Review: Future of Virtual Reality and Augmented Reality

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Abstract: Virtual Reality and Augmented Reality are the technologies which lets user to interact with 3D environments that presents view of real world or imaginary world. It is the best way to feel the things of real world or imaginary world in virtual form which gives feel of reality of past, present or future. The advancement of augmented reality over Virtual Reality is that it augments digital elements to a live view mostly by using the camera on a smartphone. These technologies are not very novel technologies but their trend is increasing day by day with the growth of mobile devices and high power processors. Now days, there are many applications in field of medical, Manufacturing, defense and Gaming etc. which uses VR and AR and that has made many lives and work for professionals simple.
This paper surveys current available applications in Virtual reality and augmented reality and presents the future of VR and AR on the basis of their use, advancement and effects. Further, We presents review of different research papers in AR and VR which shows the future of these technologies by discussing available applications and surveys of different authors. Moreover, we have compared the reviewed papers on the basis of their future of AR and VR by analyzing them critically. We have also explained that what challenges have been faced By VR and AR technology in their past growth and what are challenges in future advancement of VR and AR.

Key words: Virtual Reality, Augmented reality, challenges of Virtual reality and augmented reality, applications of Virtual reality and augmented reality, Future of Virtual reality and augmented reality

I. INTRODUCTION

Now days, it is possible for every common computer and mobile user to get real feel by using computer graphics. In this fastest growing era of technology, there is race of real feel through technology of computer graphics and 3 dimension view where many technologies are playing their role but name of Virtual and augmented reality comes first. Virtual reality has been defined by many authors in their words and understanding level, but authors agree on one definition that it is modern technology which is used to create simulated platform. Further, those platforms can be used for many purposes in many fields, we have discussed that in paper. While augmented reality is considered as an extension of virtual reality which uses live view in addition with Virtual environment, which is used in live steaming of videos generated through smart mobile or camera. The main difference between VR and AR is that, AR adds live streaming video with virtual reality effects. When we compare AR with other reality technologies, it lies between virtual world and the real world; in the middle of mixed reality. There is another technology which is also becoming famous and has lot of scope and advantages, which is mixed version of VR and AR is known as Mixed Reality. Mixed reality is also known as hybrid realty, it is mixed form of real and virtual worlds which generates new world where digital and real objects can interact with each other in real world.
There are three main types of virtual reality, full-immersive, non-immersive and collaborative reality. Full-Immersive reality is come with very powerful computer where user can experience full virtual reality experience. While Non-immersive is mostly used in flight because it comes with extra stuff like headset and settled system with it where user is not fully immersed with virtual environment. Collaborative reality is mostly used in games that is not fully immersed which aims to give virtual experience to user and share experience with others in Virtual environment. There are major five equipment used for virtual reality, Immersive rooms, Data Gloves, Head-mounted displays (HMDs), Immersive rooms, Wands and Handheld virtual reality controller.
AR is fast growing technology and it is getting much popularity because it adds virtual world elements into real world, by augmenting the things we feel, hear, and see in daily life. There are four types of AR, Marker-based augmented reality, marker-less augmented reality, Projection based augmented reality and Superimposition based augmented reality. Marker-based augmented reality is also known as image recognization reality because it shows results only when it is sensed by marker, it is commonly used in QR code recognization. Marker-less augmented reality is commonly used for making direction, pointing positions and locating places. It is implemented in GPS. Projection based augmented reality works by projecting an artificial light on real world environments. It is used to provide feel of sensing the human interaction of that projected light. Finally, Superimposition based augmented reality is used to replace fully or partially view of present object into new augmented environment, it is commonly used for user satisfaction in marketing.
As we see, almost everyone has mobile devices. With growth of mobile devices virtual reality has got big space to demonstrate and show its power. Now days, Virtual reality and augmented reality has become common at a level then every mobile user can get advantage of it. In virtual environment we see virtual world screen is window screen but the main challenge is make that

environment look like real by giving experience of real graphics, real sound and real feel. By listening or reading word virtual or augmented reality, in most of the peoples' mind games come because we generally see its use in games. But, it has expended its umbrella of scope in every field, like Medical, education and Aviation etc. In paper we have reviewed papers which has described use and scope of Virtual reality and augmented reality and have concluded its future by focusing on results.

