



Application on Virtual Reality for Enhanced Education Learning, Military Training and Sports

Kunjal Ahir¹ · Kajal Govani¹ · Rutvik Gajera¹ · Manan Shah²

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Abstract

Virtual reality is emerging freshly in the field of interdisciplinary research. In the past years, its area has grown over research and the industry has made important investments in the manufacturing of different VR products as well as in research. Virtual reality (VR) is developed by the union of technologies that are used to visualize and interact with virtual atmosphere. This atmosphere portrays a 3D space which may be imaginary, microscopic or macroscopic and based on practical laws of dynamics or imaginary dynamics. VR technology is getting supreme using computer hardware, software and virtual environment technology through which the real world can be simulated dynamically. The dynamical conditions can react according to the human language, form and so on rapidly that humans can communicate with virtual environment in true time. Therefore, VR technology can be put into application in education, military, sports training, and is portraying an important part in the evolution. The paper summarizes the developments in VR technology in the fields of education, military and sports, and then analyses the future trends of VR in these fields.

Keywords Virtual Reality · Education · Sports · Military

Introduction

Human history has been very noticeable by the progression of media, used to convey ideas and experience. Perhaps the latest step in the progression is the use of virtual reality. It can lead us to such an extent of imaginary world where in it is an arduous task to distinguish the virtual from the true [1]. One of the most promising applications in the field of technology cannot be specified with a sole and brief

definition. The term VR has its own impression on the minds of different people [2].

Virtual reality is a man-made condition that is produced with programming and exhibited to the client so that the client suspends conviction and acknowledges it as a certifiable domain. Other than just portrayal, numerous analysts have seen that the term VR is an ironic expression, where two terms with inverse implications are joined. The word virtual signifies “not genuine” as per Sismondo, and VR is valid basically however not truth be told [3, 4].

Virtual reality can be bifurcated as vivid and non-vivid VR. In a vivid VR framework, clients are furnished with head-mounted gadgets (HMD) or extraordinary glasses to see stereoscopic pictures in which the watcher’s head development is being followed progressively though non-vivid VR is normally significantly less expensive and clients do not wear any gadget likewise the perspective does not pursue the watcher’s development. Rather, the gadgets intelligently explore in the virtual world and the picture is commonly a first individual’s view [5]

Except the fact that from time to time, we found out that whatever we have acquired either from the senses or through the senses and which have up till now been

✉ Manan Shah
manan.shah@spt.pdpu.ac.in

Kunjal Ahir
kunjahir1210@gmail.com

Kajal Govani
govanikajal@gmail.com

Rutvik Gajera
rutzgajera007@gmail.com

¹ Department of Computer Engineering, LDRP Institute of Technology and Research, Gandhinagar, Gujarat, India

² Department of Chemical Engineering, School of Technology, Pandit Deendayal Petroleum University, Gandhinagar, Gujarat, India

accepted as almost true is a bluff, because senses deceive. When building a virtual world what we strive for is the ability to berk sensory system [1]. Objects in virtual condition additionally have their properties, for example, shape, weight, shading, surface, thickness and temperature, much the same as the articles in genuine world. The urgent segment of virtual reality is tangible criticism, which is given direct to clients as indicated by their physical area, and thus it must contain the ability to progressively quantify the position and direction of articles in reality. In the event that VR experience is to be viable, it must recognize the watcher's activities; at the end of the day, it must be intelligent [3, 6].

The Bourne of this experience is to deceive us and to bring clearly before the mind a truth that can educate, train, entertain and inspire [1].

Virtual reality brings unfamiliar and new scenarios by entering many of the fields, especially education, military training and sports. Although it is just a beginning and not much contributions has been made by VR, the researchers surely believe that VR has a great potential for giving us the positive outcomes from this fields [7].

Some of the applications of VR are listed below, which will be discussed in this paper.

