Shopping in Virtual Reality

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1 author:

Marco Speicher
Deutsche Hochschule für Prävention und Gesundheitsmanagement
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Shopping in Virtual Reality

Marco Speicher*

German Research Center for Artificial Intelligence (DFKI)
Saarland Informatics Campus (SIC)

Abstract

In contrast to traditional retail stores, online shopping offers many advantages, such as unlimited opening hours and a stronger focus on functionality. But this is accompanied by a complex categorization, limited product visualization and immersion. Virtual Reality (VR) has the potential to create new shopping experiences that combine the advantages of e-commerce sites and conventional brick-and-mortar shops. We examined the main features of online and offline shops in terms of buying behavior and customer frequency. Furthermore, we designed and implemented an immersive WebVR online purchasing environment and aimed to retain the benefits of online shops, such as search functionality and availability, while focusing on the shopping experience and immersion. This VR shop prototype was evaluated in a case study with respect to the Virtual Reality Shopping Experience (VRSE) model. The next step is to classify, investigate and evaluate the next generation of VR shops, including product interaction and navigation techniques, as well as store and product representations.

Index Terms: Human-centered computing—User Studies; Human-centered computing—Virtual Reality

1 Introduction and Related Work

Current online shops may be functional and efficient, but do not offer enough of an immersive shopping experience [2]. Not only have technological changes in online or pop-up shops, and the current wave of digitization of the retail brought economic benefits, they also caused a change in strategy, with retailers increasingly placing greater emphasis on customer satisfaction and the shopping experience. This is why it has already been invested increasingly in research in recent years and decades to improve the performance and usability of online shops' user interfaces. However, it is just as important for the performance of such user interfaces as it is for the customer's satisfaction and shopping experience to provide the user with interactivity and information in an appropriate and supportive manner. Current online shops usually only offer ordinary 2D content (e.g. product photos or advertising videos) and use simple 2D interfaces, which are mainly used in a classic way with mouse and keyboard on the home PC. Here, the product sales are in the spotlight, and products must be found as quickly as possible for the sake of convenience and conversion rates. This focus comes at a cost as it leads to limited search functionality, confusion and product visualization [4]. While the common list-based approach using scrolling or page-based navigation can have good usability ratings, especially in the search for products, it abstracts from the actual "3D world" of a store and neglects the important aspect of user experience and immersion, especially with increasing number of products and categories.

A virtual reality (VR) shop could benefit from its third dimension and 3D interfaces such as 3D graphics or natural metaphors. It is claimed that shopping in VR offers a better shopping experience than two-dimensional e-commerce systems and that 3D applications are feasible for e-commerce [6]. Clearer content presentation and more adaptive user interfaces, which are designed for the tasks at hand, could lead to more positive consumer feedback and shopping experience. The use of VR systems in the retail sector has recently gained importance in the form of commercial applications and is becoming a new trend (e.g. eBay[1], Macy's[2], Saturn[3]). However, there is a lack of user-friendly and intuitive user interfaces and interaction techniques, as well as a connection to previous findings from basic research on VR, 3DUI and HCI. This work therefore focuses on the development and evaluation of novel and immersive VR shopping experiences, aim to include the main advantages of offline and online shopping. The main goal is to take the next step in exploring novel, efficient and user-friendly interaction techniques and user interfaces, as well as application-oriented store representations with regard to the different types of goods (e.g. furniture, electronics or groceries). The influence of marketable consumer input and output devices will be examined in more detail with regard to task performance and user preferences in order to support future designers and developers of VR shops with guidelines and lessons learned.

Figure 1: Important aspects and dimensions of shopping in VR.

2 Completed Work

Navigation and object manipulation in immersive virtual environments (IVEs) are universal interaction tasks. Even though they have been on the focus of research, still no universal and suitable solutions for VR-based environments and commodity hardware exist. 3D interaction requires more complex techniques, which consequently lead to a higher degree of user instrumentation and workload, such as increased physical and mental demand or frustration [3, 7], thus 3D mid-air selection achieved better results in VR when the participants were in a comfortable pose [5]. One example VR scenario for a 3D object manipulation task could be a furniture arrangement application. As a common task in 3D is docking, we explored task performance and users' preference of mid-air hand interaction in a 3D docking task experiment using 3D furniture objects [8]. The experimental results showed that translation and rotation preci-

*e-mail: marco.speicher@dfki.de

[1] https://vr.ebay.com.au/

[2] https://qz.com/835171/singles-day-virtual-reality-lets-chinese-customers-shop-macys-famed-new-york-store/

[3] http://locationinsider.de/saturn-startet-virtual-reality-shopping/

sion benefits from the use of a large projection, while participants preferred a HMD in terms of user experience and task workload. Besides interaction in IVEs, we explored the main characteristics of on- and offline shops with regard to customer shopping behavior and frequency [6]. Orientating oneself and finding products in physical retail stores is a well-known problem, in contrast to search functionalities of online shops. Common modern retail stores have up to 10,000 square meters and offer more than 100,000 products. We introduced the ProductFinder [9], an intelligent product information system for situated interactive public displays in retail environments in order to equip physical retails stores with a search functionality and make them comparable with online shops. To fill the missing link between on- and offline shopping, we designed and implemented an immersive VR online shopping environment and aimed to maintain the benefits of online shops, such as search functionality and availability, while simultaneously focusing on shopping experience, clarity and immersion [6]. By touching the third dimension, VR provides a more advanced form of visualization, which can increase the customers satisfaction and shopping experience. We further introduced the Virtual Reality Shopping Experience (VRSE) model [6] and conducted a case study of a first VR shop prototype, based on the product database and spatial layout of the ProductFinder [9], and evaluated it with respect to the VRSE model. The results showed that the subjective feedback (user experience and usability) of our system was above average overall. Furthermore, searching for a product in a WebVR online shop using speech input in combination with VR output proved to be the best considering task performance (speed, error rate) and users' preference (usability, user experience, immersion, motion sickness).

