to the essential photos will completely transport the shopper to the physical store.

All of the above creates the VR of the store. What is left is the merchandise the store sells, the shopping cart and the checkout counter where the shopper pays and selects delivery options. These are created via photos of merchandise to sell in the internet store. The textual information is also made about the merchandise to sell in the store and audio clips describing the merchandise to sell. The Shopping Cart Software maintains the product inventory and provides the purchasing processes.

**Figure 1** The existing virtual reality shopping architecture

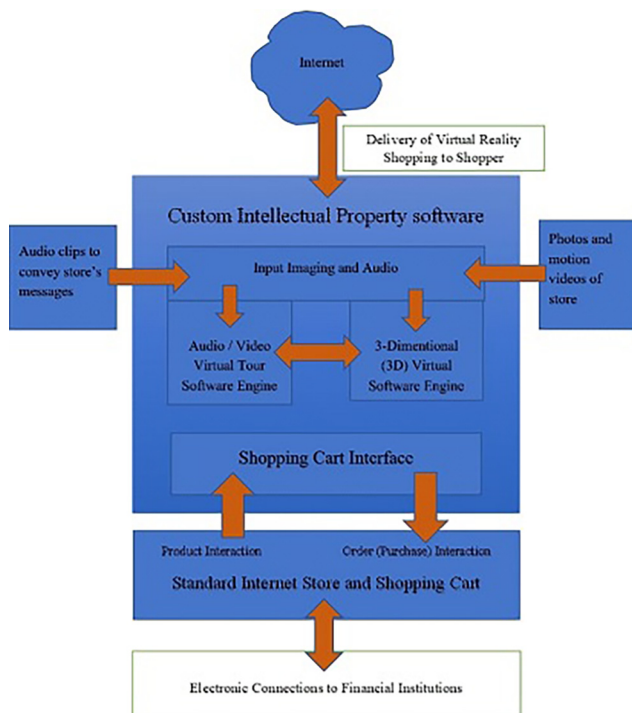


The shopper can virtually walk through the aisles of the store, stop and examine an item. The photos, textual information, support this examination process and audio clips that describe the item. Depending on the completeness of the pictures, the shopper can virtually touch and examine the merchandise from all angles. Now the Shopping Cart Software starts to take over putting potential purchases, collecting customer information, completing the purchase and order confirmation. This function is standard to all Internet Shopping Cart Software. Examples of such software are Yahoo merchant and Ebay's pro stores (Peukert *et al.*, 2019).

Figure 2 is showing the five major components of the VR shopping software. First is the VR shopping software itself, the Audio/Visual Virtual Tour Software, 3D Virtualisation Software and the external system interfacing components, input imaging and audio media and shopping cart interface. The latter four components provide a support function for the virtual shopping experience. The VR shopping software coordinates the VR Shopping Experience (Glazer *et al.*, 2010).

The Audio/Visual Virtual Tour Software pro videos streaming of digital images (digital photographs) of a location sequenced in such a way that through the software and its navigation controls, the viewer has a fully spherical, navigable and continuous 360° field-of-view. This software is commonly known as "Virtual Tour Software". Companies such as the IPIX Corporation and Tour Vision, Inc provide commercially available Virtual Tour Software. To date, this software is most commonly used to provide virtual real estate tours. For use in the virtual shopping experience, it will give the background ambience, the audio/visual tours of the streets and shops of the virtual store.

**Figure 2** The components of the virtual reality shopping software



The minimum requirement for the virtual shopping experience is these software packages commonly allow a virtual tour or movement in two dimensions, along with the "X" (left and right) and "Y" (up and down) axis. Ideally, to give a complete virtual tour, movement along a third axis, the Z-axis (forwards and backwards) will provide the shopper with the sense of walking down a street or store aisle. The shoppers get the shopper's ability to look left and right and up and down, complete the knowledge of strolling through the virtual store and browse the shelves.

The 3D Virtualisation Software, whilst not an essential component to the VR shopping experience, can enhance the shoppers' experience. Examples of commercially available 3D Virtualisation Software are the torque game engine, V3X and the reality engine. Integration of 3D Virtualisation Software engines with the Audio/Visual Virtual Tour Software via the VR shopping software will add a level of shopper interaction with the virtual store that simulates a real-life interaction that shopper would have as if shopping in a brick and mortar store. The shopper can talk to a store clerk, select and examine items off the store's shelf, experience a taxi ride through the streets whilst travelling from one virtual storefront to another, etc (Van Kerrebroeck *et al.*, 2017).

