

Virtual Reality

Sanni Hafiz Oluwasola¹, Ibrahim Munir Ayinde²

¹Lens Polytechnic, Department of Computer Science and Engineering, Km2 Irra Road, Offa kwara state- Nigeria

²Federal Polytechnic Offa, Offa Kwara State- Nigeria

Abstract: *Virtual reality: is the term that applies to computer simulated environment that can stimulate the physical presence in place of real world or imaginary world. All components of VR application and interrelations between them are thoroughly examined: input devices, output devices and software. This Paper will show how to use Virtual Reality to increase the business productivity, application in health sector, entertainment industry, military sector and other sectors. The paper explain different types of virtual reality, architecture of the haptic devices methodologies of the devices, algorithm and conclusion of the research.*

Keywords: Virtual Reality, telepresence, artificial environment, Immersive Virtual reality, Haptic, force feedback, kinesthetic, rendering, Augmented Reality, simulation, imaginary

1. Introduction

Virtual Reality is a combination of two words “virtual” and Reality. Is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accept it as real environment. It refers to high end user interface that involves real time simulation and interaction through multiple sensorial channels. Is an imaginarily world where user interact with it in real time to increase the realism.

VR is quite different. It makes you think you are actually living inside a completely believable virtual world. VR systems that include transmission of vibrations and other sensations to the user through a game controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming, online shopping, entertainment and military training applications. Virtual reality also refers to remote communication environments which provide a virtual presence of users through telepresence and telexistence or the use of a virtual artifact (VA).

Types of Virtual reality

- Immersive Virtual reality
- Desktop Virtual reality
- Projection Virtual reality
- Simulation Virtual reality

Immersive Virtual Reality: is the ultimate version of Virtual reality system that let the user totally immerse in computer generated world(virtual world) with help of (Multiple input and Output devices) Head mounted display (HMD) that support stereoscopic view of the scene, Fiber optics wired gloves, position tracking devices and audio system .

Augmented Reality. Is the variation of immersive virtual reality, where a see through layer of computer graphics is super imposed over the real world to highlight certain features and enhanced understanding. As example in medical sector where a surgeon can first practices a complicated surgery in virtual world where all the certain feature have

been highlighted before implementing it in real world surgery.

Desktop Virtual reality. Also known as window on world (WoW) system, this is the simplest type of Virtual reality, it uses a conventional monitor to display the images (generally mesoscopic) of the world.

2. Explanation of the Used Terms in the Paper

- Haptic:** is the term derived from Greek word “haptesthai” which means “sense of touch”. Haptic is a science of applying tactile sensation to human interaction with computers. It allow the user to feel and manipulate three dimensional virtual object with respect to such features as shape, weight, texture and temperature.
- Virtual environment:** is a computer generated model of a real environment. A virtual environment can be constructed as an exact replica of the real environment or can be a highly simplified reality. Regardless of its complexity, however, there are two completely different ways of interaction between the environment and the haptic interface. Environment may behave as impedance, where the input is the velocity or position and the output force is determined based on a physical model, or as an admittance, where the input is force and the output is velocity or position.
- Force Feedback:** relating to the mechanical production of information that interact with the human kinesthetic system (muscles, Joints and tendons) that gives the human sensation of force being applied with hardware of touch and feel through tactile vibration or force feedback.
- Tactile:** Feeling of kinesthetic (motion).
- Tactile Feedback:** it makes use of devices that interact with the nerves ending in the skin to detect whether user is in contact with object in virtual world and indicate heat, pressure and texture.
- Cutaneous:** it indicate sensation of pressure, pain and temperature.
- Haptic interface:** is the interface that allow user and machine to communicate.
- Haptic perception:** the process of perceiving the characteristics of objects through touch.

- i) **Tele-haptics:** is the process of sending the information from virtual world and real time through a network medium such as internet
- j) ***Haptic rendering:** the process of calculating the sense of touch, especially force. It involves sampling the position sensors at the haptic device to obtain the user's position within the virtual environment. Haptic rendering is, therefore, a system that consists of three parts, a collision detection algorithm, a collision response algorithm, and a control algorithm.

k) Telepresence/Teleoperation

The concept of cyberspace is linked to the notion of telepresence, the feeling of being in a location other than where you actually are

l) Gloves

Gloves are 3D input devices that can detect the joint angles of fingers. The measurement of finger flexion is done with the help of fiber-optic sensors (e.g., VPL DataGlove), foil-strain technology (e.g., VirtexCyberGlove) or resistive sensors (e.g., Mattel PowerGlove). The use of gloves allows the user richer interaction than the 3D mouse, because hand gestures may be recognized and translated into proper actions [Mine95a]. Additional gloves are equipped with a tracker that is attached to the user's wrist to measure its position and orientation.

