NEXT-GEN E-COMMERCE in the METAVERS

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ABSTRACT

The Metaverse's goal is to create a virtual world that incorporates augmented reality, virtual reality, 3D holographic avatars, and other forms of communication. In this paper, a new e-commerce experience was developed to contain the new technology in user friendly applications that can be used in the Metaverse as a facility to combine online trading and the new technology of the virtual reality.

Keywords: E-commerce, 3D-scanner, mesh cloud, point Clouds, segmentation, classification, photogrammetry, application developing.

Index Terms: K.6.3 [Management of Computing and Information Systems]: Software Management—Software development; K.7.0 [The Computing Profession]: General.

1 INTRODUCTION

VR has definitely caught people's attention in recent years. Being a new user interface paradigm that offers many advantages in many application areas, also providing easy, powerful and intuitive way of human-computer interaction. User can view and manipulate a simulated environment without any need to learn how the complicated user interface works. Hence many applications such as aircraft Simulators, architectural exercises or data visualization systems are relatively well developed. More recently, VR has been used as a remote collaboration environment in the recreation, educational and social area. Also a big sector of industrial work is now facilitated due to the new technology and drifting a lot of huge worldwide companies to enter this virtual world due to the amount of advantages that they can find in this technology.

As written in the article "A short history of the Metaverse" Bernard Marr mentioned that the term "Metaverse" was first used in Neil Stevenson's 1982 novel, Snow Crash. Stevenson's "Metaverse" was a virtual place where characters could go to escape a dreary totalitarian reality. In the early 1990s, Sega introduced VR arcade machines like the SEGA VR-1 motion simulator, which users enjoyed in many arcades. On October 28, Mark Zuckerberg announced that Facebook would change its name to "Meta" to reflect a new focus on creating the "Metaverse", a vast, immersive online empire that encompasses the entire digital society and economy. Facebook (aka. "Meta") sees the Oculus virtual reality headset as an industrial portal. Just like today's smartphones are connected to the mobile internet.

Two months after Facebook announced it, the term "Metaverse" began to be used. A search of the Factiva database turned up more than 12,000 news articles in English in the past two months, fewer than 4,000 in the first nine months of 2021 and fewer than 400 in previous years (surprisingly, Facebook was the most mentioned company in the article, nearly 10 times more than Microsoft, the next company mentioned.) Meanwhile, Google Trends shows that the word has a large number of searches concerning the "Metaverse", About 20 times higher from mid-October. One of the biggest sectors that was affected by this new trending technology was the commerce sector, and as a continue to the idea of E-commerce which first start as "Boston Computer Exchange" which launched all the way back in 1982. It was primarily an online market that served people who wanted to sell their used computers. Passing through all the online shopping websites (applications such as Amazon, Alibaba, etc...) which were aiming to affect the market growth of all the commerce rate around the world and also facilitate the process of buying and selling. Every shop now days have an online site which aims to simply the process of buying or even watching the products from your 2D screen. With the new era of the "Metaverse" the technology of the virtual reality is taking a few steps toward the traditional 2D platform experience and many companies started to get involved in the world of virtual shopping experiences, as mentioned before, the "Metaverse" was improving a lot of sectors, and one of these sector is the E-commerce sector in which the "Metaverse" will take a huge part in constructing the future of virtual sopping due to the abilities of visualizing spaces, interacting with virtual models and connecting with the world throw your headset.

The application aims to improve the normal virtual tours and turn it into a more integrated and interactive application for a better user experience. The main idea is to replace modeling/drawing/designing an artificial shop, the reverse engineering and 3D scan is used for digitalizing a real shop. A mesh cloud that contains millions of points captured by a 3D scanner can be used as an environment for the user's avatar. Using this environment to integrate the user in a realistic virtual world that can be accessible throw any VR headset. User can walk throw different spaces that are presented as a realistic captured mesh cloud points and interact with the products to create a fully immersive shopping experience. Using the VR headset controllers to move, hover, rotating and selecting.

With this application, user can visit a whole shopping mall using a VR headset and also explore items and even complete all purchasing steps starting from exploring and specifying specifications of the product to trying the production ending with the payment and shipping details and checking out.

