

## A Virtual Reality Shopping Mall Framework

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**Abstract:** E-commerce is a commercial area that has expanded greatly in recent years thanks to the advent of the internet, however the current model, which is basically implemented through websites, offers a limited consumer interaction with the product. The details about the products size, colors, geometry, etc., in most of the cases, are very limited to be visualized on the majority of e-commerce sites, which can discourage consumers from making online purchases. Virtual Reality technology makes experiences in virtual environments more immersive. This technology has become increasingly widespread and accessible due to the technological advances. In order to unite these two concepts, this work aims to introduce a shopping mall framework in Virtual Reality (VR) with the objective of making the shopping experience more immersive, besides proposing a system of rent or purchase of stores, where the buyer could customize his environment according to his liking, close to what he would be trying to sell. We will make a revision about some related works, we will explain the methodology used to develop the object of study and the research carried out, a brief explanation about the 3D platforms used in the development of the project. A 3D mall for Virtual Reality developed to be tested will also be presented. In order to obtain feedback from people who have already done some kind of online purchase, a questionnaire was applied to these individuals after using the virtual shopping environment. From the research performed, the results were promising, where the most relevant element was the immersion quality.

Keywords: E-commerce, VR shopping, Virtual Reality.

### 1 - INTRODUCTION

Nowadays Virtual Reality (VR) technology has become an increasingly widespread tool, the range of applications is great, being much used in games. One of the great advantages of this technology is the level of immersion that it provides, taking the user to an experience that is closer to reality. An area where VR technology can be applied is in E-commerce, as it can offer a more real user interaction with the product, thus presenting a better understanding of the details of the product. We believe that a 3D environment can be more effective for digital marketing because it is less limited than a web page, since in a virtual scenario can be applied animations, 3D drawings and more physical details of the products and the store itself.

This work aims to demonstrate an framework of a shopping mall in Virtual Reality, as well as to bring a brief introduction about some related works and the specification of the development platforms involved. The idea of this framework is that it would be possible to customize Shopping Mall from a series of elements

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provided by the framework itself. The Purchases would be made by imitating what happens in the physical malls, so the customer must visit the store in the virtual environment to make their purchases.

We found few similar works developed with VR in E-commerce (PAPADOPOULOU, 2007; LAU; LEE; LAU, 2014). Therefore this work seeks to bring an innovative application, using the immersion provided by Virtual Reality to better approximate the experience of shopping in physical malls.

The 3D development tools that are being used is SketchUp for scenario building, Blender for 3D modeling of elements with a lot of details and Unreal Engine 4 used to organize assets, for support to the VR technology and as a bridge to work with Visual Studio Community 2015 using the C++ language. This paper is divided into the following parts: The section 2 presents some related works developed in the VR E-commerce area; section 3 demonstrates the methodology used to develop the study object of this paper; section 4 discusses some aspects about VR in E-commerce; the section 5 describes the workings of the framework proposed by the paper; section 6 describes the development tools used and their characteristics; section 7 gives the details about the experiment realized; section 8 bring some results and discussion about it; Finally the session 9 brings the conclusions about the work.

## **2 – RELATED WORKS**

As inferred by (CHITTARO; RATION, 2000) Virtual Reality interfaces to e-commerce websites have recently started appearing on the Internet, promising to make the e-shopping experience more natural, engaging and fun for customers. The author seeks to introduce a prototype of an adaptable VR store. The store would adapt according to the customer's behavior, making the environment more pleasant for him. Changes in the store would be made in the display of the products, assistance of navigation to the customer and the appearance of the store. As stated in (PAPADOPOULOU, 2007), the application of Virtual Reality have a potential to transform online shopping into an equivalent real-world shop. However, the growing research on creating an virtual reality E-commerce ambient without considering other behavioral aspects of online shopping as trust. Trust is a critical success factor of any physical shopping, but still an open issue in the E-commerce. The project of Panagiota Papadopoulou, Applying virtual reality for trust-building E-Commerce environments, proposes an advanced customer experience compared to conventional we stores that can enable customers trust.

