**A COMPARITIVE STUDY OF AUGMENTED REALITY AND VIRTUAL REALITY DURING PANDAMIC SITUATION**

**What most excites about augmented reality’s future is its role in the arts. It has heaps of potential in this way, to scale cultural experience and make it accessible to broader audiences at lower costs. Augmented reality (AR) refers to technology that incorporates real-time inputs from the existing world to create an output that combines both real-world data and some programmed, interactive elements which operate on those real-world inputs. the technological advantages of virtual reality, primarily focusing on the possible applications of this technology in the educational sector and the necessity of utilizing it during times of pandemic when regular remote learning is hindered. Pandemic created many issues and its influence on the educational system is particularly concerning. The conventional methods of education have come to a standstill and students are suddenly pushed into a world of computerized learning, which is inadequate for providing a wholesome and effective learning experience. At a time like this, we should maximize the resources available and implementing virtual reality in education will enable students to learn by getting a perception of the real-world objects rather than what is presented on a computer screen. (AR) has established a definite zone in fields like entertainment, marketing, education, and many and many more. The use of AR apps in the enterprise have grown to $2.4 billion in 2019. So here is a comparative study of Augmented Reality and Virtual reality**

***Keywords—Virtual reality, Education, Oculus Rift, Wired Glove, Augmented reality***

**I INTRODUCTION**

With the existing social distancing norms and worldwide lock downs and travel ban, our world has confined into four walls and especially to various sized digital screens. They range from home theatres, PCs, Laptops, tablets and our small mobile screens. From elder to younger everybody is longing for better experiences from these screens. There has been a huge technological boom in past two years. Developers and investors are working towards enhancing the digital experience. There is a huge demand in the field of education, medicine, gaming and entertainment. Distant education was never thought to come so near to us. Gaming sites is running a race to give their players the best experiences. AR (Augmented Reality) and VR (Virtual Reality) is a general topic for discussion like never before. Surveys shows that AR and VR based studies increased in the past five years and sufficiently even more in the past two years.

Virtual reality is an environment that consents the physical presence of the real world to each user. The definition of virtual reality is that it is an environment generated by a computer which mimics reality by means of interactive devices that send and receive information and are used as goggles, headsets, gloves, or bodysuits. The delusion of being in the shaped environment is acquired by motion sensors that pick up the user’s movements and alter his or her vision accordingly. Using different methods of VR and artificial experiences a replication of the real-world environment can be reached. Not only vision but other senses like touch, smell, and hearing will be made possible. Head Mounted Display devices allow vision of 360-degree in a virtual environment. VR came into being from the 1950s. The Sword of Damocles [1] is known as the first virtual head mounted display system invented in 1968 by Ivan Sutherland a computer scientist and one of his students Bob Sproull.

# **II VIRTUAL REALITY IN EDUCATION**

Virtual reality creates a virtual atmosphere for learners where they can develop their skills without any real-world consequences of failing. They can change from a two-dimensional view of objects to three dimensional experiences where learning becomes easier. Primary education, anatomy teaching, military, astronaut training, flight simulators,miner training, architectural design, driver training and even bridge inspection has been applicable by virtual reality. VR enables engineers to see prototypes in a virtual manner. Expanding remote training methods with virtual training systems is becoming useful in military, engineering and healthcare training.

VR technology implemented in classes creates the advantage of concentrating on things in front of the eyes with much attention and also provides interaction with live study materials and excludes any potential side stimuli. This technology can make books, lectures and exercises more interactive and immersive thus becoming an ultimate solution for seizing the attention of students. Benefits seen using virtual reality learning techniques are:

### **a.VR and distant education**

Virtual reality applications in school education allow students to take part in any classes from anywhere on Earth. Different technologies like rumii, Engage, AltSpace allows students enroll in different courses or to join different groups acquiring knowledge and practical skills.

### b.**Training and Vocational Education**

Technological applications like [zSpace](https://zspace.com/) provide a virtual environment which allows technical training for students in specialized manner

### **c.Education for specials**

VR in school education provides aids for special students. Technology called Near Sighted VR Augmented Aid helps students with vision problems. SignAloudGloves allows such students to communicate within a virtual environment using sign language.