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Figure 1: Realized application screenshot.

In the Metaverse, digital experiences that are very realistic will be created, unlike the 2D interface of traditional e-commerce experiences. The Metaverse has the potential to bridge the gap between e-commerce and the physical shopping experience. A recent study from "Shopkick" found that 70% of consumers believe they can try, touch and see physical products are the most important aspects of shopping. Creating an online platform that is flexible and modifiable to allow the application to improve and learn more about the users and also be able to expand and add more spaces to collect the biggest amount of data to help users access and connect with more virtual places that exist in real life (as shown in figure 1) without the need to 3D model and also giving the user the complete six degree of freedom that allows the user to move in the 3 axis of movement and rotate in the 3 axis of rotation in any scanned space. Using artificial intelligence can help in segmentation of the mesh cloud captured by the 3D scanner to help developer select products in the environment without having to manually cut each product from the environment to add the required scripts and animation to improve the interface and the application sequence and simplify the animated steps for all type of users making the application considered as user friendly for all ages above 12 years old.

2 STATE OF THE ART

The Metaverse is at this point not hypothetical; it's inside the strategy for realizing itself and a result of reforming the E-commerce scene with the shift from "add to cart" to "add to room". As a matter of fact, E-Commerce inside the Metaverse offers the final word joining between conventional physical stores and internet shopping. It will be intriguing to perceive how more stores embrace Metaverse innovation and furthermore the manner in which purchasers adjusts to it. The long run of E-commerce inside the Metaverse offers vast potential outcomes, benefits, and detriments. By and by, the present moment and long haul impacts the Metaverse will wear society at large still ought to be completely investigated by architects and organizations.

Alibaba is one of the foremost effective companies in China when it comes to VR. In 2016, it set up its possess VR Lab called "GnomeMagic" Lab and accounted its VR technique within the future. In Alibabab's VR shop Purchase+ , clients can choose in case they need to go shopping within the US or in Australia (as shown in figure2). Another highlight from Alibaba is VR installment. In VR shops, clients can pay the charge essentially by "head nodding". The negative part about this application was mainly about the isolation of the virtual world and not interacting with any human being or even interacting with a virtual character

which affected the customer service support and also affected the feelings of users inside the virtual world.

Figure 2: Alibaba VR application.

3 PROPOSED APPROCH

Taking advantage of the technology of 3D scanners to collect accurate data of the surrounding space and export it in the form of point cloud to integrate the user as a character in the virtual space using a VR headset and allowing the user to move around virtual spaces and interacting with different products and be able to watch, spectate and buy products throughout the VR headset. This could be the E-commerce experience in the Metaverse that could build the future of online trading for the next generations.

3.1 3D scanning VS 3D modeling

3D modeling is the process of developing a mathematical representation of a surface of an object in three dimensions using software that manipulates edges, vertices, and polygons in a simulated 3D space. Three-dimensional models represent a physical body by using a collection of points in 3D space, connected by various geometric entities. 3D modeling consumes lots of time and limit the quality of the output because of the lack of image reality and accuracy of the rendered output. 3D scan gives more accurate textures and level of details making the output closer to reality than the 3D rendered model, it also much easier to use 3D scanners than using 3D modeling software. Time consumption is also a huge aspect that should be considered as a barrier in 3D modeling. On the other hand an individual 3D scan usually takes between 1.5 to 7 minutes.

In this research, 3D scanning was the optimum solution to collect the maximum amount of spaces in the form off cloud point and moving to the experience developing phase.

3D Laser scanners rely on trigonometric triangulation to accurately capture a 3D shape in the form of millions of points. More precisely, they work by projecting a point or a laser line onto an object (explained in firgure3) and then recording its reflection with sensors. Since the sensors are at a known distance from the laser source, accurate point measurements can be made by calculating the angle of reflection of the laser light. Knowing the distance from the scanner to the object, the scanning hardware can map the surface of the object and then acquire a 3D scan. This method is called triangulation because the laser dot (or line), sensor and laser emitter form a triangle as shown in the image below. There are many types of laser scanners on the market, you can choose from portable, desktop or professional/industrial devices. The key is that they work in a short amount of time.
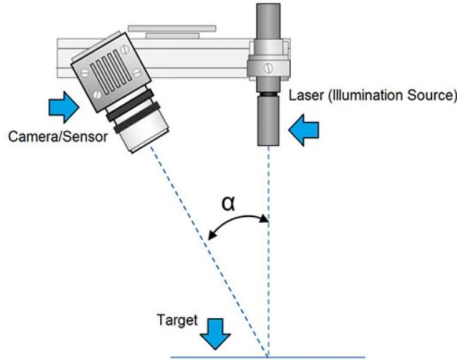
Figure 3: Laser 3D scanner.