A study was also carried out on what factors are important in an E-Commerce VR environment (LAU; LEE; LAU, 2014). The author points out that some factors that may decrease the quality of the experience in VR E-Commerce environments, such as lack of photorealism, the difficulty of movement within the environment, dizziness caused by the excessive use of VR devices, virtual products without visual fidelity with the physical product and the lack of the human factor.

### **3 – METHODOLOGY**

For this work, a 3D environment was developed using Blender, SketchUp and Unreal Engine 4 platforms. This environment was used as the basis for an experiment with possible e-commerce users. This experiment consisted of the application of virtual shopping environment with a VR glasses on a android smartphone and then later an interview. This interview was conducted in order to discover information about the opinion of the individuals involved in the research from their experiences in the 3D environment of VR, then later analyze if the virtual reality can have a positive impact on online shopping based on the data obtained.

The project is still under development but to exemplify the operation of the Framework, in addition to the Shopping environment, a furniture store was implemented. The choice of this model was given because this is a type of commerce that deals with a wide variety of products, thus, it is possible to test the hypothesis that an environment in virtual reality improves the online shopping experience, since the customer may have a better understanding of the details of the products for sale.

### **4 – VR COMMERCE**

When it comes to E-Commerce, there are some problems pointed by the buyers that can make them opt for the common commerce like risks of transacting with fake company, stolen credit cards, inaccurate billings and receiving wrong items (LEE, 2002). Another problem with E-Commerce is the interaction with the product, the buyer does not have a good idea of the product size and its details, because it is often limited to images and technical specifications.

VR Commerce brings a new way to interact with products in E-Commerce. It can make use of some technologies like Google Cardboard and Samsung Gear, which makes the

E-Commerce shopping experience more immersive and realistic.

## **5 – VR SHOPPING MALL FRAMEWORK**

The intent of this project is enabling the developer to build his own shopping mall in VR, without putting efforts in the actual Virtual Reality implementation. The developer will be provided with tools to build the structure of his shopping mall, like paths, stores, decorations and food court. Basically, the framework helps the developer to construct it with customized positioning of the departments stores, thus providing more flexibility in the arrangement of the shopping mall areas. Besides that, the developer will be capable of editing the intern part of the stores, like adjusting products, product shelves and furniture positions. This enables the use of the same logistics in physical stores.

Sections 5.1 and 5.2 will discuss details about the implementation and operation of the Framework, as well as detailing the environments developed for the experiences.

### **5.1 – THE SHOPPING MALL**

To build the shopping mall, the developer will have to add components into the shopping, assembling the components one into another, creating the main construction. Components are assets provided by the framework or external source from 3D modelling softwares. Therefore, the developer can by himself compose new objects to put in the shopping mall.

Components are categorized by its type, as components can be a wall, furniture, product, door, window, and other shopping mall objects. Components positioning is entirely arbitrary, as developers can create a visually unique environment. Product components are more unique, in view of its purpose of this project, product components have attributes that can be modified by the developer. Those attributes can be description, a brief how-to video or even a comparison review.

For this work a 3D environment was developed to simulate a shopping mall, which has only one floor where 7 rooms are distributed to simulate the stores. The look of Shopping was inspired by real Shoppings as we believe this can make the experience more familiar to the user. More details of the implementation can be seen in the figure below.



Figure 1: The VR E-commerce shopping mall

## 5.2 - STORES

Each mall store can have dimensions according to the developer's will, its internal components can be changed to fit the type of product that will be sold. The elements that can be customized are the shelves, the appearance of the walls, floor and ceiling, the products that will be sold and vendors if any exist. Each store will be a space inside the mall, which can be rented by someone who has an interest in selling their products in the model proposed by the framework. Anyone who accesses the mall can enter a store, where they can add products from the shelves to their shopping cart.



