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3D Virtual Reality

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Introduction

The multimedia technology of a virtual reality system has already entered our life with popular computer hardware and network. The most extensive input equipment of virtual reality is keyboard and mouse at present. Both devices really bring very great convenience to computer science and technology. Whether other different choices are suitable for virtual reality application. [1]

Here, we are going to see certain types of VR present in the world. Like WebVR, VR in advertisements and VR for interior designing. We have also included different gadgets for VR, with the challenges present and the advantage and disadvantages.

3D Virtual Reality

What is VR?

It requires physical and mental immersion, and it offers interactive behaviour and sensory stimulation (Sherman and Craig, 2018, p. 58) [2]. How does VR (Virtual Reality) work? Nowadays, everything is influenced by virtual reality in different areas including gaming, travelling to even far galaxies, advertisement, interior design even up to web VR by the aim of virtual reality headset make you think the considered matters such as the HTC Vive and Oculus Rift, to more affordable choices like smartphone-based headsets and even Play Station VR that is used by Sony consoles.

Gadgets used in VR:

The purpose of VR is the providing an environment in which everything seems so real to the people who experience the VR. Therefore, all the mentioned headsets and also additional hardware must provide such an environment that can be used in gaming, travelling, advertisements, browsing the web through web VR so on and so forth. For instance, by moving our heads, the perspective of the globe is altered instantly and accordingly. This fact must be simulated in the VR through the minimizing "time between the movement of our head, and the graphics updating to our new view." (Tustain J, 2018, p.22) [2]

The regarded latency that is called motion-to-photon latency must not be greater than 20 milliseconds. In order to speed up the latency, various techniques can be used such as using faster chips or using software techniques like Asynchronous Timewarp (ASW) in which latency can be improved by predicting what would be the next frame.

Another aspect that must be considered is the Field of View (FoV) that is everything you see in a specific moment. "FoV is measured in degrees, and human sees between 200 degrees and 220 degrees." (Tustain J, 2018, p.24) [2] However, even only about 110 degrees is supported by heavyweights headsets that is just above the half of real human's FoV that must be improved through using double convergent Fresnel lenses to reach 180 degrees FoV by Wearlity. Even a 210-degree FoV at 5K resolution is achieved by the Starbreeze Company by mounting two 1440 pixels panels side by side at an angle.

In addition, fast response time is considered as another aspect which must be implemented in VR headsets by using OLED (Organic Light Emitting Diode) panels to provide a real experience to the users of VR. The better image quality is achievable through high-resolution panels like what is offered by the HTC Vive and Oculus Rift. The mentioned headsets offered a resolution of 1080*1200 pixels for each eye in which a total resolution of 2160*1200 is obtained.

It must be noted that our eyes are not able to capture a consistent resolution across our FoV. You may notice that only a small portion of what you see is very clear to you that lead us to Foveated Rendering technique. As a result, ultra-high resolution images are shown in front of the fovea only.

Moreover, the frame rate is an undeniable fact that must be considered precisely due to brain's merging ability to put images together which is measured by the number of images are depicted to the eyes per sec in Hertz (Hz). 90Hz that is considered as minimum refresh rate for good

quality VR headsets to give you a sense of real experience. Even up to 120Hz is supported by the Sony PlayStation VR.

However, Lifelike VR experience would not be achieved without fluid tracking of head and body. As a result, VR headsets must be able to track your movements in VR to make a decision through various techniques such as Basic Tracking in XYZ axis up to Haptics.

Basic Tracking is supported by the even cheapest headsets but what if you want to have a complete VR experience like a Full-Body Experience which is now achievable through Hardlight VR suit. “Haptics,” is regarded as the artificial sense of touch which can be incorporated into gloves up to the above-considered suit. This suite consists of 16 haptic feedback zones in which every muscle group is targeted precisely that are suitable for VR Gaming.