II. PRELIMINARY

A. Literature Survey

The main reason of doing research on VR and AR is that these technologies have applied and making their space in different fields like education, construction, medical and entertainment etc. Researchers in [1] have used real estate display model to get user experience. Authors in [2] have discussed current perspective and past research in AR. Which indicates the role of AR in bringing advancement in enable technologies like display technologies and tracking technologies. Display technologies are categorized in three types such as head mounted displays, projection based displays and handheld displays. Head-mounted displays are used in both VR and AR technologies. One of the problem found in [3] using HMDs is, the virtual image shown through HMDs come across various optical distortions. Such distortions are predictable as several pre-distortion techniques are already used in HMDs. Due to the limitations of proposed techniques, authors have given a new method based on photogrammetry for both radial and tangential distortions.

Technology can lead students to an effective process of learning. AR, as an advance technology can interact users in virtual and real-time applications. As authors in [4] have discussed the advantages of integration of technology tools in education. It provides an efficient way of visualizing models such as AR minimizes misconceptions in studies like chemical bonds by visualizing through AR advance techniques. AR is very helpful in real world in many ways. Picture it that you want to attend a conference in different country and the organization has sent you 3D AR view of city or location or the live view then you can easily approach there. This is future of AR that light weight systems with minimal to no social impact on their users. AR systems as defined in [5] have different architectures for different applications such as, defense, surgery, gaming etc. The major missing element in AR systems is that there is no single way of interaction with various systems. Paper [6] describes advances in AR since 1997. New applications are divided into three areas, collaborative, mobile and commercial applications. In collaborative applications, AR systems benefits group of people to view, discuss and interact with virtual models at same time. Mobile AR systems are developing by advancement of tracking and computing power. Commercial applications are playing main role in marketing. The main challenge in advancement of AR are three limitations, technological limitations, UI limitations and social acceptance issues. The evolution of information technology in form of smart phones and new devices such as Hololens enables software-only solutions for AR, where custom hardware assembly was necessary earlier. However, the technical limitations of existing devices make it challenging. Particularly, it is necessary to design novel efficient real-time computer vision and computer graphics algorithms, and create new lightweight forms of interaction with the environment through small form-factor devices. [7]

Authors in [8] have worked for the betterment of image quality with cost reduction using a simple display modulation scheme. Researchers have described augmented reality, optical see through display with an extremely fast 16kHz binary update rate, which is based on DMD chip. The post-rendering 2D offsets and novel modulation techniques with tracking updates were combined for turning binary pixels in to perceived gray scale. The average total latency of 80µs has been observed for a generated novel image on a pipeline capable of multi-kilo hertz update rates. The stability of real time navigation system of AR over large areas is focused in [9]. The new kalman filter framework is introduced using local measurements obtained from image based motion estimation though visual odometry and global measurements from the visual landmark matching module. To minimize the jitter, a local 3D reconstruction uncertainty of each point is captured as a covariance matrix and implicity rely more on closer points as global measurements in the Kalman filter framework. It provided more stability and accuracy for required AR systems.