### **d.Determine Future Careers via VR**

Creating virtual environment in education benefits students to determine their future careers with “Google Expeditions”. It drives through an individual expert's workday, duties or career paths.

# **III VIRTUAL REALITY DEVICES**

Development in technologies has brought different specific devices for enhancing the use and working of Virtual Reality (VR). Here we mention some basic descriptions about the highly advanced and most frequently used technology devices with VR, these devices are popular devices in the market.

## **3.1Head Mounted Display**

While talking about VR, an image comes to our mind of someone with a device on his head, covering his eyes. Many Head-Mounted Displays (HMDs) are used and purchased from our market. Some devices have solid displays and tracking systems that enables its user to visualize 3D images/videos through a virtual medium and consists of a virtual camera which moves according to the user’s head movements. [10][2] Commonly used HMDs are:

### **3.2Oculus Rift**

The Oculus Rift is a headset device which is used repeatedly and is focused on gaming and learning purposes. It comes up with an extended view, in-depth vision, and fast head movement detections. It works by processing data which is observed through a 3-axis gyroscope, accelerometer and magnetometer, which gives the user a fast and clear image, without any delays. It is having innovative maintenance and improving technology day-by-day. [2] Four years after introducing oculus rift to the market, the first market introduction was launched in early 2016 and sold initially from the official Oculus VR website which gradually made its path in the market between retailers and users from different parts of the world.

**3.3Cave**

Cave Automatic Virtual Environment also known as CAVE is a room used for visualization, mainly to set up a virtual reality environment and creates much experience virtually. Many projectors cover the walls of a room with stereoscopic images and the user has to use head mounted devices or glasses which coexist to various alternating images through projectors and speakers that are placed on all corners of the room to deliver a better high-quality sound [3]. The device named ImmersaDesk was developed and created for the CAVE.

## . **3.4 Input Devices**

The usual perspective to input data in VR systems includes movement recognition. Having a device which reads senses and processes natural movements would change the human-computer interaction to a more instinctive way. The most commonly used data input devices associated to virtual reality is:

### **1) Wired Gloves**

A wired glove is a device which comes up with various sensing detectors and data input using human-computer interaction. A motion tracker is a magnetic tracking device which is connected to attain the position and movement of the glove. The movements get collected and analysed by certain software, so that these can be structured and developed into useful information to recognize signs or other symbolic languages. It senses the movement of hands and fingers to give instructions based on its movement.

### **2) Wands**

In wands the console has the ability to acquire the IR light by a sensor which is placed at the top/bottom of the television and has five emitters of infra-red in each of its sides. The console calculates the area between the console and screen so that the movement of the controller is measured by triangulation which denotes the distance between a certain point and the place where the controller reads the infrared to get information regarding the user movements.

## **3.5.Computer Vision**

The Microsoft Kinect is one of the most famous device technologies for computer vision. It is used by many industries, universities and hobbyists as it gives a perfect visualization technique through reverse engineering and particular motion sensors. [2] [18]

# **IV VIRTUAL REALITY APPLICATIONS**

virtual reality is a leading technology now-a-days and has many applications. For detailed studies main applications that are given below:

## **4.1 In Laboratories**

We know that virtual reality is a modern technology for experiencing the Real World (RW) virtually by computer-generated content on a particular range of a system or presentation. In the last few years, the applications of VR have changed the marketing levels and have got many users. It is portable and widely accepted and is now available on mobile and other technological devices. They can create a wide impact in laboratory purposes and for students who use these technologies for learning in an exciting manner. It can immerse the user into a virtual computer world, where you get a chance to visualize things much better and clearer.

In laboratories, this can be implemented in various forms of simulations and learning. VR helps in providing professionals use laboratories as an opportunity to experiment, evaluate studies and improve their skills and ideas in a safe and well-mannered environment. Also, the traditional scheme of education for engineering students is through lectures or seminars which are usually held in classrooms or halls. The verbal explanation along with use of educational tools like a white board, projectors and desktop or laptop lets the teacher to avail the digital materials such as slideshow presentation or multimedia projecting through a digital projector onto the white board will create a learning approach which is active from the instructor side but passive from the student side as described by Sampaio, et al. [14] So definitely use of such small methods can bring changes in students perspective to traditional education and VR can issue them much advanced and innovative method of learning.