Structured light 3D scanners technology also uses trigonometric triangulation, but it works by projecting a light pattern onto the object to be scanned and not through a laser line (or point). The pattern is projected onto the object using an LCD projector or other stable light source (as seen in figure4). One or more sensors (or cameras), slightly offset from the projector, observe the shape of the light beam and calculate the distance from each point of the field of view. The textured light used in the scanning process can be white or blue, and the light pattern is usually a series of stripes, but it can also be a dot matrix or other shape. This type of device, like the laser scanner, works at close range and can be handheld or mounted on a tripod.
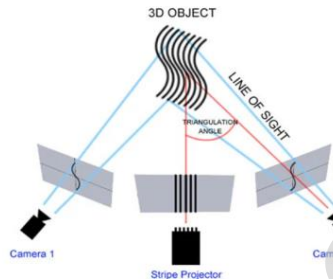

Figure 4: Structured light 3D scanners.

3.2 Point cloud segmentation

Segmentation is the process of grouping point clouds in multiple homogenous regions with similar properties, while classification is the next step. Edge-based segmentation algorithms have two main stages: edge detection to outlines the borders of various regions and grouping of points inside the boundaries to deliver the ultimate segments. Edges during a given depth map are defined by the points where changes within the local surface properties exceed a given threshold. The mostly used local surface properties are normal, gradients, principal curvatures or higher order derivatives.

3.3 Integrating avatars

After collecting the required data for the environment using the 3D scanner, developing avatars that represent the user in the virtual world in a TPS (third person shooter) game mode, giving the user the freedom to choose their gender and their looks to integrate the user in the application and making it more immersive (as shown in figure5). Developing the movement and the rotation of the character in the 6Dof (six degree of freedom).

3.3.1 Application interface

Developing an easy interface with big and clear buttons that has fixed locations allowing the user to easily pick their choice between different choices. Simplifying the controllers of the VR headset by adding ray cast that guide the user and demonstrate their hand motion. After choosing the avatar, an animated human model will appear the present the user in the Metaverse and will act as the user's body during the E-commerce experience making the user feel more immersed in the scanned virtual space.
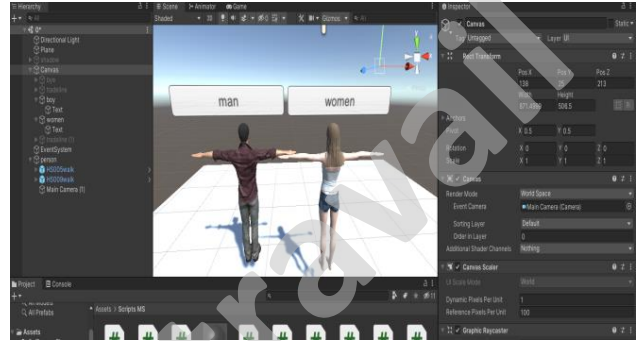

Figure 5: Avatar choosing.

3.3.2 6DoF (six degree of freedom)

Alludes to the particular number of axes that an unbending body is able to unreservedly move in three-dimensional space. It characterizes the number of free parameters that characterize the setup of a mechanical framework. Particularly, the body can move in three measurements, on the X, Y and Z axes, as well as alter orientation between those axes in spite of the fact that revolution as a rule called pitch, yaw and roll (see figure6).
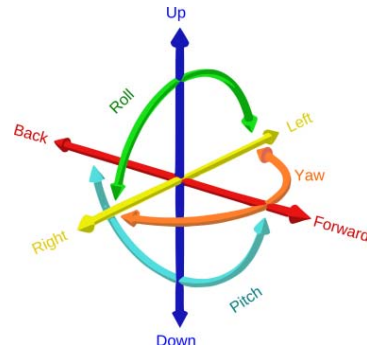

Figure 6: Six degree of freedom diagram.

