Computer-Simulated Environments in the Commercial Sector: Enhancing Customer Experience through 3D Spherical Image Technology

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Abstract
This build and test study investigated the use of immersive environments in the commercial sector, focusing on 3D Spherical Image Technology to enhance the customer experience and explored user engagement in virtual reality experiences, in the context of integrated marketing communication (IMC). A 3D immersive shop was developed and tested on seven people with marketing experience to determine customer satisfaction. Seven themes emerged from the interview data: Pandemic challenges, design challenges, design improvement, safety during the pandemic, accessibility, business growth and efficiency. Four themes emerged for further research: Effectiveness and Impact of immersive marketing, technical considerations, business strategies and adaptation, and social media and consumer behavior.

Keywords: Immersive environments, 3D Spherical Image Technology, customer experience, user engagement, integrated marketing communication.

JEL classification: L81, M31.

Introduction

This feasibility pilot study investigated the use of immersive environments in the commercial sector, focusing on 3D Spherical Image Technology to enhance customer experience and engagement, in the context of integrated marketing communication (IMC). The research addresses the agenda for augmented reality (AR) proposed by Jayaswal and Parida (2023). It covers aspects such as consumer psychology, individual differences in AR acceptance, stakeholders' views on AR deployment in e-commerce, user-friendly interfaces, factors influencing adoption, and the pandemic's impact on AR success. The study was driven by four key questions:

1. How does user engagement vary within virtual reality experiences offered through computer-simulated virtual environments in the commercial sector?
2. What design challenges are faced by users of immersive virtual spaces?
3. How does embedded digital communication contribute to enhancing customer engagement within immersive virtual spaces?
4. What is the impact of technology, especially 3D Spherical Image Technology, on the transformation of marketing strategies and user engagement within virtual reality environments during a pandemic?

Literature review

In keeping with the research questions listed above this literature review covers four aspects:

- Enhancing end-user engagement and experience in immersive settings
- Shaping the modern world via computer simulation systems and digital touch points and design considerations
- Leveraging integrated marketing communication for user engagement in immersive virtual reality spaces
- Impacting and transforming marketing strategies and user engagement using technology within virtual reality environments amid a pandemic

End-user engagement

During the COVID-19 pandemic, technology played a crucial role in helping businesses adapt to new challenges, manage digital customers, and predict consumer behavior. Innovative marketing techniques attract customers to the market, leading to research on their influence on marketing strategy (Giantari et al., 2022; Ysik and Opaciski, 2019; Filip et al., 2018). AR and VR are important tools in business marketing strategies in various industries, and they help boost sales and draw in clients (Mazurek, 2011). Combining real and virtual worlds in AR makes it easy for users to get involved and interact smoothly with 3D objects, creating an exciting user experience. (Stuart, 2018). VR in marketing improves promotion of products and services, and these technologies let businesses create unique and immersive experiences that grab customers' attention. (Bonetti, Warnaby, and Quinn, 2018) (Scott, 2016; Mandelbaum, 2015).

Design considerations

Customer experience involves interactions a customer has with a company over their lifetime, emphasizing personalization and memorability (Ratcliff, 2015). Successful customer experiences include sensory, emotional, cognitive, behavioral, and relational aspects, and move beyond mere functionality (Schmitt, 1999). Customer Experience Management (CMX) involves five steps: understanding the customer's world, establishing an experiential platform, crafting a brand experience, guiding the customer's journey, and continuous improvement (Schmitt, 1999). Edelman and Singer (2015) propose evaluating customer experiences from a journey perspective for overall enhancement. Technologies like self-service counters can impact customer experiences (Verhoef et al., 2009). Virtual reality (VR) and augmented reality (AR) are immersive technologies that revolutionize how businesses and market research add value to customer experiences (Vo et al., 2022). AR significantly influences brand experiences, interactive advertising, and consumer engagement in marketing (Scholz and Smith, 2016). VR with eye-tracking headsets helps to assess customer perceptions and intentions, facilitating in-store product placement and flexible design adjustments (Białowąs et al., 2019). Emerging technologies like AR and VR engage customers in personalized experiences that bridge mobile platforms and physical stores (Orús et al., 2021). Virtual showrooms offer a store-like experience at home, letting customers explore products at their pace (Yoon et al., 2010). Interaction in computer-generated environments is a pivotal development in VR and AR (Yoon et al., 2010). Customer loyalty and managing comprehensive customer experiences pose challenges for competitors (Homburg et al., 2017).