Following points shows the importance of implementation of VR Labs :

* Ease of Learning
* Useful and futuristic design
* Continuous improvement and update
* Reduces installation costs
* Varied range of experiments
* Environmentally harmless

Based on some team research, it was found that last year Samsung India inaugurated their Samsung AR-VR Innovation Lab at IIT-Jodhpur, to train students on augmented and virtual reality and make them job-ready. This initiative has inspired in choosing VR over any other technology as it stays so close to the minds of learners and will benefit in the growing digital technology market and develop their talent.

They create an advantage for the universities, promote distance learning, and help students who need special attention or have disabilities. Utilizing this VR application, the basic need for laboratory works is shifted from being location-to device-oriented. If distance learners have the means to buy their own VR devices, they can absorb by experiencing the same level of education as full-time students on campus as detailed by M. Soliman. [15] VR Laboratories avoids any possible physical, chemical or biological waste that is produced as a final result of various experiments.

## **4.2 In School Education**

For education purposes, virtual platforms usually simulate the children in classrooms as we find that human beings learn different things by their experiences, interactions with their surroundings and by using senses to gather information from all around the world. Virtual reality gives an experience the same as in the real world by the sensory input created by computer simulations. It provides an interactive atmosphere by responding to the human acts and movement by the natural behaviours of humans in the real physical world. So, it verifies that VR is a powerful and useful resource that helps in teaching by visualizing things through a virtual environment that allows students to learn to experience various situations, which is better than creating imagination of various topics. The nature of VR systems derives from three sources: immersion, interactivity and multi-sensory feedback as explained by Chris. [4]

Now the virtual environment is more reliable than the real environment and it undoubtedly develops a better education system for students in primary, intermediate or higher secondary levels schooling. Virtual reality allows the user to build their ideas and critical thinking

Virtual reality is attempted in classrooms by following ways:

***a.* Augmented Reality**

Augmented reality (AR) is a technology which imposes virtually created images onto the physical real world. The visualization of the virtual objects in this real environment have encouraged and motivated students in experimentation and developments of things that are not applicable in this world. [13]A study done by Antonietti et al. (2000) found that by analysing some children through an in-depth virtual tour of a painting and allowed them to examine every characteristic of the painting made them understand by their description and interpretation of the paintings, compared to another group that studied the painting without using of VR. [6] This study conveys how learning by virtual visualization is better than any modes of education induced. Another experiment was carried out on primary students in sixth-grade where they used an AR application "WallaMe" which educated them on instructive methods in education of arts. After analysing the end result of studies, they found a great significant improvement in academic performance, gathering of information, collaborations and motivations. [13] According to Wikipedia use of virtual and augmented reality in primary education, augmented reality has developments for more mainstream academics. 3D customized and printed textbooks for students provide a more collective way of educating and evoking. The Institute for the Promotion of Teaching Science and Technology has launched a geology textbook which gives students a chance to learn traditional information of virtual interaction with the various layers of the earth's core.

**b. Virtual Field Trips**

Exploring field trips virtually, students can study and visit places as part of their education which is much reliable in this COVID-19 scenario. Virtual field trips help in developing learning simulations in students while experiencing the lessons. They could visit museums, historical monuments and to different regions through a complete virtual enhancement. Virtual field trips can also allow primary school students in rural areas to have an improved career exploration opportunity that’s hardly available for them. These experiences develop a growth in their interest and encourage them to pursue better careers and create a whole new world of intellectual learning and growth. Close visualization of objects which are difficult to find in this physical world improves their educational values.The main focus of the Virtual Field Trip at present is not to substitute the traditional field trip but to introduce students to the fundamental and basic skills needed to recognize the environment before going for the ‘real’ field trip. [16] This mode of field trips encourages the participation of the students and engages them in the virtual environment with their instructors or tutors.