The developmental process of Virtual technology is researched in [10] which describe four periods of virtual technology, namely telepresence, interactivity, connectivity and synthesis. Such conditions are demonstrated that can provide a high impact on virtual technology development. The research focused on future of developing stereoscopic 3D virtual worlds. To enhance the experience of telepresence, future VR should provide human-avatar interactivity. Telepresence means controlling instruments of remote robot and it feels like operating by one's own hand. Authors in [11] have presented telepresence system that permits different groups of user to interact in shared space. They used virtual reality framework, *AVANGO; a distributed applications framework and Kinects to* develop multiuser telepresence platform that accommodate up to six users at a time. In [12] the differences in experience of using VR mobile applications and simple mobile applications is evaluated. Two versions of identical applications were developed. The participants experienced an insight of their subjects while using VR based mobile application and were able to carry task which cannot be achieved in real life by using other tools. The comparison between AR and VR under different circumstances have been made by researchers in [13] on the basis of use of mouse and 3D input. The main effect is that visual response of seeing one's own hand is helpful in performing tasks while in AR due to this effect shadows, occlusion and lighting effects can mislead user in performing tasks. This study determines that how different physical environments effects user and quality of video images matter a lot in AR. This can be great research to understand and compare VR and AR on user's experience point of view for companies who want to launch AR or VR products. The human emotional response of living space is affected significantly by space making elements such as light, color and texture. To see if this phenomenon is possible in a virtual environment in [14], a user study was conducted in a six-sided projected immersive display. The study was aimed to assess that at what extent design attributes such as Brightness, color and texture which are equivalent to light, color and texture affect the emotional response in a virtual environment. The outcomes of the studies proved the hypothesis that the generation of emotional response by humans after perceiving real world spaces is also possible in a virtual environment by simulating design attributes. Moreover, the data obtained from the studies can serve for designing principles of a virtual living spaces. The paper [15] explains positive outcomes of therapy of posttraumatic stress disorder PTSD using Virtual Reality. Author's has explained efforts to deliver exposure therapy by using VR and provide stress

flexibility trainings. VR simulated technology can simulate challenges that we face in naturalistic environments can use for clinical assessment and treatment purposes. Further, clinical VR simulation can use in reduction of phobias. The use of VR, AR and MR technologies has a different behavioral impact on people of all ages. The paper [16] focuses on ethics of using AR, VR and MR with children and youth. Children development is very main factor from centuries, so what children see and what they do effect on their ethics. Children are exposed to emotional virtual reality stimuli and that effects their lives in positive and negative ways. Three things in Virtual environments effects development stages of children, content, social affordances of technologies and modes of social interaction within the environment. In [17] authors have predicted decision making using virtual reality in real context. They predicted that personality differences to some extend are responsible in decision making and they can be studied in virtual simulation. They used Unity3d car game to make car driving simulation. The investigation is done on the basis of situation and divided people into groups and finally categorized by people who applied Brake, No-Brake and avoided. An upward surge in popularity of 36o virtual environments is witnessed due to recent breakthroughs in consumer level virtual reality devices such as VR headsets. However, there are certain limitations to the experience provided by monoscopic 360 videos. A novel wrapping method is adopted to minimize distortions and a prototype is developed that can produce novel views for each eye to increase 3D depth. A user study revealed in 6-DOF system, users constantly moved around to explore the scene whereas with a monoscopic video they were limited to rotational movement as the video did not respond to translational motions. [18]

B. Results

The evaluation of AR and VR in [1] is done on basis of technical functions, Utility value and aesthetic sensibility. Fig 1. Shows the tabular results on functional behaviors of AR and VR display systems which indicates that information retrieval from AR display is greater than VR display and satisfaction and emotion feeling in AR is also greater than VR. AR is fairly open system though VR needs to make virtual environment.

Tab.2 Function behavior of AR and VR real estate display system

AR real estate display system		VR real estate display system	
Process	Function(i)	Process	Function (i)
Project overview	Project introduction(words, pictures, video) Detailed information web links	Project overview	Project introduction(words, pictures, video)
Display apartment	Apartment overview Sales information Model edit (decoration scheme, weather scheme, self-editing) Characteristic introduction Screen shot/video User sharing Touch function(zoom, select, freeze, annotation)	Building outdoor roaming	Automatic roaming Autonomous roaming (zoom, rotation, move) navigation
Sample house customize	Set of decorative scheme selection Independent fixed layout Screen shot/video/user sharing	Apartment roaming	Automatic roaming Autonomous roaming (zoom, rotation, move) navigation Select different decorative scheme apartment
Hidden project preview	Fire protection system/special equipment/construction technology /water heating system		
Surroundings display	Outdoors landscape/traffic		