1. Education.
2. Military training.
3. Sports.

VR in the Field of Education

As one of the first-class advance in innovation that will prompt the emotional changes in way of life and hierarchical structure that people have turned out to be acclimated with, augmented reality (VR) brings phenomenal scenes into numerous fields, particularly training. In spite of the fact that it is simply starting to start to expose what's underneath in instructive applications, numerous specialists accept that VR has incredible potential for positive instructive results [7]. The significant worry of teachers is the manner by which to improve the result of training. Analysts in the instructive innovation area have continually looked for better training media used to help educating. VR has been distinguished as one of them. It has been utilized as training devices in connected fields, for example, avionics and restorative imaging. It has been utilized in schools and universities in the ongoing years [1]. The utilization of VR in instruction does not just encourage understudies' inspiration to member in learning exercises yet in addition advances their capacity of investigation and express their own perspectives [8]. In view of its high intelligence and capacities to exhibit a virtual situation that

takes after this present reality, it is utilized for instructive and preparing purposes. Pantelidis [9] pointed that the fundamental explanations behind misusing VR in the study halls are the intrigue for understudies to adapt effectively, abnormal state of association and independence learning style. It could improve execution and applied comprehension on a particular scope of undertaking. Students can investigate and control three-dimensional (3D) intelligent condition, with this innovation [9]. In any case, it is only an instructive apparatus, which can be utilized to help adapting, however probably will not work for a wide range of learning [10]. VR has been considered as a standout among the most understood and hopeful instruments to propel learning results. There is a need to realize how to utilize VR in training and have a very look about the applications that has been misused in study halls with constructive outcomes. This paper audits the sorts of VR that have been utilized for learning, the hypothetical system for a VR learning condition and instructional structure for VR-based learning condition.

Most teachers and specialists agree that it is basic to move far from the present model of training that is largely dependent on inactive guidance and unreasonable evaluations, and rather develop learning as a scholarly experience and a long lasting enthusiasm in the psyches of youthful students. In their book "The Future of Innovation and Technology in Education", Visvizi et al. [11] upheld for a turn towards more prominent commitment and comprehension between the student and the educator. The utilization of vivid advances, for example, a VR-based learning condition, the scientists noted, can be especially useful for this situation by encouraging an exchange designed for inciting the student with world perspectives, aptitudes and a moral position helpful for the improvement of open, comprehensive social orders that are deferential of opportunity, liberal qualities and great administration. With falling prices of hardware, lesser limitations in terms of tech specs, and more and more parents and teachers waking up to the benefits, immersive technologies are poised to become a standard part of every classroom in the future. By building on students' natural aptitude for learning and appealing to their insatiable curiosity, a global provider of affordable, immersive learning solutions delivers the necessary last mile push that makes all the difference between an ordinary education and an extraordinary one. While VR conditions are novel and interesting, Gomes et al. [12] in their venture considered if learning medical ideas in a VR situation really improves the maintenance, cognizance and inspiration of medicinal school understudies. Their paper exhibited the key after effects of a writing survey of the present corpus of concentrates on these themes. The survey uncovered an unobtrusive number of friend investigated thinks about that evaluated the maintenance, cognizance

and inspiration of grown-up students utilizing VR in medicinal instruction. In any case, they did find ponders that show that maintenance and inspiration among medical understudies improved when learning was exhibited in VR conditions.

Virtual reality offers an exhilarating method of rediscovering the acquainted world through an unknown lens. As Michael Heim posits in his 1993 book, *The Metaphysics of Virtual Reality*, VR has signalled a metaphysics shift in how persons interact with and utilize technology. However, the foremost necessary question for educators and developers alike pertains to the optimum utilization of our technological innovations and the ways within which we are able to harness their power to form the future of education. Many challenges persist in the education system nowadays and will continue do so within the future; thus, our aim should be to use immersive technologies like VR to deal with those challenges by designing dynamic and artistic solutions. Immersive technologies will drive forward the advancement of learning and teaching by providing interactive and fascinating content to students, enabling active types of learning, facilitating productive sorts of assessment, promoting pedagogy-supported implementation of academic technology within the school room, and most significantly, nurture ecosystems of learning where students become the passionate agents of their own education [13].

It does not endeavour to cover all VR advances for the most part since this innovation is growing quickly, and new strategies are consistently developing regular.

Application of VR on Education

At present, VR in instruction is in the first place stage yet it has been brought to use in the customary study halls on an enormous degree. VR because of its expansive prospects has numerous applications in different subjects. By utilizing VR, diverse learning situations can be made, particularly for the things that are difficult to contact and feel or do not exist on the planet. In view of number of studies, we bifurcate the utilizations of VR in instruction into four sorts: observational learning, operational learning, social learning and scholarly research. In reasonable, these four kinds are consolidated and utilized in the equivalent virtual condition and are not commonly exclusive [14].