## **4.3Astronomical Research**

A virtual world or virtual representation is used for many purposes, mentioning one among the many applications is for space representation and for studies regarding astronomy. Creating a virtually visualizable world where researchers and scientists can inspect and study about various astronomical objects and notice various studies. NASA has been using VR technologies from past decades and primarily used for training astronauts before flight and visualizing the take-off. Apart from scientists, for students it creates a development in imagination and aids in sighting the space from our world. The most notable feature of VR is the immersion. The immersive characteristics of Virtual Reality Learning Environment (VRLE) utilizes role playing and learning by much interactive experience on learning main science and astrophysics. To enhance immersion through VR, we can wear stereo glasses to see the 3-Dimensional visuals or we can use a 3D head mounted display (HMD). [9]

This empowers students to study and get further concepts about each planet, celestial bodies, comets, galaxies and several other astronomical objects.

The idea for the study was for their Virtual Solar System programs. The scholars were supposed to learn about our planet Earth and its Moon system and the characteristics of the orbits. Then after presenting the virtual solar system visualization and many other class activities, they tested the students' knowledge developments and noted the students' suggestions and reviews on the virtual solar system program and IVRS. [8]

## **4.4 Medical Informatics and Technology**

The medical need for virtual reality is developing frequently, and the ideology has changed from a basic research level to a complete clinical area for health informatics and for various other developments. [11][5]

The practice of virtual reality in training for different medical groups embraces diverse aspects. In some cases, virtual reality is effective. VR can help with the study of gynaecology and obstetrics which could show much on the growth of infant and maternal health. Image guided surgery is another application where virtual and actual objects are fused into a single plot, calling for virtual and AR techniques. [17]

**V DIFFERENCE BETWEEN AR AND VR**

Augmented reality (AR) is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology. [4] It holds the promise of creating direct, automatic and actionable links between the physical world and the electronic information. It gives us a simple and immediate user environment to a technologically enhanced physical world. AR goes beyond mobile computing and it act as a connecting link between virtual world and real world. An AR system must have the following three characteristics:

* Combines real and virtual
* Interactive in the real time
* Registered in 3D

Where as in a Virtual Reality, a user is placed inside a completely computer-generated environment. [5] Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience, where, instead of viewing a

screen in front of them, users are immersed and are able to interact with 3D worlds. By simulating as many senses as possible, such as vision, hearing, touch, even smell, the computer is transformed into a gatekeeper to this artificial world. The only limits to near-real VR experiences are the availability of content and cheap computing power.

**VI FUTURE OF VIRTUAL REALITY**

Looking more towards the future developments of VR, we can see that it’s still advancing technology which is capable of transforming the educational, business, and medical system.

There are a number of proven advantages of using VR expertise in education. Firstly, VR enables an outstanding visualization, which might not be possible to obtain in normal traditional classrooms. This reflects the world of thoughts and minds of our future young generations and finds it comfier. It’s making everybody be anywhere they want to discover, despite their status, financial backgrounds and inability to be a part of various educational methods. It allows virtually accessing unlimited resources, information, books or articles. These modern technologies should be accessible and implemented in classrooms and based on our current scenario where students struggle in traditional methods of learning practice and find it hard to understand various lessons and practical skills. Throughout this pandemic and remote learning situation, introducing these technologies to curriculum could easily help students in effective learning and also increase engagement, cooperation and their involvement in studies. It will help undergraduates in using this mode for highly efficient technique of learning, which encourages self-study and individual pursuit of knowledge. [7]

**VII CONCLUSION**

Everyday technology is bringing drastic deviations to our world and virtual reality is one among them. It can rise to the next footstep towards development in future. VR technologies should be increased to higher levels as it helps to level up the social, economic and educational status in our lives. The method of bringing virtual worlds or objects to the actual world just in front of us and visualizing them through machines from anywhere is mysterious. Virtual reality makes it possible for us. As more technologies use this growing trend, augmented reality application may certainly grow to include much more than what it does now, but by understanding the users’ needs and wish, developers and designers will then be able to create a successful and efficient augmented reality.And how its expansion in the market leads to a promising fast-growing technology for future generations throughout their life.

Reference

[1] Gigante, Michael A. “Virtual Reality: Definitions, History and Applications.” Virtual Reality Systems, 1993, pp. 3–14., doi:10.1016/b978-0-12-227748-1.50009-3.