Most of VR Tracking is confined within a limited range like what is offered by HTC Vive Tracking through 4.6 square meters that enables VR users to stand up, lie down and even jump in the mentioned size room. Nevertheless, in Next Generation Tracking VR users must not be limited to a confined space. In order to do so, motion tracking and depth sensing must be combined accurately in real time. One of the proposed techniques for depth sensing is measuring the transmit time a beam of infrared light and capturing its reflection. In this new tracking system, a user’s position must be extracted precisely. PICO NEO CV is the headset that uses gyroscope, accelerometer and a camera in order to do so.

Walking through exhibitions, libraries are the real senses that must be adopted through VR via Locomotion. Variety of software techniques and correspondent hardware allows us to “span vast distances in Virtual worlds while remaining within our small physical-world constraints." (Tustain J, 2018, p.38) [2]

For instance, ROVR allows us to move freely in VR on the Omni-treadmill. This can be achieved by utilizing special low friction shoes and adopted sensors. The information that is captured through the sensors and shoes are translated into user direction in VR.

To recapitulate, all the mentioned techniques consisting of both hardware and software techniques must allow a VR user to get involved in the 360-degree environment in which the user feels participation in a completely new environment.

Challenges for developing 3D VR software and hardware

There are some aspects that can be used to explain the challenges to develop 3D VR hardware and software. Firstly, the price of VR devices is too expensive to large-scale use in daily life, therefore, it needs to build a solution to integrate industrial chain to reduce cost. Abulrub, Attridge and Williams (2011, p. 7) mention that the cost is recognized as a key challenge. It seems that the cost is the biggest challenges for developing 3D VR hardware. For the hardware, VR devices need high-quality displays and too many sensors. Some of them are really expensive, this led to the high price of equipment that not everyone can buy it. The research and development of products and the requirements of product hardware require a huge investment by enterprises. For instance, the Virtual Reality helmets need to run in a high-performance

computer, these hardware facilities cost more than most people can afford. For the software, the company should pay a high cost in personnel costs and maintenance costs. In addition, some development engines may charge a high percentage of licensing fees. Although cost is the biggest problem that companies need to overcome, it could be solved with the maturity of the industry chain.

Another challenge for developing the hardware of VR is that the performance and power dissipation of the devices need to make great progress. Currently, the development of hardware level has not met the requirements of VR. Morton (2016, p. 2) states that hardware graphics seem to be a non-stop challenge, graphics rendering requires strong display and graphics card support. For example, the display of devices is very low-resolution, and poor graphics bring an uncomfortable experience. this caused some objects to look blurry in the VR world. The company of ARM also indicates some indicators of high-end VR user experience, such as the image refresh rate should reach 120 Hz, the screen resolution should reach 4K and the delay of graphics processing is less than 4ms. Calvert and Tan (1994, p.135) state that those who played a virtual reality for a while also feel dizziness and uncomfortable. This phenomenon may be caused by blurred picture quality and slow video refresh rates. In order to solve this problem, developers need to focus on increasing the quality of the picture and reducing the latency. It seems that if such problems can be solved, the quality of VR products will be greatly developed.

In addition, Interaction can be a complex way to design VR software. In the virtual reality world, interactive means users communicate with their surroundings. As more and more companies are investing in VR hardware, there are more and more different devices on the market. It becomes harder to develop software. Calvert and Tan (1994, p. 128) mention that deploy software on all virtual reality system can be an extremely difficult task. Different devices have their own interactive and specification. At present, Virtual Reality lacks industry standard, which leads to the incomplete development of the whole industry. Furthermore, A variety of complementary machines have emerged as the supplement of VR devices. It can be difficult to achieve a unified way of interacting in a short time. Some VR devices rely on the handle for interface selection and interactive operation, this mode of operation is cumbersome, it should be replaced by a flexible way. For example, by capturing motion to free user's hands. Importing the action of real hands into the virtual interface to achieve the operation of selecting the menu. This may increase the user experience.