Integrated marketing communication

Integrated marketing communication (IMC) ensures transparent and continuous communication with stakeholders, helping businesses create consistent brand identities and seamless product experiences across various media (Rehman, 2022). IMC combines various communication specialties to create compelling marketing messages that influence customer decisions, building brand loyalty (Kitchen, 2010; Camilleri, 2018; Kitchen, 2010; Keller,

2000). A consistent brand identity across various media platforms enhances a company's image and stakeholder connections (Yeshin, 2008). IMC effectively uses both traditional and modern media in marketing campaigns, playing a vital role in multi-channel advertising and public relations in immersive VR worlds (Yeshin, 2008). In immersive VR settings, IMC benefits from digital marketing, improving communication with the target audience, and enabling precise customer targeting based on their interests and actions (Athey et al., 2013). Data-driven marketing in VR helps create compelling advertising and brand messages (Tan et al., 2022). VR fosters deep user engagement with products and services (Yoon et al., 2010), blurring the lines between physical and digital realms through interactive experiences and 360-degree virtual tours. As VR shapes the future of marketing, understanding in-game marketing communication (IMC) is crucial for long-term customer loyalty and competitiveness.

The pandemic and transforming marketing strategies

Technology played a crucial role in marketing decisions during COVID-19. Entrepreneurs relied on technology for various aspects, including product validation, development, market research, and identifying opportunities (Morrish and Jones, 2020). Entrepreneurial innovation is vital during a pandemic, ensuring that products and services are ready for the market (Sharma et al., 2020). Various sources of funding are necessary to support entrepreneurial ventures (Mogaji et al., 2020). During the pandemic, entrepreneurs used AI to analyze opportunities (Bartlett and Burton, 2020; Ploum et al., 2018; Polas and Raju, 2021). Information technology helped businesses adapt to the pandemic, using technologies such as the Internet of Things, robots, AI, and data analytics to improve business processes (Nah and Siau, 2020). Social media marketing and internet technology influenced corporate operations during the pandemic, and adopting internet and e-business technology was positively influenced by perceived benefits and external factors (Patma et al., 2020). Entrepreneurs employ a combination of societal norms, external factors, and personal perspectives that allow them to develop products, processes, and marketing methods (Jahanshahi et al., 2020).The pandemic has led to breakthrough AI-based products and services, creating new entrepreneurial opportunities. Technology, like AI-powered chatbots, assists in handling customer inquiries quickly and sensibly (Javaid et al., 2020). As customers are concerned about virus transmission, remote interactions become vital. AI-powered online services help business owners make relevant marketing decisions during COVID-19 (McCall, 2020). Technology streamlines opportunities' identification, development, and exploitation, which reduces operational costs and fosters entrepreneurial spirit. These factors influence marketing choices positively (Boone et al., 2019; Murnieks et al., 2020). Moreover, technology plays a crucial role in data processing and informs marketing decisions based on customer feedback (Polas et al., 2020). AI-enabled data management systems enhance security, fraud detection, and overall operations during the pandemic (Di Vaio et al., 2020). AI allows businesses to understand their ideal customers, their needs, and anticipate their behavior, aiding marketing plans (Ienca and Vayena, 2020; Haider Syed et al., 2020; Donthu and Gustafsson, 2020).

Method

This build-and-test experiment used the ADDIE (analysis, design, development, implementation, and evaluation) process to produce and evaluate a computer simulated virtual environment using 3D Spherical Image Technology in a commercial context. Qualitative data were collected through semi-structured interviews during the analysis and evaluation phases. The analysis of the data involved identifying themes and patterns in the participants' responses using NVivo.

Participants

Seven participants were chosen through purposive sampling (Creswell, 2014) from a larger group of experienced stakeholders in retail, marketing, and IT fields. All the participants had educational backgrounds related to these areas. The sample included two men and five women. Semi-structured interviews served as the primary data collection method. Participants were first given the opportunity to interact with a virtual tour of a shop using 3D Spherical Image Technology The environment was developed and tested using the ADDIE model.