[2] Boas, Y. A. G. V. "Overview of virtual reality technologies." Interactive Multimedia Conference. Vol. 2013.

[3]C. Cruz-Neira et al.: The CAVE: Audio Visual Experience Automatic Virtual Environment. Communications of ACM, Vol. 35, No. 6 (1992)

[4 ]Christou, Chris. (2010). Virtual Reality in Education. 10.4018/978-1-60566-940-3.ch012.

[5]<https://www.marxentlabs.com/what-is-virtual-reality/>

[6] Antonietti, Alessandro & Cantoia, Manuala. (2000).To see a painting versus to walk in a painting: an experiment on sense-making through Virtual Reality. Computers & Education. 34. 213-223. 10.1016/S0360-1315(99)00046-9

[7] Kamińska D, Sapiński T, Wiak S, Tikk T, Haamer RE, Avots E, Helmi A, Ozcinar C, Anbarjafari G. Virtual Reality and Its Applications in Education: Survey. Information. 2019; 10(10):318. <https://doi.org/10.3390/info10100318>

[8] Lee, H., Park, S., Kim, H., & Lee, H. (2005). Students' Understanding of Astronomical Concepts Enhanced by an Immersive Virtual Reality System (IVRS).

[9] Lee, H., Park, S., Kim, H., & Lee, H. (2005). Students' Understanding of Astronomical Concepts Enhanced by an Immersive Virtual Reality System (IVRS).

[10] Parmaxi, Antigoni, et al. “Leveraging Virtual Trips in Google Expeditions to Elevate Students’ Social Exploration.” Human-Computer Interaction – INTERACT 2017 Lecture Notes in Computer Science, 2017, pp. 368–371., doi:10.1007/978-3-319-68059-0\_32.

[11] Riva, G., Bacchetta, M., Baruffi, M., Borgomainerio, E., Defrance, C., Gatti, F., Galimberti, C., Fontaneto, S., Marchi, S., Molinari, E., Nugues, P., Rinaldi, S., Rovetta, A., Ferretti, G. S., Tonci, A., Wann, J., & Vincelli, F. (1999). VREPAR projects: the use of virtual environments in psycho-neuro-physiological assessment and rehabilitation. Cyberpsychology & behavior : the impact of the Internet, multimedia and virtual reality on behavior and society, 2(1), 69–76. <https://doi.org/10.1089/cp>

[12] Rafael Villena Taranilla, Ramón Cózar-Gutiérrez, José Antonio González-Calero & Isabel López Cirugeda (2019) Strolling through a city of the Roman Empire: an analysis of the potential of virtual reality to teach history in Primary Education , Interactive Learning Environments,  DOI: [10.1080/10494820.2019.1674886](https://doi.org/10.1080/10494820.2019.1674886)

[13] Sáez-López, J., Sevillano-García, M., & Pascual-Sevillano, M. (2019). Application of the ubiquitous game with augmented reality in Primary Education. [Application of the ubiquitous game with augmented reality in Primary Education]. Communicate, 61, 71-82. <https://doi.org/10.3916/C61-2019-06>

[14]Sampaio, Alcínia Z., et al. “3D And VR Models in Civil Engineering Education: Construction, Rehabilitation and Maintenance.” Automation in Construction, vol. 19, no. 7, 2010, pp. 819–828., doi:10.1016/j.autcon.2010.05.006

[15] Soliman M, Pesyridis A, Dalaymani-Zad D, Gronfula M, Kourmpetis M. The Application of Virtual Reality in Engineering Education. Applied Sciences. 2021; 11(6):2879. <https://doi.org/10.3390/app11062879>

[16]Stainfield, John, et al. “International Virtual Field Trips: A New Direction?” Journal of Geography in Higher Education, vol. 24, no. 2, 2000, pp. 255–262., doi:10.1080/713677387

[17] Székely, G, and R M Satava. “Virtual reality in medicine. Interview by Judy Jones.” BMJ (Clinical research ed.) vol. 319,7220 (1999): 1305. doi:10.1136/bmj.319.7220.1305

[1 8] T. Leyvand, C. Meekhof, W. Yi-Chen Wei; Jian Sun; Baining Guo, “Kinect Identity: Technology and Experience”, Computer, 4 (2011)