These engines will need input data about the neighbourhoods, streets, stores and items (Pizzi *et al.*, 2019). This data is digital images, motion video, audio clips and plain text. This data is input into the respective Audio/Visual Virtual Tour Software and 3D Virtualisation Software packages specific to each package's application programmatic interface. Therefore, an essential component of the virtual shopping experience is the input imaging and audio media software. This custom software component lowers the technical and data processing barrier to quickly and efficiently bring the complex media formats into the respective engines on an as-needed basis.

The input imaging and audio media software component optimise interfacing with external computer systems such as hard discs, file systems and data caches with the Audio/Visual Virtual Tour Software and 3D Virtualisation Software packages. This data input interface is the first step in providing the shopper with a "smooth", non-interrupted virtual shopping experience. One of the significant characteristics of media data (regardless of the format) is it is enormous. Therefore, the ability to locate the appropriate media and transport it into either or both of the Audio/Visual Virtual Tour Software and 3D Virtualisation Software packages quickly and efficiently is an apparent necessity in providing a "realistic" smooth, non-jittery VR shopping experience (Jiang and Benbasat, 2005).

The "virtual reality shopping experience" implies that shopping is involved; the act of placing items in a shopping cart and purchasing them is expected. The VR shopping software will leverage the function and features of commercially available Internet Shopping Cart Software. Examples of such software are Yahoo merchant and Ebay's pro stores (Chittaro and Ranon, 2000). The interaction of Shopping Cart Software and VR shopping software is bi-directional. Input to the VR shopping software from the Shopping Cart Software is the items offered on the store and all the necessary data the shopper will need to make a purchase decision. This information includes but is not limited to pictures and descriptions of the



item and pricing and inventory information. Input to the Shopping Cart Software from the VR shopping software will be the shopper's information to complete a purchase transaction. This information includes but is not limited to customer name, address and credit card data. There is an additional characteristic of this interface regarding the sensitive nature of a purchase's data and transactional nature.

Customer sensitive information is shared across this boundary, including customer name, address and credit card information. This interface, when a purchase action is being taken, is transactional. Credit card information is supplied along with the shopper's address and items to be purchased. It gets cleared to the shopping cart to perform the necessary steps with the bank and clearing services and gateways to complete the transaction. Once complete, the shopper is returned with a Successful transaction and purchase tracking number or rejection with the respective reason for the purchase rejection. Therefore, the Shopping Cart Interface Software must support the same data protection and transactional level as the Shopping Cart Software.

Figure 3 shows the software stack of the VR shopping software components and will be referenced when discussing the main functions of the VR shopping software; the main component is the heart of the virtual shopping experience. This is the component that coordinates all the functions and features of the other four components described above. Adds functions and features to provide the complete Shoppers' VR Shopping Experience. To best understand the function and feature of this last component, we will consider what must be delivered to the shopper, as viewed by the shopper.

The VR shopping software tightly integrates with the Audio/Visual Virtual Tour Software features, Shopping Cart Software, the variety of media data and optionally the 3D Virtualisation Software. These all features are building upon these components so that it adds features specific to the VR Shopping Experience.

#### 4.2 Existing system problems

This system is very useful for giving a VR experience where the user does not have a VR headset and uses only a mouse and keyboard. With the development of new technology and more commercial availability of headsets, it is essential to update virtual E-Commerce to a more immersive experience even competing with real-life shopping in terms of realistic knowledge. The existing also lacks features that allow the user to interact with the product and enhance the user experience. The main requirement for this system was constant high-speed internet, which is not always possible as not everyone has high-speed internet.

### 5. Proposed system and architecture

Figure 4 proposed system is an updated version of the existing version with a VR headset giving more immersion than the traditional mouse and keyboard. VR headset provides the user with freer movement and a 360° view of the shopping centre. The action allows the user to have a real shopping experience such as walking to the products.

This architecture can be integrated into any open-world game like GTA to enable users to buy from in-game shops for real life. It allows the companies to sell their merchandise even

**Figure 3** The functions of virtual reality shopping software



through in-game shops, which will most certainly increase sales.

The main software consists of the virtual store, the database of the products with basic security protocols and the neural network for personalising the experience. In this, the virtual store has the basic architecture of a Standard Internet Store and is common for all users. It reduces the amount of bandwidth needed during the session as the basic architecture gets store in the cache of the browser of the application. The architecture helps to reduce the traffic. There is no need to load it again and again. Even if the internet is weak and the user visits the page or reloads the page, it provides a hassle-free experience.