Fig 1. Function behavior of AR and VR real state display system [1]

Study shows that number of students are decreasing in science; so use of AR technology can help by visualizing models that needs deep understanding. AR minimizes misconceptions in studies like chemical bonds by visualizing through AR advance techniques. AR makes students more interactive due to their advance applications. [4]

Table 1. Advantages of using AR in education

Author	Advantages of AR
Singhal et al. (2012)	Supports seamless interaction between real and virtual environments and allows the use of a tangible interface metaphor for object manipulation
Coffin et al. (2008)	Provide instructors with a way to strengthen students' understanding in the classroom by augmenting physical props with virtual annotations and illustrations
Burton et al. (2011)	Creates a learning experience that is linked to the formal classroom, so that students can learn outside of class hours and outside of school limits
Medina, Chen, and Weghorst (2008)	Enables the visualization of interactions among amino acids and protein building processes as static 2D/3D images and 3D dynamic images (animations)

Fig2 AR in education [4]

Particularly, it is necessary to design novel efficient real-time computer vision and computer graphics algorithms, and create new lightweight forms of interaction with the environment through small form-factor devices. [7] Using these technologies there are many applications in different fields like, in medical Doctors use AR to monitor and train aid for surgery, in manufacturing AR models helps for better understandings etc. [2]

The experiment over AR and VR display technology was carried out in [13] using a 3D input device which shows faster task completion time in AR than VR. Surprisingly, a similar effect occurred while using a mouse: users, were about 17.3 percent slower in VR than in AR. This can be great research to understand and compare VR and AR on user's experience point of view for companies who want to launch AR or VR products. The research focused on future of developing stereoscopic 3D virtual worlds. To enhance the experience of telepresence, future VR should provide human-avatar interactivity. [10] VR simulated technology can simulate challenges that we face in naturalistic environments can use for clinical assessment and treatment purposes. Further, clinical VR simulation can use in reduction of phobias. Finally, among different approaches they found Cognitive-behavioral therapy (CBT) with prolonged exposure (PE) best for treatment of PTSD. A history's review about war's impact in advances in clinical care might suggest VR as best idea. [15] A user study revealed in 6-DOF system, users constantly moved around to explore the scene whereas with a monoscopic video they were limited to rotational movement as the video did not respond to translational motions. [18]

Three things in Virtual environments effects development stages of children, content, social affordances of technologies and modes of social interaction within the environment. There are four main factors in development of practical framework, expertise, design, orientation and developmental. [16] The outcomes of the studies proved the hypothesis that the generation of emotional response by humans after perceiving real world spaces is also possible in a virtual environment by simulating design attributes. Moreover, the data obtained from the studies can serve for designing principles of a virtual living spaces. [14]

C. Future work

Augmented reality and Virtual reality were initially developed for entertainment purpose, but it has grown its applications in areas like education, medicine, institutional trainings and research. The concept of virtual reality and augmented reality is predicted to be "The next big thing" in learning according to many articles. This modern technology also contains chances of becoming the topnotch technology of the decade. The aim of this research paper is to determine what the future to this technology is. Researches have evidently demonstrated the usefulness of virtual reality in deployment of applications which were previously impossible with other tools, such as telepresence and teleoperation. Virtual prototyping and simulation and training,[19] Finding more natural approaches to enable user interaction in a virtual environment and shrinking time period of building virtual spaces is a bigger challenge in the field of virtual reality, nevertheless VR technology is involved everywhere. As computing is becoming faster and more efficient there is a better possibility to create more realistic graphic images for simulating reality better. It is also possible that in near future virtual phones become a new innovation of the decade Nippon telephone and telegraph (NTT) in japan is working on a system for where a user would be able to see a 3D generated image of the other person on the line via VR techniques[20] .However, the term Augmented reality is a blend of both real and virtual worlds, providing user with an experience of real word with virtual information. Augmented reality overlays computer generated images and audiovisual experience to user's view of the real world hence providing user a composite view. Augmented reality combines real and computer-based scenes and images to deliver a unified but enhanced view of the world. Imagine if your car could project maps and directions onto the windscreen, augmenting your view of the road with information about traffic and the next turn this is possible with augmented reality. In past the augmented reality was primarily used for gaming, entertainment and scientific visualization but in the recent times AR is being used commercially. For example, the traditional construction sites were heavily dependent on 2D paper designing which required skilled and experienced designers to deploy a successful and flawless construction layout in most of the cases the traditional approach is time taking and ineffective. Thereby an AR platform is introduced namely AR planner to shorten the time