WebVR:

Virtual Reality (VR) is the interaction by users with 3D models that behave like the real world. Virtual reality exploits the phenomenal visual skills of a man in the fields of pattern, structure and object detection in images for the analysis of abstract data or prospective designs. However, VR-based learning systems are not yet available on a large scale to support these processes in school environments, but it may be still possible to address these issues through what may term

degrees of ‘virtuality’. In examining the relationship between multimedia and VR, Hedberg and Alexander (1996) proposed that the defining attributes of VR could produce better interaction than multimedia. For this reason, the WebDeGrator system uses VR technology to advance the learning effect. WebVR technology has the potential to revolutionize the way we use the web. It allows users to experience VR through a web browser, and several companies have already developed WebVR apps. Here's how WebVR works [6].

Technology:

To build the project we can use A-Frame, an open-source framework for creating WebVR experiences [2]. The content is written in HTML, the work required for setting up a renderer, looping animation, and adding the controls with a single <a-scene> tag. The island model used in this tutorial was made with Google blocks for creating 3D models [2].

Code:

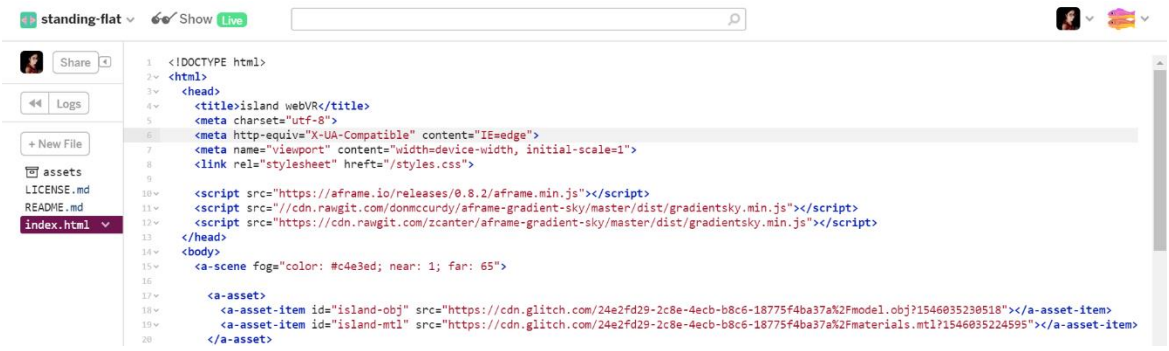

Figure 1: Part 1 Code WebVR

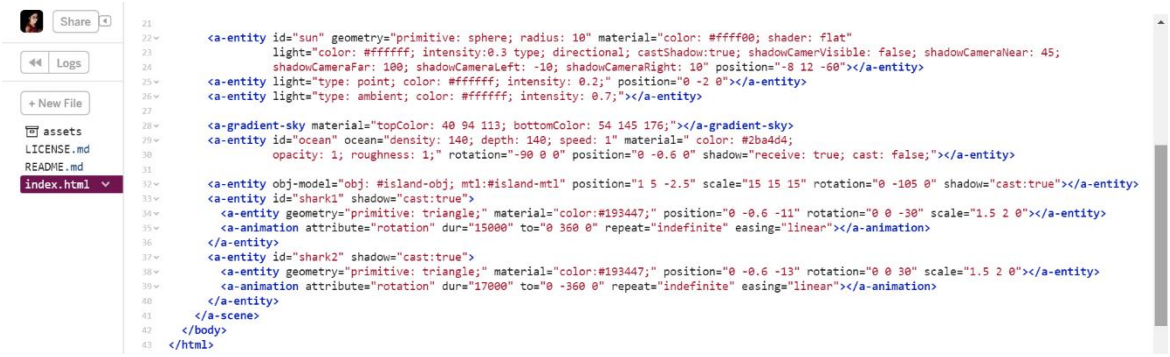

Figure 2: Part 2 Code WebVR

<a-gradient sky> and <a-entity ocean> are components built by A-Frame users, found at github.com/aframevr/awesome-aframe [2]. The sky’s bottom and top colour should be specified in RGB. All tags which are included in these scenes are called “entities”. The sun is made of an entity of a bright sphere which has geometry and material components so that it can render. By configuring light properties, we can generate real-time shadows in our scene with our model.

For 3D -island model we made in Google Blocks

URL: vr.google.com/objects/bZ67CTcq7ad.