Figure 2: Some Stores of the VR E-commerce shopping mall

For demonstration purposes, a store was developed and set up inside one of the implemented Shopping rooms. As described previously in the section 3, a furniture store was chosen because it has a wide variety of products with different sizes and peculiarities. The figure 2 Demonstrates in more detail the stores of the mall and the figure 3 refers to the cited furniture store.



Figure 3: An example of a rented store in the mall

## 6 - IMPLEMENTATION

In this project we are using some open tools like Blender, Unreal Engine, Microsoft Visual Studio Community and SketchUp. The Blender is a free and open source 3D creation suite. It supports the 3D pipeline modeling, rigging, animation, simulation, rendering, compositing and motion tracking. Unreal could be described in a short way as a system that organizes your "assets", your characters, artworks, props, weapons, music, sound effects, voiceovers, etc, into a visually stunning interactive environment. Visual Studio is a powerful (BUSBY; PARRISH; WILSON, 2009). Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web apps, web services and mobile apps. SketchUp is a 3d modeling software that provides simple and intuitive tools for work. By appearing a simplified look in your 3d models, it becomes a lightweight tool, great for developing uncomplicated scenarios, buildings or elements with simple shapes.

The tools described have been used together to build the framework in C ++. However, in addition to the framework, it is also necessary models for new item and functionalities to be added to the system, making it increasingly complete and making cooperation possible. For this reason, one of the objectives of the work is to provide models that can be used by companies to virtualize their products, or to create new functionalities, in stores or malls that use this framework while maintaining compatibility. Such models may be adaptations of existing models (XIAO; BENBASAT, 2007).

## **7 – EXPERIMENT**

In order to validate the work done, experiments were carried out with 11 participants. The experiments were applied to people of different ages and sex, since these people may be possible customers of e-commerce sites, so that none of the people interviewed were underage. The place chosen for the experiment was a university, so the participants were teachers, students and technicians of the institution.

In order to be visualized, the store in virtual reality was used the VR Google cardboard glasses and a Samsung Galaxy S6 smartphone. Participants used the virtual reality glasses to access virtually developed environment, where they interacted with the environment through a Bluetooth control connected to the smartphone.

The research participants experimented with the prototype that had one of the shops of the decorated mall, in which they could have contact with the products like sofas, books, TV, etc.

The second part of the experiment aimed at obtaining feedback from the volunteers who, after experiencing the virtual reality environment, a questionnaire was applied to each participant, where the questions were always the same. It was found that all participants had no prior contact with the platform, as this could prejudice the results.

## **8 – RESULTS AND DISCUSSION**

As the tests were carried out on students, teachers and technicians of the institution that have at least high school completed and have frequent access to computers and the internet, it should be considered that a research with a different public may have results divergent from those obtained.

People involved in the research do online shopping often and have never had problems with fraud, but expressed dissatisfaction with the

delivery of the product. The interviewees were open to the idea of shopping in virtual reality, considering this a more attractive environment.

The graphical quality of the environment developed through Blender and Unreal demonstrated beyond the initial expectation due to the high visual quality that both software can provide, this seemed to influence the opinion of the interviewees. Interaction with the environment was acceptable because participants could move and interact with objects, but the joystick does not contribute to the immersion, other devices like Leap Motion or Kinect may be more suitable for the application, since they can greater interaction and immersion with the environment and the objects belonging to the scenario.

## 9 - CONCLUSIONS

VR Commerce is a topic that has been discussed for some time. One of its main focuses is the benefits that it can bring to the area of E-commerce. Reducing the price of virtual reality accessories by making the technology more widespread, adapting the tools to meet the need to develop this modality, makes it possible to implement VR Commerce more easily. However, there are still few companies that anticipate to meet the demand of this new market.

The elaboration of models for the creation of new products and functionalities is necessary for flexibility and generalization to meet the needs and creativity of the developers. This work is being developed with the intention of contributing to the developer community in order to make technology more popular, bringing benefits to companies and consumers alike. In the future we intend to expand the framework so that it can connect to one database and create more appropriate models to handle the needs of virtual reality, so that they can be used in other applications thus ensuring quality and compatibility with other frameworks and applications.

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