and upgrading the quality of construction site planning [21]. Augmented reality is now also involved in maintenance operations. According to [22] an architecture based on augmented reality termed as "Augmented reality in maintenance an information-centered design framework" an information framework which analyses the information requirements for integration of AR in industrial maintenance systems. It helps to determine the type of data and information to be acquired from and displayed in the AR systems, as well as how to relate it with existing maintenance information. New learning methods and techniques are being studied to understand in depth of the concept of virtual reality. Different models of VR applications such as (MARIE) "An interactive Multimedia Augmented Reality Interface for E-Learning" (MARIE) is used to enhance teaching and learning experience in augmented reality. The main advantage of this system is a low-cost real time augmented presentation applied to education [23]

Despite the advancements in VR and AR technologies there have been mishaps in some previous innovations. Despite of the uniqueness of this technology there is a slow growth in adaptation of technology, especially by organizations. However, it has a large-scale scope overall, the benefits outweigh the mishaps. It will take some time for augmented and virtual reality to become a mainstream standard and attain novel accuracy. As VR and AR technology becomes cheaper and more organizations begin wiling to adapt VR into their learning programs, the growth of technology could take off in the near future. Future of these technologies seems promising based on the researches being conducted in this decade. Students who are visual learners can benefit from visual learning and study field trips. Innovations like virtual medicine, virtual traveling, space exploration, virtual construction worksite and aviation practices will bring a positive change to lives of humans, eventually improving the quality of life. Moreover, further research is required about the capabilities of AR and VR to explore the diversity of this technology. Finally, augmented reality and virtual reality are in process of being deployed to different applications of life but here is slow progress in adaptation of new technology due to its high costs.

D. Conclusion

As the latest technologies are supplanting the traditional ones, Virtual reality and augmented reality have started to influence day to day disciplines of human life. Virtual and augmented reality converts change an ordinary display into a user interactive display, giving the user an interactive experience. Virtual reality allows the user to experience the virtual world by wearing a headset using head tracking techniques whereas the augmented reality instead of transiting the user to the virtual world captures digital images and layers them on the real world around the user. The sustainability and the growth of Augmented and Virtual reality in depends on its present use and effectiveness. Both of these technologies are being implemented in different ways. Companies are using these technologies for giving virtual tour of their products, foreign languages are scanned and translated in real time. In medicine surgeons practice complicated surgeries and various diseases in military camps are being treated using VR. The prediction of human decision-making power is possible with AR and VR. 3D virtual worlds and telepresence systems are the main innovations of VR. Moreover, in education how VR and AR can contribute and what effects it has on different age groups is also define in this paper. Overall, AR and VR have sprung a long time ago and with more research it is in the phase of consistent upgrading and is being expanded to many fields which increase the quality of life. VR technology is heavily dependent on software whereas, AR is dependent on hardware. In many ways AR leads the VR technologies. AR innovations are more optimized and noble than VR. However, AR embraces a drawback which is as it's highly reliable on hardware it gets complicated to handle system inefficiencies as there is lesser software than hardware.

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