Observational Learning

With the assistance of VR innovation, student's conduct and developments can be changed over to three-dimensional space that empowers students to unreservedly explore in the virtual conditions and addition activity affections for the items inside from various spatial

viewpoints. Here, learning exercises are being brought out through various spatial exceptional points of view in a 3D virtual condition which is abridged as observational learning. One among the most punctual utilization of VR is the virtual grounds that invigorates the first grounds by the assistance of 3D virtual innovation and comprises of four sorts of virtual space: open space, amusement space, participate space and study halls. The motivation behind virtual grounds is to make understudies acquainted with the grounds environment and furthermore the grounds offices before they enter the college grounds. It additionally supported addresses, rich modules can be included into the framework boosting the connection speakers and students [15].

Operational Learning

The VR technology opens up the scope for tangible learning. By the help of settled learning atmosphere created by the virtual reality, the trainee is able to work with the objects, to note and to experience precisely. At the same time, immediate response of trainee's operations and behaviours is provided in order to help the trainee's correct their mistakes and understand properly throughout the learning. Additionally, VR technologies encourage the learner to practice repeatedly the skills like driving or medical operation by simulating the real scenes.

VR advances can be utilized in those trainings that are costly and perilous in reality. By utilizing virtual reality in such trainings, one can give a preparation stage, which can be progressively advantageous and more secure. Additionally, in the learning procedure of complex ideas, the students can take note of the learning results and analyse them by working or controlling the items in the virtual condition in order to get them and build profound perception. For an occurrence, the "Science Space"—an undertaking created with NASA store comprises of a virtual stage called "Newton World", which can mimic the scenes where there is no gravity or grating. The students can dispatch and catch the wads of different masses with the assistance of virtual hands and foresee, test and clarify the physical wonders to learn Newton's law of movement and the law of protection of energy [16].

Social Learning

The social Learning in VR condition is alluded as nature where students can consider through collaboration and communication with different students in the re-enacted social situation. VR innovation is considered one of the significant pieces of separation learning process as it can bridge the confinements of physical separation by utilizing

3D multi-client virtual condition through which the understudies and instructors can lead social learning exercises. The students can likewise take part in the ongoing class association and complete the gathering talks with the assistance of multi-client virtual condition.

Scientific Research

Today, virtual reality additionally has high significance in the logical research field controls notwithstanding its utilization in instructing field. VR research facilities have been created by numerous organizations everywhere throughout the world. The principle motivation to utilize VR research centres is that it is fit for mimicking distinctive science and building conditions and subsequently diminishing the expense and danger of directing similar trials in the genuine lab. Additionally, to include a bit of leeway, VR research facilities is equipped for making some surprising situations and impacts that would not be conceivable in reality and through which the tests conditions can be effectively controlled and adaptably controlled. For an occurrence, as per Morehead et al. [17] in the field of restorative research utilizing VR, one can imagine the internal organs and subsequently make it open for the analysts to work some virtual apprehensive tissue.

Future Works

In his seminal work on VR, *Power, Madness, and Immortality: The Future of Virtual Reality*, Cline [18] pointed out that in education, VR is likely to lead to an increasing emphasis on interdisciplinary perspectives and technical training, while the use of video game-based technologies will contribute to changes in the “look and feel” of the classroom environment. Cline asserted that the adoption and integration of VR in education will also signal a much needed shift away from learning that is too abstract and disconnected from practice and experience, and empower students by offering a more experiential mode of learning and promoting the need for conceptual understanding. The development of the virtual classroom, Cline noted, is likely to move education towards immersive and interactive learning environments, involving various components such as games, field trips and simulations to make learning more effective, more hands-on and more fun. Although students will still be required to learn reading and writing, mathematics, critical thinking, etc., there will be an equal emphasis on developing self-discipline, cognitive skills and technical proficiencies, the forte of immersive technologies like VR [18].

VR in the Field of Military

The earliest and the foremost vital applications of VR technology is the in military training and is also one among the fields where VR technologies is used at a large extent. It was mentioned in the list of seven important technologies that would make sure the supremacy of the US army in the 21st century. Additionally, U.S. Defence department stated VR technology is the technology that would bring a change in the ideas and ways to military utility. The use of VR in military consist of many fields such as virtual training, virtual weapon manufacturing and designing, virtual battleground exercises, maritime applications, warfare and also engineering designing [19].