These downloads consist of the.OBJ file which represents the 3D geometrics and the.MTL file which defines the colours used in the model. We need to import both the files into <a-assets>. At last for creating a moving object we need to add Animation. <a-animation> is attached as a child of the entity that we are animating. We rotate triangles elements (Shark) 360 with constant speed in animation. [2]

Output:(This output is without using VR gadgets)

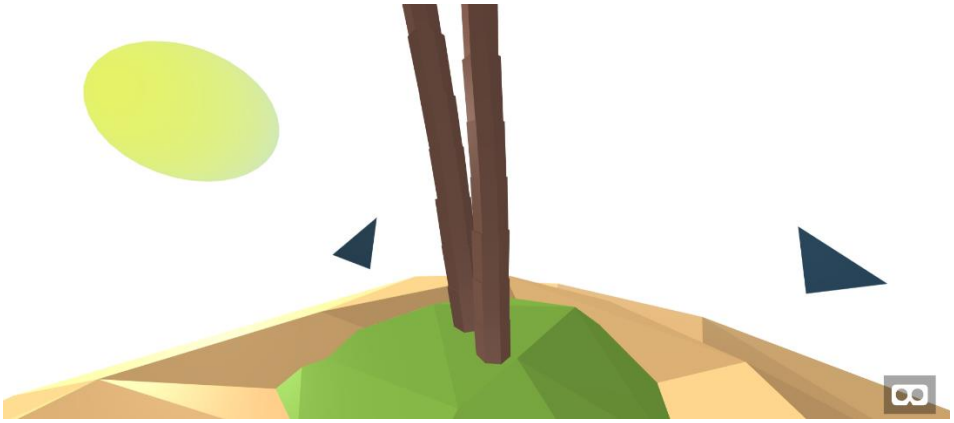

Figure 3: Output WebVR View1

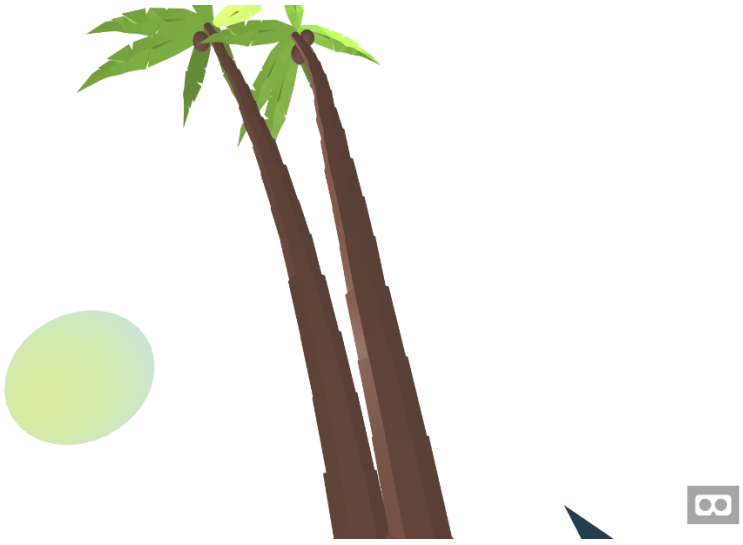

Figure 4: Output WebVR View1

URL: https://standing-flat.glitch.me

This was a single type of WebVR, their many technics to conclude WebVR like by using HTML for the 2D view, VRML for 3D multisensory experience and JAVA is used to control the behaviours within 2D- screen, 3D-screen and interactions with the user.

VR virtualization for Interior Designing:

The traditional interior design method is mainly to communicate with customers, and then draw 2D design drawings according to customer requirements, and finally carry out construction according to the designed scheme. This approach has many drawbacks, even if it is customer-centric.

For instance, there are usually some differences between language expression and visual expression. Although the designer and the client agreed at the beginning, but in the latter stage, due to the imagination, the objects can not coordinate cooperation in some way.Perhaps the color problem, or the shape of the item,even it may be related to Feng Shui.