- m) **Software:** beyond input and output hardware, the underlying software plays a very important role. It is responsible for managing of I/O devices, analyzing incoming data and generating proper feedback.

According to [Heil 92] examining contribution of human sense

Sight	-	70%
Hearing	-	20%
Smell	-	5%
Touch	-	4%
Taste	-	1%

Based on the analysis version contain the most information pass to brain down to taste based on the chart. This paper will focus more on application of virtual reality especially in business.

n) Prototype designing

VR technology to build virtual prototypes of new vehicles, systems, houses or any form of devices, testing them thoroughly before producing a single physical part. Designers can make alterations without having to scrap the entire model, as they often would with physical ones. The development process becomes more efficient and less expensive as a result.

o) Application in Health

It is used to train medical student and some institutions using the computer-generated images for diagnosis and treatment. Virtual-reality simulations, such as those created by software companies Surgical Theater and Conquer Mobile, use actual diagnostic images from CAT scans or ultrasounds to construct 3D models of a patient's anatomy. The virtual models help both new and experienced surgeons determine the safest and most efficient way to locate tumors, place surgical incisions or practices difficult procedure ahead of time. Beyond surgery, virtual reality could also serve as a cost-effective and engaging tool for rehabilitation. Stroke

and brain injury victims across Europe can now use an immersive virtual-reality therapy created by Mind Mazeto regain motor and cognitive function faster than with traditional physical therapy, according to the company. The virtual exercises and real-time feedback in Mind Maze are made to feel like games, helping to motivate patients to practice everyday activities.

p) VR in the film industry (Entertainment)

For the film industry rather than just being a spectator looking at the screen you could feel, see and hear what is going on around you. Other sensory tools could also be added such as smells and more intense touch such as soft, cold, hot to give you a more realistic experience. In the medical field it could enable training practitioners to perform surgeries and medical care before they are introduced to real patients. The possibilities for the future of virtual reality are endless.

q) Military

The military have long been supporters of VR technology and development. Training programs can include everything from vehicle simulations to squad combat. On the whole, VR systems are much safer and, in the long run, less expensive than alternative training methods. Soldiers who have gone through extensive VR training have proven to be as effective as those who trained under traditional conditions.

r) Museums

Virtual reality could add a lot of culture to our lives. The technology could instantly transport users to the Louvre in Paris, the Acropolis in Athens and the Guggenheim in New York City, all in one day. In fact, a number of museums have already collaborated with developers to create virtual spaces where people can experience the museums' physical collections. Last year, the British Museum in London launched its first virtual-reality weekend and the American Museum of Natural History in New York City made some of its collections virtually accessible through Google Cardboard. Anyone with a smartphone and a Cardboard VR headset can now take a tour of the museum

s) Driving equipment design and innovation

Another popular use is sports manufacture: virtual reality is used in the design of sporting clothes and equipment, e.g. running shoe design. Innovation is a key factor in this industry as the bar is raised higher and higher in terms of sporting achievement. Sportspeople are constantly looking at ways of gaining them that edge which can mean being faster, stronger, better endurance etc. They are constantly pushing boundaries as regards what their bodies can do which drives the sports clothing and equipment industry. This industry has to keep pace with this constant drive for sporting perfection and using the very latest technology to do so.

t) Space

NASA's been using VR for years, especially in training situations. One recent use has more to do with improving the quality of life and mental health of astronauts on longer term missions. The idea is a Virtual Space Station, which would be "a set of interactive behavioral health training and treatment programs with support from NASA's National Space Biomedical Research Institute," according to a release. And

Dartmouth's Digital Arts Leadership and Innovation lab got a \$1.6 grant for the project

u) Crime scene:

Forensic and crime detector has been more active by collection of image of the crime scene and arrange in 360 degree virtual environment and reproduce the crime scene by Waldo world.

3. Application in Business

Virtual reality can be brought into online businesses to increase the efficiency of the business and make the buyer more comfortable about the product. The buyer will develop an interest when it view the virtual product in a realistic way such as testing of the product by touching to feel the texture, pressure, smell, sound, temperature etc. The interesting part is that the buyer will not go for online shopping that he/she will confirm the authenticity of the product after delivery, right way the buyer can travel into virtual environment to confirm the authenticity

3.1 VR in Business

Real estate management. A buyer can confirm the nature of the house from images and videos but with VR, buyer can travel into virtual space to confirm the nature of the house by touching to feel the texture of the building, buyer can enter the rooms etc. with virtual reality Real estate Manager will gain the client attention more.