Virtual Training

Training simulation is a type of physical simulation technology. It essentially cultivates the battle abilities of single fighter or little case battle bunch by recreating real vehicle, genuine officer or real battle environment. For example, all the more driving re-enactment is by and by utilized, and multi-reason compound laser fighting recreation framework. The precision and striking quality of those re-enactment frameworks are extraordinarily improved, and the level of the recreation of the picture has also been about the indistinguishable with the genuine.

For instance, Fracas’ machine for general flying flight getting ready is arranged as a test framework for single- and two- overlap dispatch course with a specific cockpit, significant standard vision structure, atmosphere control frameworks, electrical stacking controls, automated sound, powertrain, coordinated flight deck, electronic flight instrumentation structures, engine sign and group fore-warning systems, airborne crash avoiding structures, theater airborne prepared structures, improved ground closeness alerted outline works and amassing structure which can give high steadiness amusement, so tutors in the little danger, low usage conditions setting up a strong.

Virtual Battleground Work Out

Mao and Chen [20] in their study show the increased reality innovation and 3D data representation for Army’s military instruction to understand the intuitive strategic course educating and considering the client focus research and human PC collaboration design as an answer for improve the regular operational picture. The design is to improve the Army’s direction and general staff officers in strategic activities to learn battlefield situational attention to upgrade enthusiasm for learning and viable choice help. We developed a model enlarged reality program, the

customary strategic picture and images of war games into 3D virtual pictures, which incorporates military gear, urban design and topography scenes and different models, instructing applications to import strategic activities, not exclusively to get through the impediments of a conventional 2D picture, upgraded special visualizations and advanced innovation data, uncovering a progressively complete battlefield scene.

Battlefield situational awareness was the centre of military strategies, and the motivation behind cultivating military students' viable direction and control. The principle instructional apparatus in military strategies courses is the basic operational picture (COP) [21]. At present, military units around the world spot military maps under acetic acid derivation tablets to shape activity overlays, and imprint military strategy pictures and images on the overlays to participate in military reproductions [22]. Ongoing examinations on order and staff activities in Taiwan [23] have concentrated on techniques and steps in military tasks. Studies call attention to that AR has demonstrated to have the option to give incredible effect on influence and make better recognitions and learning encounters [24, 25]. This is on the grounds that AR licenses students to associate with genuine world and virtual articles. What's more, the adequacy of AR-based learning exercises [26] demonstrate that AR can encourage essential information, flexibility, innovativeness [27] and increment inspiration among students [28].

As a rule, the customary type of armed force exercise expends huge measure of time and is exorbitant. By utilizing virtual military frameworks, key exercise and production of enormous degree scenes of war for practices can be accomplished at a moderately minimal effort and furthermore in a similarly brief time. With the utilization of virtual battleground, both the warring gatherings can be engaged with a genuine war exercise dependent on changes in the virtual condition and distinctive situations [29].

Maritime Applications

Test systems for ground vehicles and vehicles working submerged are likewise being created utilizing virtual reality. Army personals can be trained to operate specialized vehicles such as tanks and heavily armoured vehicles due to emerging invention of specific devices. VR also makes it possible to train officers for various dangerous weather conditions or different landscape by recreating the scenarios. For the simulators to be used by the navy, the technical requirements are somewhat different. In the case of submarine simulators, the practical requirement of environment and land has no much importance, as there are windows to the external environment. Something that is viewed as significant is to produce a vibe of drenching by

physically mimicking a jump or surfacing operation [30]. It is additionally critical to give the down to earth readings as the group explores through the re-enactment procedure.

Yin et al. [31] in application of virtual reality in marine search and rescue simulator said that the system generates virtual surroundings with powerful immersion effect and is also capable of giving a naturalistic simulation system with good environment realism, behavioural realism and physical realism.

Virtual Reality in Air Power

In military area, the job of VR develops past straightforward pilot training program. Ordinarily it is necessitated that more than one learner works in the virtual condition requesting increasingly complex condition regularly called as cutting edge engineered situations. It ends up obligatory to make air-fighting re-enactment with large amounts of authenticity. For such reasons, it gets important to incorporate PC models, re-enacted situations and different conduct models, flying stage and weapon framework test systems and numerous other basic war-battling frameworks.

VR preparing is advancing these days as it is financially perceptive and furthermore maintains a strategic distance from the misfortune to human life. It is normal that the real flying endeavours somewhat as it offers most financially savvy approach to prepare pilots [32].