Therefore, for these problems, the emergence of VR technology has solved them well.VR technology has become one of the most popular high-tech technologies in the world. VR technology is mainly to let people enter 360-degree visual content, thus create the impression in a variety of environments. VR is achieved with some devices, such as VR-specific devices (Oculus Rift or HTC Vive) and VR head-mounted displays (HMD).

It is amazing when VR technology is applied to interior design because people can wear VR equipment to complete home style they like. They can decorate their living room, kitchen, and bedroom in a virtual scene. This is a good alternative to the traditional 2D design approach. Moreover, people do not have to worry about the difference between the expectation and the reality.Meanwhile people can judge whether their ideal interior design is what they really want, which further improves the rationality of people's investment.

The most famous about interior design tools should be TrueScale developed by Immersion. It not only creates 2D floor plans and 3D models, but also creates a complete indoor environment at the same time. People can use it to design their house in just a few minutes, then experience it in their own designed scene. The reason why this interior design tool has such a powerful function is actually due to the room size technology of HTC VIVE[7]. With this technology, people can walk freely in a room-scale scenario and make real-time modifications to the design according to their actual needs. This allows the user to participate in the design process and give the user the design they ultimately want.

There is always an invaluable investment behind every successful technology, including human and material resources. And ultimately the winner of these advancements will be customers. For interior design, everyone is always looking for a new environment, a new layout, new furniture. However, before the interior design has no VR technology, it is likely to become an unpleasant

process[8].

As for the future development of interior design virtualization, because the competition among new technologies and software developers and interior designers become more collaborative.The development direction of VR in interior design will be comprehensively developed to create greater commercial value and higher production efficiency.

VR in Marketing:

So far, about 75%big brands in the world have already mixed 3D VR in their marketing strategy, which is enough to explain virtual reality is very powerful and useful for marketing.

Diversified communication:

In the traditional advertisement, the user just can watch or listen no mater on television or broadcast but can not interact with the video. And now we know about new media communication which is called interactive propagation, that produced interaction based on their Communication methods such as social media but not content itself. However, the technology of virtual reality can change the present situation.

In future, maybe everyone can watch different advertising film. If the user is interested in the product or just like the plot, he or she can stay in the story 10 minutes or even half an hour. And if you do not like it, you also can just stay in that a few seconds. That totally depends on the selection of customers. Under these circumstances, the medium has become less important for brands, because customers will only be attracted by the content of the advertisement.

The results of the study demonstrated that “advertising in Virtual Reality was between 1.5 and 18x more effective than more traditional video advertising” [9]. That means customers have higher opportunities to be impressed with your products and make a decision about purchase through 3D virtual reality. This is mainly due to the achievement of immersive experience without the disturbance of surroundings and establishes emotional connections. For example, customers can fit on in virtual environments, like eyeglasses, clothes, watches, shoes and so on.

Technology improvement:

In the early stage, they played videos to participants for exercise simulation shop, and collect data from interview and investigation. But now the technology of virtual reality can record information about the action of customers accurately. Because participants can see the same products with a real shop in mimic shop, and they can check the information of products and put it in a shopping basket or not and so on like that do in real stores. Moreover, there are some methods such as Amazon Sumerian to make VR marketing easy. Businesses do not need any professional knowledge about coding or 3D graphics, they can build highly immersive and

interactive environments with hardware like Google Daydream, HTC Vive, HTC Vive Pro and so on [10].

What are the other benefits of VR:

As is known to all, there are so many factors that affect people to make the decision about what they will buy. For example, some people may buy something they did not want to buy just because they happened to see them. This requires a lot of precise research. The technology of virtual reality is able to provide this kind of research. Unilever made their product shape design and shelf settings rationalize through eye tracking software.

Despite the high cost, in the beginning, the preparation time is long, once the preparation is completed, the system can be used repeatedly. That makes the use of virtual reality technology economical and efficient in the long term. Businesses can test as many times as they want in different practical scenes based on the minimum risk. In this case, they can get rid of many problems before investing a lot of money and grasp all control over testing. By the way, in this respect, it is cost-effective as well.