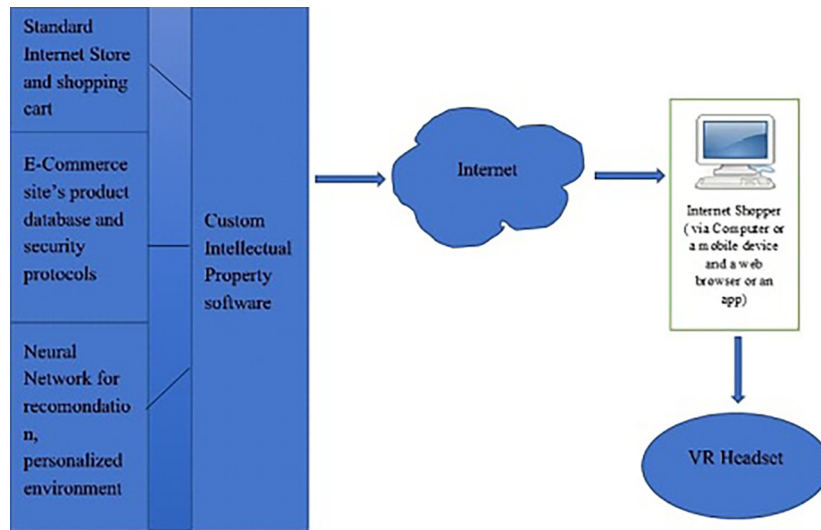
According to the user, the neural network in the software trains the system as every user is different but will show some similar traits. These traits and historical data of the user help the software to recommend the product that may attract the user's attention and discounts that may appeal to the user in making a purchase. This feature is very useful when the user has been using the E-Commerce site for a long time as it allows the neural network to train and provide more exciting deals and products. If the user is a regular customer, then the probability of him being interested in the product also increases, increasing the likelihood of purchasing the product.

These features with the basic architecture, product database and security protocols give every user a custom experience. These data are then sent to the device users, a computer, tablet or phone. The hardware of phones and tablets has evolved many folds over the year and can be as good if not better than the one available in a high-end computer and allows cross-platform compatibility without any big hassle. The computer or phone is connected to a VR headset through which you can interact with the virtual environment. The VR is directly connected to the system either through an HDMI cable or a USB 3.0 cable or wireless means over WIFI.

USB 3.0 provides a better experience as it supports faster data transfer, but the only downside is its a wired connection to restrict the movement. This problem could be solved shortly as the new WIFI 6 gives bandwidth close to USB 3.0; sooner rather than later, it will become better than USB 3.0 allowing the full movement and providing a better immersive experience.

Figure 5 represents how the virtual store can be connected to a video game's in-game store. The flow of the in-game shops



**Figure 4** The modified virtual reality shopping architecture

will be once you enter the shop; the game redirects your avatar to a virtual E-Commerce showroom where you can search for the product you want and an AR character guides you to that product (Zhu *et al.*, 2004).

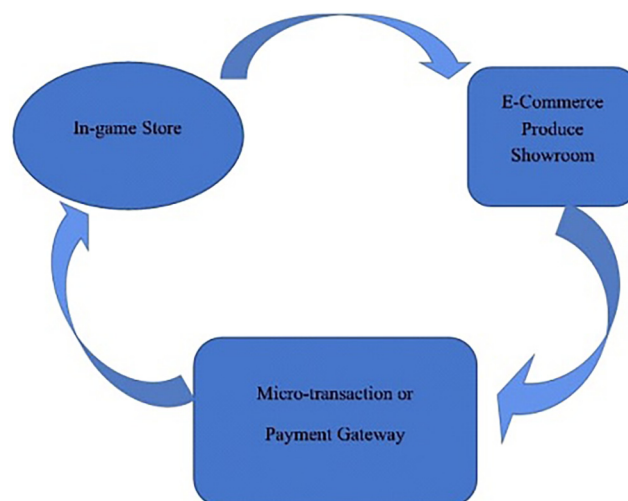
Once you get to the product, you can try it on and if you like it, you can proceed to the counter and carry the payment. The payment can be through credit card or in-game currency, which you previously bought like UC in PUBG and gives the game developers an additional income stream which is beneficial.

The seamless transition from the game to the virtual store needs to handle through a gateway. The gateway connects the game to the virtual store only when the user enters the in-game store, as this allows the game to run independently so that it would not be affected too much by the E-Commerce site's traffic. The cache memory of the user used to personalise the user's experience in the software can also be used in the video game to advertise. The software will make the user aware of the deals even when he is playing. Still, at the same time, there is a need for awareness

amongst the developers and E-Commerce sites that an advertisement that affects the users' gaming experience will negatively impact the number of visits to the virtual store by the user.