4 REALIZED PROTOTYPE

A test application was developed as a prototype to be the first application based on 3D scanning for an E-commerce mall; this mall is located in Cairo, Egypt. We will discuss the different stages of developing this application, the final result, the reflection on the market and the E-commerce trading in the Metaverse world. The application consist of a welcome interface created using "Unity" which allows the user to select his character and then can select which store he wants to virtually visit, and by clicking on the button responsible for the specific store it will automatically immerse the user in the 3D scanned mesh cloud that is ready to act as an environment for the user and will be ready to contain the user's avatar and immerse the user in the virtual shop as if he was physically inside.

The starting point was "Tradeline" one of the first to introduce Apple Authorized Resellers to the Egyptian market where you can buy all Apple products. The store has dimension of 15m*8m which required around 36 scans (marked in figure7 & 8) to cover the first floor of the store.
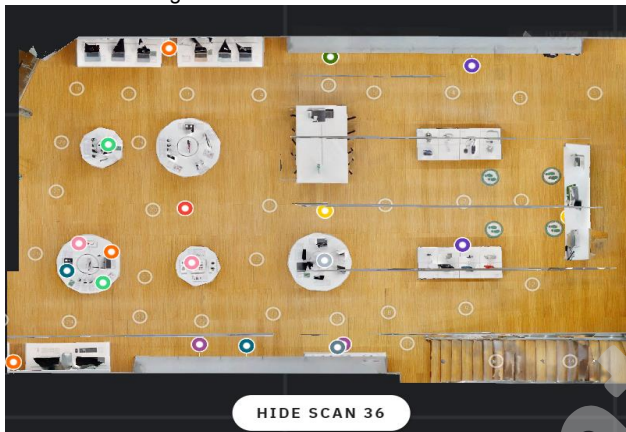

Figure 7: Store scanned elevation.

HIDE SCAN 36

Figure 8: Store plan with scanner position.

4.1 3D scanning

In this project we used "Matterport pro2" (shown in figure9) which is a High-quality 3D capture camera with unlimited 4K print quality photography. It helped in gaining professional photo resolution output (134 megapixels) and 3D accuracy. It is also recommended at scanning homes, apartments, hotels and commercial buildings.

Due to the high technology used in this version, the scan has a high 3D sensing using infrared; 20 seconds capture time per scan/sweep, 99% accurate within range, Automatic 3D data registration, depth resolution equivalent to10 points per degree (3600 points at equator, 1800 points at meridian, about 4 million points per pano).

Figure 9: Matterport pro2 3D scanner.

4.2 Exporting point cloud files

Matterport allows to download MatterPak™ Bundle, which is a set of exportable and downloadable assets, generated from Matterport 3D models, that designers, architects, engineers, and construction professionals can use to jumpstart design projects or a can be imported into third-party programs (such as 3Ds max, ReCap, Revit, or AutoCAD). This method did not bring the best quality of the 3D scan but it ws more practical to test the application using this pack due to the small size of OBJ file which was 625MB. Using "MeshLab" to filter the cloud point (see results in figure10) and trim the unnecessary meshes.
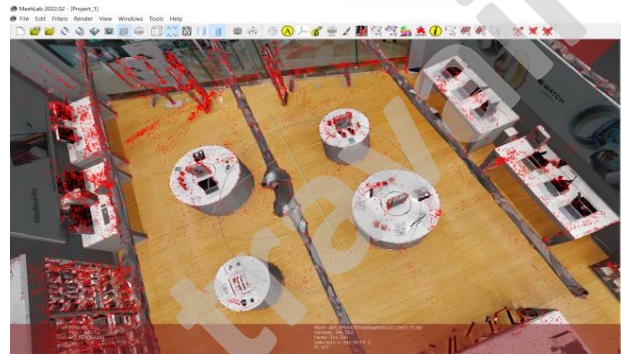

Figure 10: Point cloud with connected meshes.