Vehicles Dealer. Buyer can travel into a virtual space to test the car he/she want to buy, he/she can drive the vehicle in the virtual world and feel the temperature of the engine,

texture of the inner part of the vehicle, the sound of the engine and every part without being there in real world. With all these method of testing the buyer will get confidence on the product he/she want to order for.

Other online stores such as Ali express, Jumia, Kongaetc can bring the VR software into business where a buyer will have a confidence on the product he wants to make payment for online or place order for, is possible for buyer to like the color and appearance of a cloth but on delivery of the product he/she may not like the texture of the cloth but with VR software buyer can feel the texture before placing the order such as taste of the product which can be done in virtual environment.

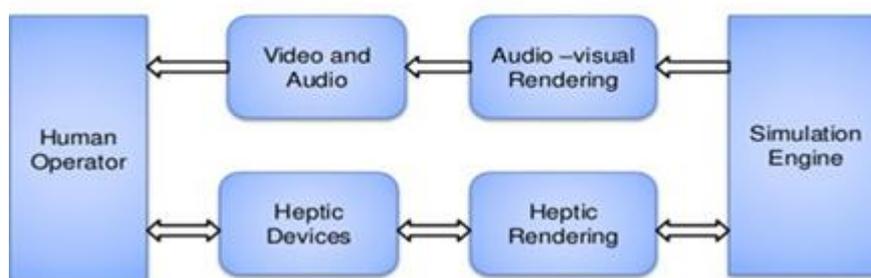
Implementing VR software will increase the business productivity since it will increase the customer rate of order.

There is no doubt with the fact that virtual reality holds immense potential to transform our lives for the better. With the gaming industry reaping huge benefits from the world of virtual reality, its impact has spread in other domains as well. One of these domains is healthcare and medicine.

The kind of three-dimensional, immersive experience that virtual reality provides is highly beneficial for Business owner. In fact, it has been estimated that by 2020, the global market for virtual reality will reach \$3.8 billion with no chances of it slowing down.

In addition to the above scenario, there are a number of situations where the implementation of virtual reality can solve a number of major problems in the businesssector.

Architecture of the device



4. Methodology and Analysis of this technology

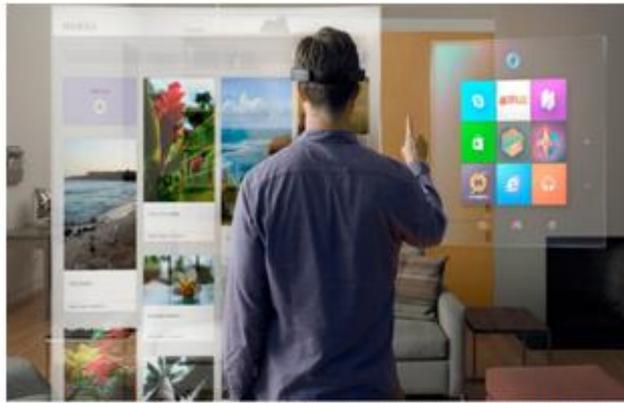
User will enter into the virtual world with aid of Haptic devices that contain 3D demisional input and output device such as Glove that can detect the joint angle of the user finger. It will measure the finger flexion with help of fiber optic sensor, the glove also contain the tracker that being attached to user wrist to measure it position and orientation, there is a software program (Haptic interface) that relate all the hardware component to the user and An algorithms such as collision detection algorithm, Response algorithm and control algorithm. The haptic device contain a force feedback that interact with muscle, joint and tendons that gives the human sensation of pressure, temperature or texture. i.e user will feel all the sensation of the object in Virtual environment. The part of haptic device called haptic

rendering will calculate the sense of touch by obtaining the user position within the virtual environment and Actuator will read the data sent by the haptic rendering and transform it into perceivable information by human. The user will now completely immersed in that world and believe he/she is in the virtual world this process is called telepresence. All the data that Actuator has converted into perceivable information will now be compressed to reduce the size of the information without losing any content (Data compression) and it will now be forwarded to user in the real time with aid of tele-haptic, the part of haptic devices responsible for transmitting the sensation from virtual environment and real time vice versa.