Analysis: involved identifying the research problem, objectives, and target audience for examining user engagement in virtual reality experiences using 3D Spherical Image Technology in commercial environments.

Design and development involved selecting a physical retail store with a digital twin in the form of an online store. A 3D Spherical Image was created of the interior of the store using an Insta360 camera and Matterport platform. Hotspots were added that link to YouTube videos, Websites with more information, larger images of the goods on display and to the online store where items could be purchased. The virtual store also linked to the Facebook and Instagram profiles of the store, as well as the Twitter feed.

These processes culminated in the scenes described below as Figure 1 to Figure 4. The online artefact can be viewed at http://bit.ly/3Qe7cJ9 . At the outset of a Matterport virtual tour, the entry view presents a scene, chosen to showcase a striking aspect of the environment to be explored. It resembles the gateway into a new world. Users can observe the entire scene in a 360-degree panorama, allowing for exploration in all directions, just like turning one's head. Interactive elements may comprise links or icons facilitating navigation to different locations within the tour. Figure 1 illustrates the initial glimpse of the store environment when commencing the virtual tour. A play button triggers scrolling and/or viewing.
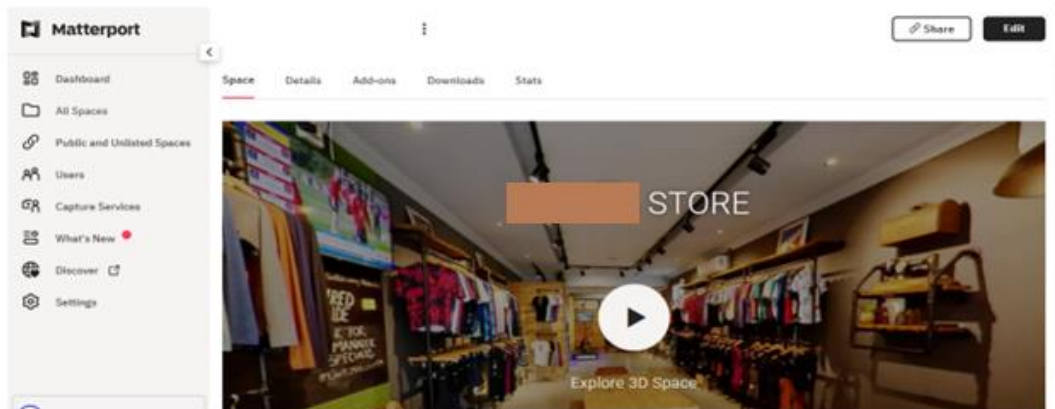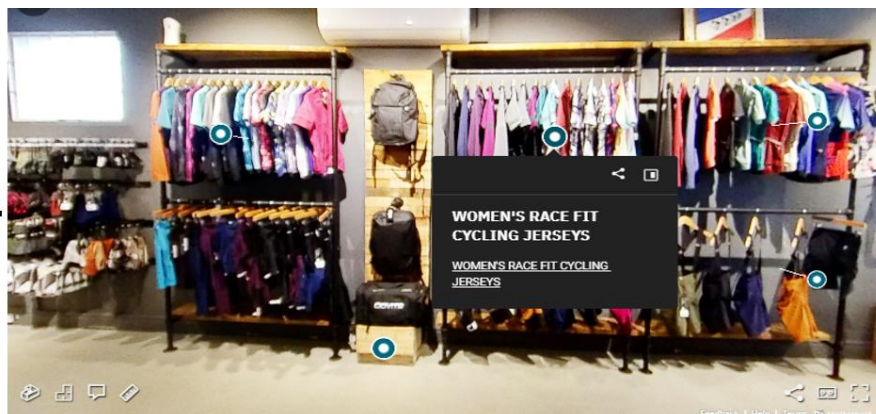