Virtual Reality in Weapon Manufacturing and Designing

Weapon structure, generation arranging, investigate examination, fabricating and different viewpoints are where computer-generated reality assumes a crucial job. In weapon structure and generation, VR innovation has a significant influence by giving development delineation to the engineers and clients in a manner with the end goal that they can go into the virtual fight environment and run weapon frameworks around then, testing the structure plan, strategic, specialized exhibitions files and task sanity, amalgamate the propelled structure conspire into weapons. To make it closer to the certifiable fight prerequisites alongside guaranteeing its general quality standard and adequacy, the whole technique of hardware advancement is separated into two sections; accelerate the improvement cycle of the weapon framework and a sensible appraisal of its operational viability.

By embracing the VR innovation in the entire procedure of advancement F-22 and JSF, the fourth era warrior of the USAF understood the joining of 3D computerized plan and assembling additionally diminishing the improvement cycle by half and sparing the improvement cost by over

93%. By utilizing VR, demonstrating strategies reproduce plane carrying warship get together subtleties at a low cost and risk [33].

Virtual Reality in Engineering Designing

In the area of military forces, virtual reality and its connected branches have its effectiveness in many different fields either directly or indirectly. One such area is engineering designing. The area to which VR is possible to be applied ranges from the defence industry to the local camps in different armed force establishments. In the field of development of prototypes, maintenance, manufacturing and repair of different military equipment's, virtual reality has broader scope.

The advancement of VR innovation in the field of military is mostly because of it being perceptive and safe. Utilizing VR to test its optimal and common sense plans in connection to weapon frameworks or support approaches is practical. It additionally spares time as it is not important to construct a physical model for testing of the structure and furthermore as to advancement of innovation. Another field where VR adds to the military framework is front line representation. It is not just a key component in preparing but on the other hand is significant for choosing battle plan [30].

Recent and Future Works

The advancement of VR for militaries requires to be seen distinctively contrasted with different innovations. The reason is VR is a greater amount of an application situated and not a stage for battle flying machine, tank, ship or submarines. VR still is in the domain of creating innovation, extraordinarily in the military setting because of expense and mechanical information. Just a few militaries today are trying genuine endeavours to concede VR advances. Additionally, because of the military mystery, very little data are accessible on the web or open hotspot for the pertinence of VR in military. The USA and some European nations are the primaries who have taken research in military VR. Government associations like the US Naval Research Laboratory and some other military research organizations are engaged with military computer-generated experience look into. The FOI-Swedish Defence Research Agency, FMV-Swedish Defence Material Administration and SNDC-Swedish National Defence College are doing some inventive Research in VR.

The significant VR innovation for the future is by all accounts the use of computer games for military purposes. The advanced gaming industry is keeping in view the expanding pace of PCs for planning the recreations [34]. It is likewise discovered that the gaming modules that are

being created are progressively practical to serve the expanding market rivalry. Because of this, the divergence between the military test systems and game is discovered diminishing. It tends normal that in a brief timeframe military would begin building up their VR-based devices by altering the recreations accessible as opposed to making the wheel. Additionally now the jobs of military are getting re-imagined and are likewise the one to deal with catastrophic events like tidal waves, atomic fiasco, tremor, etc. During such conditions, it winds up imperative to prepare the power and augmented reality may exhibit inventive arrangements in this regard [34].

VR in the Field of Sports

Pierre de Coubertin gave the Olympic aphorism "Quicker, higher and more grounded" which has been motivating individuals to set out themselves. At the outset period of Olympic Games, the mentors and the teachers imagined that 10 s was the quickest and as far as possible for a 100-m race, however Owens' landing down and out the idiom. In 1983, Smith made a record of finishing 100-m race in simply 9.93 s, after some time in 1991 Lewis broke the record by finishing the race in 9.86 s at World Athletics Championships held by Japan, and in the end in 2009, Bolte-Jamaican flier set another precedent of 9.58 s at the World Athletics Championship. With the improvement in the preparation strategies and the progression of innovation, individuals have turned out to be fit for extending their breaking points. Here, investigation and research on the application and elements of virtual reality in games are depicted. There are different zones in games where VR innovation is assuming significant job, for example, building different preparing conditions, making virtual adversaries, gathering physiology and biometric record and assessment of preparing impact to give some examples.