5. Images representation of virtual reality



Virtual training exercise



Virtual shopping right in your home, user travel into virtual space right in his home



Virtual gaming



Heart surgery training by medical student with Virtual reality



NASA's been using VR for years, especially in training



Virtual reality devices



VR technology to build virtual prototypes of new vehicles



Virtual reality stadium lets distant friends watch the game together

6. Conclusion

By continuing to advance this technology, virtual reality can become more realistic, making its applications more sophisticated. Military trainees would be able to pick up objects in the virtual space. Likewise, doctors could interact with their patients on a physical level during simulations. As such, it is my opinion that such technology as the Wolverine Haptic Device is a reasonable way to improve upon virtual reality and make it even more engaging. The technology of virtual reality is advancing rapidly and it won't be long before it becomes a most exciting source of entertainment, online shopping and put 'touch , feel' into long-distance relationships in our homes in nearest future.

References

- [1] Ma and Payandeh (2010). Analysis and Experimental Study of a 4-DOF Haptic Device, *Advances in Haptics*, Mehrdad Hosseini Zadeh (Ed.), InTech, DOI: 10.5772/8687
- [2] Dr.R.V.Krishnaiah, PG-Coordinator, DRKGI, Hyderabad.HAPTIC SCIENCE AND TECHNOLOGY, *International Journal of Computer Engineering & Applications*, Vol. II, Issue I/III (2013), PP-139-146
- [3] Guido Böttcher, Dennis Allerkamp and FranzErichWolter. Virtual reality systems modeling haptic two-finger contact with deformable physical surface”, *IEEE Trans.OnCyberworld*, 2007.
- [4] Mihelji, M., Podobnik J. *Haptics for virtual reality and teleoperation*. Hardcover p216,2012 ISBN:978-94-007-5717-2
- [5] CyberTouchGlove, CyberGlove Systems Inc. <http://www.cyberglovesystems.com/cybertouch/>. Last accessed April 8, 2017.
- [6] Tomasz Mazuryk, Michael Gervautz, “Virtual Reality History, Applications, Technology and Future”.Institute of Computer Graphics
- [7] PACCHIEROTTI, C., T IRMIZI, A., AND PRATTICHIZZO. Improving transparency in teleoperation by means of cutaneous tactile force feedback, *CM Transactions on Applied Perception*, 2014.
- [8] Hilary McLellan, *VIRTUAL REALITIES*, MCLELLAN WYATT DIGITAL
- [9] Mark Paterson (2006) *Environment and Planning D: Society and Space*, volume 24, pages 691 -708
- [10] <https://filmora.wondershare.com/virtual-reality/uses-of-virtual-reality.html>Last accessed July 8, 2017
- [11] <https://www.livescience.com/53392-virtual-reality-tech-uses-beyond-gaming.html>Last accessed July 8, 2017
- [12] <http://electronics.howstuffworks.com/gadgets/other-gadgets/virtual-reality6.htm>Last accessed July 8, 2017
- [13] <http://www.techrepublic.com/article/9-industries-using-virtual-reality/>Last accessed July 8, 2017
- [14] <http://www.aect.org/edtech/ed1/15/15-03.html>Last accessed July 8, 2017
- [15] <https://www.gamerbolt.com/gimmicky-virtual-reality/>Last accessed July 8, 2017
- [16] <http://www.4tecdirect.com/4tec-blog/Virtual-Reality-Technology-of-the-Future> Last accessed July 8, 2017

- [17] <https://www.raconteur.net/technology/what-is-the-difference-between-augmented-and-virtual-reality> Last accessed July 8, 2017
- [18] <https://www.raconteur.net/technology/what-is-the-difference-between-augmented-and-virtual-reality> Last accessed July 8, 2017
- [19] <http://www.designboom.com/technology/immersive-virtual-reality-entertainment-system/> Last accessed July 8, 2017
- [20] <https://www.springwise.com/virtual-reality-stadium-lets-distant-friends-watch-game-together/>
- [21] <http://www.broowaha.com/articles/26193/impact-of-virtual-reality-on-healthcare>Last accessed July 8, 2017
- [22] https://en.wikipedia.org/wiki/Virtual_realityLast accessed July 8, 2017
- [23] <https://www.slideshare.net/kirbadh/haptics-46251816>Last accessed July 8, 2017
- [24] <https://www.slideshare.net/anjaliashah/haptic-technology-10570739>Last accessed July 8, 2017
- [25] <https://www.springwise.com/virtual-reality-stadium-lets-distant-friends-watch-game-together/> Last accessed July 8, 2017

Author Profile

Mr. Sanni Hafiz Oluwasola received degree in BSc. Information technology, Kebbi State University of Science and Technology, Aliero, Kebbi State Nigeria.

Mr. Ibrahim MunirAyinde did MSc. Computer Science, University of Ilorin, Ilorin Nigeria.