Even though we have the technology to implement E-Commerce in VR, there is a need for developers and E-Commerce companies to take advantage of this technology. There is a need for more peripherals to give the users a more realistic experience. As we only have a headset that provides the user with audiovisual experience and controllers for unrestricted movement, the following peripherals can be related to other sensory functions such as odour or touch.

Digital merchant pipelines are the company's next big step. Here are a few of the most popular ways Amazon AR can be used: Our primary goal with 3D content is to make one instance and reuse it in many different places. The researchers are rigorously working on 3D Cloud to be flexible and quick to respond to our partners' changing needs. The system is to make such a way to think the way we are supporting multiple

**Figure 5** The game-store environment

file-formats and standards such as USDZ, FBX and OBJ (as well as 3D content platforms such as Wayfair and Amazon) is that we are helping various 3D content platforms.

With video games becoming as realistic, they can be used for simulation purposes. To enhance deep learning in self-driving cars, the application of VR is beyond imagination and maybe one day, with the help of deep learning and VR shopping on E-Commerce will become automated (Anthony Martinez et al., 2017).

The other limitation to the system which can be worked upon is the data speed. Even though USB 3.0 or HDMI cable does its job well, there is a need for faster wireless connectivity, which allows the virtual store to look more real without putting too much pressure on the user's system.

## 6. Conclusion

A perfect system does not exist in the world. A terrible disease has landed on our planet. Very soon, it will be impossible to escape from this current situation. The effects of this plague have been felt in every sector of the world. The researchers also claim that physical stores will continue to exist. There will never be anything that replaces the ability to hold and use products or have personal face-to-face interactions with retail professionals. For the time being, brick-and-mortar retail is having a difficult time, but immersive technology is starting to be used to enhance the in-store experience. The good news is that this should help retailers increase their chances of survival. However, the melody of 3D E-Commerce is it would help out the in-store experience (Nassiri, 2008).

If countermeasures to COVID-19 are not implemented rapidly, it may inhibit the growth of traditional E-Commerce also. The retail industry has experienced a paradigm shift due to Covid-19 (Murtadlo Hidayat and Puspo Dewi Dirgantari, 2020). To solve the issues of online business, E-Commerce companies should focus on 3D E-Commerce. Implementing such a system is quite possible as the hardware technology required for such a system is readily available. The most crucial learning during the research was the effects of immersion between VR setup and desktop setup. However, people using VR were more immersed in the environment, low on perceived product diagnostic, which the low readability could have influenced in VR setup. The software technology required for AR and VR is also available and has been implemented separately. The only implementation that needs to be done is to merge these existing technologies into one. The increasing number of VR users could help test the Beta version of this platform and make it ready for the broader market (Lu and Smith, 2007).

The 3D E-Commerce is always referred to as a technology that would profoundly impact our lives in the future. Every movie talks about the future as VR or virtual world in one form or another, but with the technology available now, the future that we always thought of is here.

## References

Anthony Martinez, M. II, Sitawarin, C., Finch, K., Meincke, L., Yablonski, A. and Kornhauser, A. (2017), "Beyond grand theft auto V for training, testing and enhancing deep learning in self driving cars", available at: <https://arxiv.org/abs/1712.01397>

Chandra, S. and Kumar, K.N. (2018), "Exploring factor influencing organisational adopting of augmented reality in E-Commerce: empirical analysis using technology-organisation-environment model", *Journal of Electronic Commerce Research*, Vol. 19 No. 3.

Chittaro, L. and Ranon, R. (2000), "Virtual reality stores for 1-to-1 E-Commerce", Department of Mathematics and Computer Science University of Udine.

Future of virtual reality (2020), "Worldwide spending on augmented and virtual reality expected to reach \$18.8 billion in 2020", available at: [www.idc.com/getdoc.jsp?containerId=prUS45679219](http://www.idc.com/getdoc.jsp?containerId=prUS45679219)

Glazer, E., Hobson, C., Deming, E.S., Royer, C. and Fehlhaber, J.S. (2010), "Virtual reality shopping experience", *Patient Appl. No.*: 12/693,294.

Grubaugh, N.D., Hanage, W.P. and Rasmussen, A.L. (2020), "Making sense of mutation: what D614G means for the COVID-19 pandemic remains unclear", *Cell Press*, Vol. 182 No. 4, pp. 794-795.

Guo, G. (2013), "A new recommender system for 3D E-Commerce: an EEG based approach", *Journal of Advanced Management Science*, Vol. 1 No. 1.