3 Proposed Work

Using the VRSE model, we will continue to develop and evaluate prior, state-of-the-art and novel VR shop concepts in order to get actionable insights on how to optimize the shopping experience, as well as performance. We will further investigate whether VR shopping should portray the real-life experience in virtual form, or design a novel type of experience that builds on the affordances of the virtual medium. Thus, we create VR shopping concepts, based on isomorphic and non-isomorphic interaction techniques and store representations using consumer and marketable input and output devices (see Figure 1). In this context, isomorphism characterizes the mappings between interactions in the real world and their effect in the virtual environment [1]. While isomorphic techniques are considered as more natural, non-isomorphic techniques allow users to manipulate objects using "supernatural" metaphors, e.g. to overcome limitations in the tracking space or anatomical constraints. Apart from the store navigation, product selection and manipulation should be considered as one of the most important interactions within VR shopping environments. Here, a study will be conducted, which compares isomorphic selection using the Virtual Hand technique and non-isomorphic via a laser tractor beam using a tracked handheld motion controller [1]. As text entry (e.g. for product search) is another interaction type which should be investigated in more detail for VR shops, an empirical analysis of selection-based text entry in VR will be conducted using consumer hardware.

The next generation of VR shops also needs to have a greater awareness of visual appearance, including store and product representation. As we develop new VR shop prototypes, we will base our models on empirical data gathered from real-world data and numerous studies from prior work. Most of the existing VR applications try to simulate a conventional store accurately, but they did not try to address the limitations of those shops. One example of this is the convention to have multiple instances of the same product, so there is no need to display the same product multiple times. We propose to use an apartment as a shopping environment, where the products are located in positions where an average buyer would expect them to

Figure 2: VR Shop concepts

be, e.g. in the fridge in the kitchen. The next step is to compare our approaches to more abstract tree-based visualizations of a retail store (e.g. eBay Australia) or one-to-one representations of existing local stores[4] (see Figure 2). We want to answer the following research questions:

- Do the isomorphic concepts provide higher virtual reality shopping experience (VRSE) due to their familiarity, or can the user adapt to the non-isomorphic methods?
- Which store representation suits better for which type of good (e.g. living room environment for furniture, real estate and electronics, virtual farm for groceries, etc.)?

Finally, we create a taxonomy to classify VR shops with regard to different types of goods and formulate design guidelines for developing VR shopping environments based on new findings from all experimental results.

References

[1] D. A. Bowman, E. Kruijff, J. J. LaViola, and I. Poupyrev. *3D User Interfaces: Theory and Practice*. Addison Wesley Longman Publishing Co., Inc., Redwood City, CA, USA, 2004.

[2] M. Buffa and J. C. Lafon. 3D virtual warehouse on the Web. In *Information Visualization, 2000. Proceedings. IEEE International Conference on*, pp. 479–484, dec 2000. doi: 10.1109/IV.2000.859800

[3] D. A. Griffith, R. F. Krampf, and J. W. Palmer. The role of interface in electronic commerce: Consumer involvement with print versus on-line catalogs. *International Journal of Electronic Commerce*, 5(4):135–153, 2001.

[4] K. C. Lee and N. Chung. Empirical analysis of consumer reaction to the virtual reality shopping mall . *Computers in Human Behavior*, 24(1):88 – 104, 2008. doi: 10.1016/j.chb.2007.01.018

[5] P. Lubos, G. Bruder, and F. Steinicke. Influence of Comfort on 3D Selection Task Performance in Immersive Desktop Setups. *Journal of Virtual Reality and Broadcasting (JVRB)*, 12(2).

[6] M. Speicher, S. Cucerca, and A. Krüger. Vrshop: A mobile interactive virtual reality shopping environment combining the benefits of on- and offline shopping. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, 1(3):102:1–102:31, Sept. 2017. doi: 10.1145/3130967

[7] M. Speicher, F. Daiber, S. Gehring, and A. Krüger. Exploring 3d manipulation on large stereoscopic displays. In *Proceedings of the 5th ACM International Symposium on Pervasive Displays*, PerDis '16, pp. 59–66. ACM, New York, NY, USA, 2016. doi: 10.1145/2914920.2915018

[8] M. Speicher, F. Daiber, G.-L. Kiefer, and A. Krüger. Exploring task performance and user's preference of mid-air hand interaction in a 3d docking task experiment. In *Proceedings of the 5th Symposium on Spatial User Interaction*, SUI '17, pp. 160–160. ACM, New York, NY, USA, 2017. doi: 10.1145/3131277.3134356

[9] M. Speicher, R. Siegel, and A. Krüger. Productfinder: A location aware product information display for retail environments. In *Proceedings of the 6th ACM International Symposium on Pervasive Displays*, PerDis '17, pp. 23:1–23:2. ACM, New York, NY, USA, 2017. doi: 10.1145/3078810.3084351

[4] https://invrsion.com/