4.2.1 Segmentation

Using "CloudCompare" automatic segmentation tool, many trial were made focusing on the segmentation of products from their stands and their surroundings to give the mesh cloud a unique separated meshes that are more practical in the use of the application for the user to pick from the store the specific product that matches his requirement. In this case the segmentation didn't go as expected (as seen in figure11) to the low amount of the points that are exported from the MatterPak™ files which did not contain enough points.
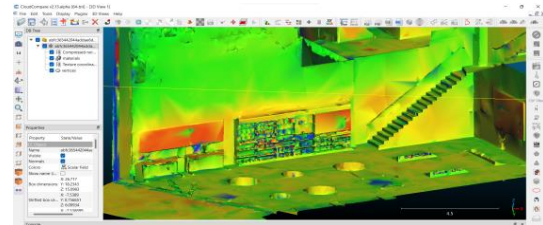

Figure 11: Automatic segmentation for "Tradeline" store.

As a plan B, manual segmentation was the way to extract a product from the mesh cloud output, of course it was not the best solution to extract each and every product but it gave quite well output for an experiment. Using CloudCompare tools to manually separate the required points and export them as a separate point cloud that will be independently selectable in the application (see figure 12).
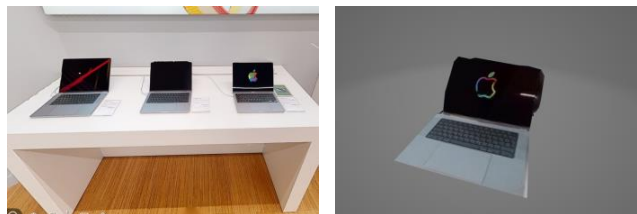

Figure 12: Connected mesh and manual segmentation.

4.2.2 Avatar

After exporting, filtering and the segmentation process, creating an avatar that represent the user's body in the virtual world. Using "Unity" we created an avatar that allows the user to walk, watch and rotate inside the environment and also a ray cast that helps the avatar pick objects and buttons in the scene. Using "C#" coding language to create scripts that control the avatar and facilitate the connection between the user and the virtual avatar that represent the user's body in the virtual reality world. Also using 'Unity' to create the interface and the buttons to allow the user to pick his character (gender, color, etc..) to make the application more immersive and to involve the user as much as possible in the virtual world.

4.2.3 Product manipulating

Using the manual segmentation output to allow the user to select each product separately and have a closer look to each and every detail in the product to help the user choose with more details and giving the ability to compare and test product using the technology of VR. A separate mesh is created over each product that allows the user to highlight an object (seen in figure13) when hovering over it, which will facilitate the selection of the required product and limits the factor of low accuracy by users who are not very experienced in using new technology special the virtual reality headset. Adding animation that helps the user move around the place to check the products in a close eye, which is technically changing the position of the camera and the specification of the camera to get the best quality out of the product and allows the user to rotate, zoom and manipulate the product as if it was between his hand in real life. And this fulfill the users physical need in shopping that most studies agreed that physical touch and freedom of manipulation is the most needed aspect in

Figure 13: Highlighted segmented mesh.

E-commerce and which is not achieved in the 2D interfaced platform that cannot allow a 3D model to be manipulated with the user hands. The application also implement virtual buttons that allow the user to connect to all the social media accounts of the store he is visiting and allowing the user to check the stores website and also switch to the 2D platform if needed.

4.2.4 Product selection

After adding the highlighted mesh over every product, scripting the ability to connect each product to allow a specific modification for each product based on different specification (color, size, etc..) and a small animation that represent the product individually and allows the user to manipulate the product to have a closer look and to test the product as if it was between his hands

in real life. After animating and specifying the different specifications, user can compare the selected product to different similar products proposed by the application based on categories and other dimensions. After specifying the product detail, user can add the product to his virtual cart imbedded inside the application which memories up to 20 products and can be modified at the end of the shopping experience. Every product is also connected to a URL that open the specific website page of the product to present all the specification and also present the price and warranty.
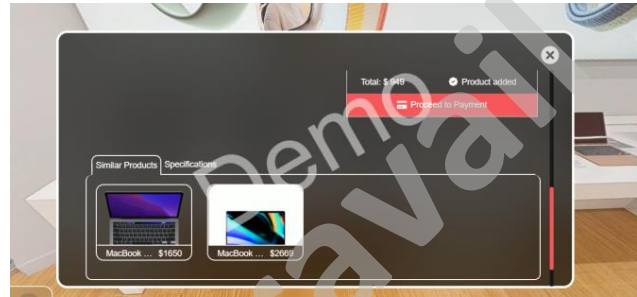

Figure 14: Similar products and specifications.