Figure 1 The environment

The store incorporates strategically placed embedded YouTube links within the virtual tour at specific points of interest. These links are clickable hotspots, which users can easily identify visually and interact with by clicking or tapping. Figure 2 shows the outcome of clicking on the highlight reel within the blue icon, demonstrating how integrated video content is launched within the virtual tour.
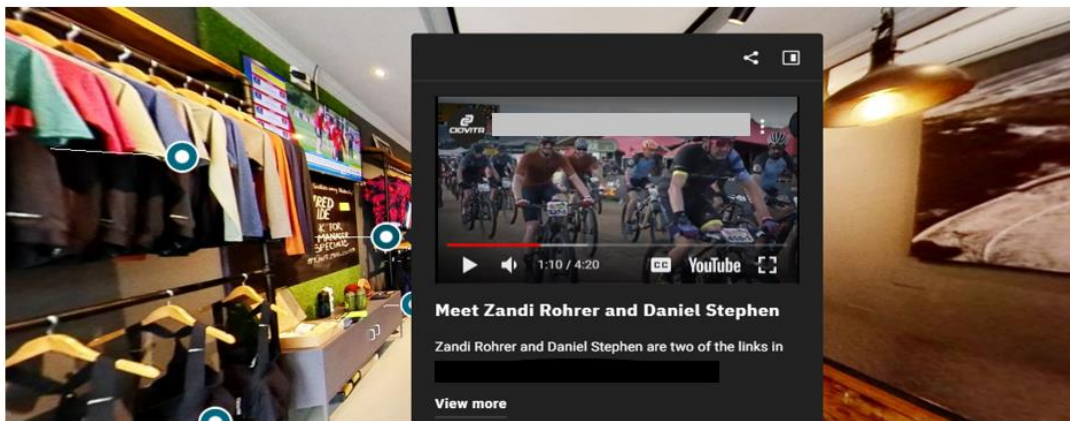
Figure 2 The store

The Virtual Tour includes embedded website links that redirect users to additional information or content. Clicking the blue icon displays a heading indicating the associated content type and redirects the user to the website (Figure 3). The Bird's Eye View, resembling a top-down floor plan, grants users an overhead perspective of the entire virtual space. This view offers a concise visual representation of the space's layout, illustrating the interconnections between various areas. Figure 4 visually demonstrates the Bird's Eye View, offering a comprehensive portrayal of the scanned environment's contents and perspectives.

Figure 3 Features of the virtual tour
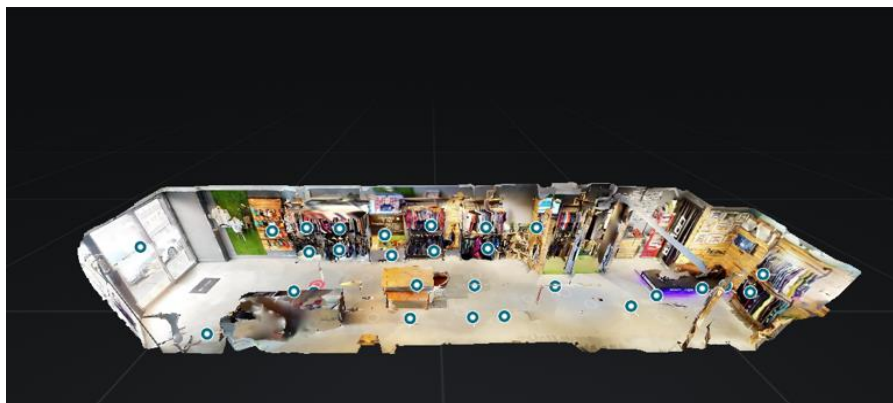
Figure 4 Birdseye and Dollhouse views

In the *Implementation and Evaluation* phase of the ADDIE framework, the artefact (virtual environment) was implemented and tested with participants. The next section will describe the results of the user testing and how the research questions are answered.

Findings

Seven themes emerged from the responses to the four questions: Pandemic challenges, Design challenges, Design improvement, Safety reasons during the pandemic, Ease of access Business growth, and Efficiency.

Research Question 1: The impact of Integrated Marketing Communications in Virtual Reality Environments during a Pandemic

This initial research question focused on unraveling the challenges encountered amid the pandemic. Participants shared insights in response to how the COVID-19 lockdown affected them. The insights collected were grouped under the theme "Pandemic Challenges".

Theme 1 – Pandemic challenges Respondents indicated that Face-to-face selling is easier than digital, but the pandemic limited physical traffic to the stores. Older people are used to the normal way of shopping, which involves physically touching a product that gives it a high selling power.

Research Question 2: User Challenges in Immersive Virtual Spaces

This research question aimed to uncover the challenges faced by users of immersive virtual spaces. The responses obtained from participants were categorized under the theme "Design Challenges," which encompassed three sub-themes: "Confusion for First-time Users," "Redirection from 3D Space," and "Font Size."