As a marketing tool, VR still has a giant space for development, whether in terms of technology or marketing concepts or equipment. But in view of the trend at present, virtual reality will play a vital role in marketing in the future.

The advantages of Virtual Reality Technology

Virtual reality technology adopts closed display mode, which can realize three-dimensional stereoscopic effect by outputting different images with parallax angles to the corresponding screens of two eyes. In this way, while ensuring the output of high-quality video images, the input cost and operation difficulty of various stereoscopic video display modes have been greatly reduced. For example, the red-blue difference picture overlay method will greatly reduce the brightness of the picture and affect the picture colour, the active shutter mode is costly and the video format is complex, and the polarized glasses have too much influence on the picture brightness. The Nintendo 3DS handheld game machine uses the prism shape. The screen requires too much line of sight.

Using commercial-grade virtual and augmented reality devices with applications created with game engines such as Unity and Unreal Engine could bridge the gap between research and personal use of these devices [11].

1. Immersive experience reduces external interference and reluctantly enters the senses. Entirely enclosed media experience reduce the range users need.

The condition around the environment greatly succumbs to the user's experience of sharing. Moreover, users can totally immerse themselves in the virtual space. Wherever the line of sight

is, the picture is also moved synchronously through the head tracking module to the viewing angle position being viewed. Users will be visually more free than ever before.

2. Virtual reality technology allows content to break through the boundaries of the rectangular screen from experience.

Traditional media content is limited by the rendering carrier and is often limited to a limited rectangular range. The experience of a series of typographical rules developed on this basis is also to balance the relationship between content, primary and secondary, and single presentation space. For example, the grid system for printed matter layout, X, y, w, h pixels (px, pixel) positioning in digital media layout, div layout, table layout, left and right floating, infinite paging, etc.

Virtual reality technology's head-mounted display screen actually presents an open virtual space for the user, and the three-dimensional space completely breaks through the boundaries of the original two-dimensional screen. The original rectangle-based media layout rules will shift to layout rules that are important to the user's perspective and virtual environment. The traditional visual composition, visual process and other visual communication design knowledge will inevitably have a new breakthrough when combined with virtual reality technology. These breakthroughs have greatly expanded the possibilities of various media content presentations and brought unprecedented imagination to practitioners in the media field.

CAE technology can be widely used in many areas of the national economy, such as various industrial construction projects, such as the construction of factories, roads, railways, bridges and tunnels. CAE technology is a multidisciplinary integrated technology involving many fields.

VR systems can be viewed as a natural extension or enhancement to current CAE systems, although very different methods to visualize and manipulate the underlying [12].

The disadvantages of Virtual Reality Technology

In the virtual reality technology, the head-mounted device makes the distance between users' eyes and the screen so close. So the problems such as myopia and visual fatigue will become more apparent. Most of the head-mounted display devices correspond to a relative display, and every device plays a parallax screen, producing a strong visual stereoscopic effect. Such a nonnegligible effect enhances the visual influence of the media and magnifies the 3D stun. For example, the HMZ-T3W head-mounted display produced by SONY, although the visual effect is outstanding, many users report that the discomfort of the head and eyes will gradually increase after wearing for more than 30 minutes.

On the other hand, although the visual display effect of much head-mounted devices is currently the effect of simulating a 2m-distance huge screen, the physical device is only a few centimetres

from the eyes. Which is, although the user feels that the distance from a giant screen is 2m away, actually they stare at a very small screen, so if users use it for a long time, it will greatly decrease the visual fatigue, and therefore harm the eyesight of users.

Conclusion

In conclusion, Virtual Reality will have an important impact on our life and business activities, especially in some commercial field like the essay mentioned in the above. For the Virtual Reality hardware, VR devices require higher refresh rates and better graphics to deal with dizziness, and according to Moore's law, this would be come true within a few years. Another aspect is VR software, there are more and more engines support the development of virtual reality. Many excellent applications emerge to enrich the ecology of the whole industry. Although this industry still has many shortcomings, both the software and hardware should make great progress. In the future, with the development of technology, there will be more manufacturers get into this field to promote the development of the industry.

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