IAMAI Report (2019), "Internet penetration in India", available at: <https://cms.iamai.in/Content/ResearchPapers/d3654bcc-002f-4fc7-ab39-e1fbeb00005d.pdf>

IBEF Report (2020), "India brand equity foundation", available at: [www.ibef.org/industry/ecommerce.aspx](http://www.ibef.org/industry/ecommerce.aspx)

Jiang, Z. and Benbasat, I. (2005), "Virtual product experience: effects of visual and functional control of products on perceived diagnosticity and flow in electronic shopping", *Journal of Management Information Systems*, Vol. 21 No. 3, pp. 111-147.

Lee, K.C. and Chung, N. (2008), "Empirical analysis of consumer reaction to the virtual reality shopping mall", *Computers in Human Behavior*, Vol. 24 No. 1, pp. 88-104.

Lin-Hendel, C. (2017), "System and method for constructing and displaying active virtual reality cyber malls, show rooms, galleries, stores, museums, and objects within", *Patient Appl. No.*: 09/631,238.

Lu, Y. and Smith, S. (2007), "Augmented reality E-Commerce assistant system: trying while shopping", *Human-Computer Interaction, Part II, HCI 2007, LNCS 4551*, pp. 643-652.

Maas, M.J. and Hughes, J.M. (2020), "Virtual, augmented and mixed reality in K-12 education: a review of the literature", *Technology, Pedagogy and Education*, Vol. 29 No. 2.

Mattsson, M. and Barkman, S. (2019), "Microtransactions and lotteries in video-games-Hedonic motivations for using microtransaction systems", Thesis, Mikrotransaktioner och lotterier i videospel (Swedish).

Mishra, S., Dr. and Rastogi, C. (2012), "Future of E-Commerce in India", *Studies in Indian Place Names (UGC CARE Journal)*, Vol. 40 No. 69.

Murtadlo Hidayat, Y. and Dirgantari, P.D. (2020), "Level of use and satisfaction of E-Commerce customers in COVID-19 pandemic period: an information system success model (ISSM) approach", *Indonesian Journal of Science & Technology*, Vol. 5 No. 2.

Nassiri, N. (2008), "Increasing trust through the use of 3D E-Commerce environment", *Proceedings of the 2008 ACM symposium on Applied*.

- Peukert, C., Pfeiffer, J., Meißner, M. and Pfeiffer And Weinhardt, T.C. (2019), "Shopping in virtual reality stores: the influence of immersion on system adoption", *Journal of Management Information Systems*, Vol. 36 No. 3, pp. 755-788.
- Pizzi, G., Scarpi, D., Pichierri, M. and Vannucci, V. (2019), "Virtual reality, real reactions: comparing consumers' perceptions and shopping orientation across physical and virtual-reality retail stores", *Computers in Human Behavior*, Vol. 96.
- Schnack, A., Wright, M.J. and Holdershaw, J.L. (2019), "Immersive virtual reality technology in a three-dimensional virtual simulated store: investigating telepresence and usability", *Food Research International*, Vol. 117.
- Statista report (2020), "Internet usage in India", available at: [www.statista.com/topics/2157/internet-usage-in-india/](http://www.statista.com/topics/2157/internet-usage-in-india/)
- van Herpen, E., van den Broek, E., van Trijp, H.C.M. and Yu, T. (2016), "Can a virtual supermarket bring realism into the lab? Comparing shopping behavior using virtual and pictorial store representations to behavior in a physical store", *Appetite*, Vol. 107, doi: [10.1016/j.appet.2016.07.033](https://doi.org/10.1016/j.appet.2016.07.033).
- Van Kerrebroeck, H., Brengman, M. and Willems, K. (2017), "Escaping the crowd: an experimental study on the impact of a virtual reality experience in a shopping mall", *Computers in Human Behavior*, Vol. 77, doi: [10.1016/j.chb.2017.07.019](https://doi.org/10.1016/j.chb.2017.07.019).
- Vincent, M. and Stefano, D. (2007), "Virtual reality shopping system", *Patient Appl. No.:* 11/355, p. 210.
- Wydick, J.R. (2008), "The impact of in-game advertising on player's attitudes and purchasing behavior towards video games", University of North Carolina Wilmington.
- Yi-Cheon Yim, M., Chu, S.C. and Sauer, P.L. (2017), "Is augmented reality technology an effective tool for E-Commerce? An interactivity and vividness perspective", *Journal of Interactive Marketing*, Vol. 39, pp. 89-103.
- Zhu, W., Owen, C.B., Li, H. and Lee, J.H. (2004), *Personalised in-Store E-Commerce with the PromoPad: An Augmented Reality Shopping Assistant*, MI State University East Lansing, MI.

### Corresponding author

Kamal Gulati can be contacted at: [drkamalgulati@gmail.com](mailto:drkamalgulati@gmail.com)