Theme 2 - Design Challenges Users encountered issues related to navigation, pricing, and product location. Many found it confusing to navigate the immersive space, especially if they were new to digital environments. The presence of links in the 3D space that directed users to external e-commerce websites also raised concerns, as it risked redirecting users away from the immersive experience. Additionally, participants found the font size too large, necessitating continuous scrolling.

Research Question 3: Enhancing Customer Engagement through Embedded Digital Communication in Immersive Virtual Spaces

This research question explored participants' suggestions for improving the immersive environment based on their challenges. The insights provided by the participants were examined and presented under the theme "Design Improvement."

Theme 3 - Design Improvement Participants recommended enlisting a technology partner to enhance the design of the 3D space, aiming to alleviate information overload. They suggested aligning the immersive space with the cleanliness and organization of a physical store to prevent data overload. Improving navigation, display shelves, and the connectivity of links redirecting users to external websites were noted as areas for enhancement. Furthermore, participants proposed incorporating real images of individuals within the 3D space and offering live feedback or frequently asked questions to enhance the customer experience.

Research Question 4: Impact of Technology on Marketing Strategies and User Engagement in Virtual Reality during a Pandemic

An additional aim of this study was to investigate the underlying reasons behind the adoption of immersive technology by businesses during the pandemic. Participants' responses

were examined and categorized into four themes: "Safety During the Pandemic," "Accessibility," "Business Growth," and "Efficiency."

Theme 4 - Safety During the Pandemic Participants acknowledged that restrictions on in-person gatherings in business establishments prompted the adoption of immersive access. They thought it reduced physical interaction, thus contributing to disease prevention

Theme 5 - Accessibility Ease of access was one big advantage of this design, as it provided an opportunity to experience spaces without physical travel. Participants felt that it could give access to people who might not have access to certain products. The 3D space's ability to accommodate multiple viewers at the same time could improve company exposure.

Theme 6 - Business Growth The immersive design could be used to acquire new businesses and boost sales for existing ones. Participants noted that the design allowed improved inventory management based on historical data which would enable companies to meet customer needs more effectively. It was also beneficial for marketing and advertisements, because it gave a comprehensive visualization of store items. Participants also noted the 3D model's role in providing additional product and company information. These features were linked to social media, to enhance companies' online community growth.

Theme Seven - Efficiency Participants mentioned that that the 3D space offered a cost-effective replication of physical stores in 3D, which could lead to savings in time and transport costs. Participants also highlighted the that the design was easy to understand.

Conclusions

This study has found that immersive technologies can contribute to business success through facilitating easy access to products, expanding business growth through online capacity, and exploring cost savings and enhanced efficiency.

Theoretical, Methodological and Practical Contributions of the Study

The study evaluated a computer-simulated environment using 3D spherical image technology to enhance customer experience in the retail industry. The study combined design-and-build approach, theoretical foundations, empirical strategy, and the ADDIE model. The study produced guidelines for evolving computer-simulated environments and best practices in the retail industry.

Limitations and Further Research

Limitations of the study included the COVID-19 pandemic itself which precluded the wider collection of feedback from customers. Thematic analysis of interview data resulted from personal perception of a relatively small sample of participants. The study explored participant responses linked to a single retail context. Further research may benefit from using a larger sample size and including a broader range of participants from fields other than only marketing. Finally the interview questions and comments from respondents focused on the positive aspects of the environment. More attention should be given to investigating the negative aspects. Further research could be conducted in other spaces. Four themes emerge for further research:

Theme 1: Effectiveness and Impact of Immersive Marketing, including the effectiveness of integrated marketing communications in immersive settings, the impact of virtual reality environments on consumer satisfaction and loyalty, and across various products and services.

Theme 2: Technical Considerations of implementing immersive technology in marketing contexts, barriers and challenges businesses encounter when implementing virtual reality environments and recommendations for overcoming them and user-friendly design.

Theme 3: Business Strategies and Adaptations such as a comparative analysis of digital and traditional marketing strategies, and transition from in-person to online shopping.

*Theme 4: Social Media and Consumer Behavior***:** Ethical considerations, the influence of external links on user engagement and the integration of immersive technology with social media for expanding online communities and boosting sales.

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