4.2.5 Customer support

The idea of integrating a virtual shop assistant that will be created as an avatar that exist inside the store and that is represented by a 3D model that works with a scripted AI form that allows the avatar to be connected to a data base of the most asked questions and with a voice recognizing technology that allows the user to ask verbally the question next to the avatar responsible of the store (shown in figure15) and based on the data based already built in inside the avatar, it will give the user the required answer. If the question or the answer was not clear there will always be a really costumer service agent that is responsible to answer the voice calls of users that are virtually in the store. With a click of a button the user can contact the customer service throw the headset's microphone to ask any question and receive the help required to facilitate the virtual e-commerce experience. Also giving the feeling of the interaction with real humans will help immersing the user in the virtual world.

Figure 15: Virtual assistant avatar.

4.2.6 Payment and shipping

Each selected product will be assigned to an updated value already saved in an external spreadsheet made by the store, and at the end of the experience the user will be able to proceed to the payment and the delivery process inside the app. Paying virtually and assigning the accurate address to deliver the shipment. User will also be connected to with the shipping company to clarify any details and secure the order shipment to the write address.
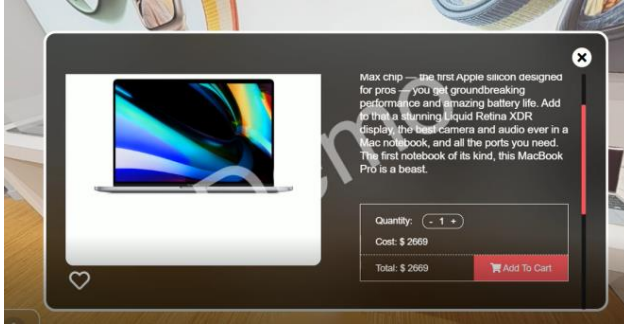
Figure 16: "Add to cart" window and pricing details .

5 EXPERIMENTATION AND EFFECTIVENESS

By following the number of users that virtually visited the store and how also following the time spent inside the store, a huge numbers where noticed and a bigger time average was noted compared to 2D E-commerce platforms. Results showing that the virtual E-commerce experience is a very attractive way for users to explorer new places and the 3D scanner making it more immersive and attract more users to watch and buy from stores that use this technology.

Although the application was not totally finalized and the application was shared locally for surveying purposes, also including a PC version to reach the maximum amount of users to test the application effectiveness. Also there will be a survey for users to test the application from different aspects, such as the friendliness of the application, the ease of use and the quality of the visualization and experience; this will help in getting the best out of the experience.

6 CONCLUSION AND PERSPECTIVES

To conclude, virtual-commerce is the future of online trading and electronic shopping. This technology will take place all other king of shopping and will connect the world together so that all humans can access shops and trade all type of products worldwide without paying for transportation or taking a lot of time or taking any risk to get certain products. The proposed application is allowing the user to walk freely in a 3 dimensional spaces already scanned with a 3D scanner and using the VR headset, user can be immersed inside this virtual store to watch and buy all types of products, starting from fashion passing by furniture ending with all types of technology.

The application can still be improved by adding and integrating more of the artificial and also training the application to fill the data base and help it build a more smart and responsive intelligence. Using the user friendly interface, the application is built in a way that allows the developer to add more stores with no limits and also allowing the store owner to always upgrade and modifying the store without the need to redo all the work but simply by adding more separated meshes that fulfill the new version of the store. Also in the future, the application is aiming to be user friendly in a way that will allow basic smartphone users to scan using their smartphone camera which will generate a 3D model in a .obj format that can be used in the 3D environment which will help in updating and improving the virtual environment without the need of redoing all the work from scratch and will also prevent from duplicating the work with a smaller cost and more fun technical solution that will help the application improve in a high pace.

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