Building Various Training Conditions

Rivalry conditions have turned into a crucial component of accomplishment in view of the expanding esteem and quick advancement of focused games. Numerous mentors are in a hunt of making preparing conditions that would prompt improvement in games men's procedure. Augmented reality innovation is the one taking care of the issue. It can pick up the intelligence of the genuine and virtual conditions and furthermore the challenge conditions or the preparation conditions. For example, tight preparing conditions loosened up preparing conditions and loud preparing conditions. Virtual preparing strategy frames intuitiveness of sportsman and virtual conditions by supplanting the customary preparing way, which requires

strategies, stamina and methods. By utilizing virtual reality, the preparation gets genuine with less harm rate during warm-ups and furthermore speculation decreases [35].

Creating Virtual Opponents

One of the significant uses of virtual reality innovation in games is making virtual adversaries whose methods and style coordinate the genuine rivals by breaking down the rival's recordings and other information. Sportsmen enter the virtual conditions by 3D strong protective cap, information garments and other essential types of gear to play with the rival. For example, in boxing, the sportsman can battle with a fighter before him, evade and furthermore assault back reflexively by the 3D strong head protector. On the off chance that the sportsmen hits the rival, at that point weight pickup transmits the power to the sportsman and by along these lines, the sportsman can battle with the most grounded virtual rival in the genuine boxing ring. It is profitable for the sportsman to gain strategies, physical and mental preparing and furthermore higher likelihood of getting accomplishment by the assistance of virtual reality innovation and genuine preparing with beneficial preparing effect [36].

Collecting Physiology and Biochemistry Index

To ace the preparation conditions and play out the ensuing preparing, physiology and biochemistry record are the vital point as they can reflect the sportsmen's intensity. A customary technique named finger strategy is utilized to assemble physiology and natural chemistry file that costs a ton of work power and time. In any case, by the utilization of computer-generated reality innovation, the issue is comprehended as VRT utilizes different detecting gadgets or instruments that gather the file and dissect the data. By the assistance of VRT, (augmented reality innovation) mentors will get an immediate and exact examination of sportsmen's athletic conditions and through that mentor can guarantee right and appropriate training [37].

Evaluation of Training Effect

To judge sportsmen endeavour and change the preparation plan quickly, assessment of preparing impact is a significant segment for mentors. By gathering the day-by-day preparing information, the mentor can mimic the preparation activity on PC by games reproduction framework. The assessment of the preparation impact is done to search out the advancement, shortcoming and the separation with others and is finished by contrasting the preparation re-enactment and the conventional simulation, the past preparing and the prevalent activity [38]. By the assistance

of this, assessment and the sportsmen's individual qualities the mentor can make a profound examination of the activities and suggest better activity plan.

Future of VRT in Sports

The fate of computer-generated reality innovation is extremely splendid. VRT as another and creating innovation will change people thinking strategy or even their reality, individual and time disposition. Augmented reality is start utilized in games at a higher rate and with some extraordinary achievement. As it is advancing, its extent of utilization will be more extensive and more profound and will be utilized in each game occasion. Envision one having the option to go to the majority of their preferred recreations, visit the arenas likewise the new ones that are not yet constructed, and furthermore take an interest in their preferred group practice and this without leaving their home. This type of VR environments are already in existence and some of them are yet developing but none of them is out in the market. Once this environment is out in the market, it will create a huge benefit to the world and will be a great contribution to the field of sports and technology [39].

Conclusion

This paper describes about the various applications of virtual reality in different fields such as education, military and sports. VRT can be helpful in all these fields because it makes grasping things easier, more convenient than old methods, and it provides a platform for different modelling different tasks that carries life or death risks in real world. It provides a safe environment for dealing with greater risks without any fears. It focuses on practical approach rather than just theory. In education, VRT can be used for the better understanding of students. Students can get more exposure with conceptual learning. VRT is used in modern armies. Development of technology has provided armies with better wealth of tools to fulfil different requirements. It can be helpful for training purposes, manufacturing weapons, improvement in tactical skills, advanced vehicle stimulators and medical training. Today in competitive sports, VRT is used for better evaluation and scientific selection. It can be used to create a virtual training grounds and virtual opponent for improved performance.

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References

- Sherman WR, Craig AB (2003) Understanding virtual reality, interface, application and design. Morgan Kaufmann Publishers, Burlington, pp 1–623
- Chavez B, Bayona S (2018) Virtual reality in learning process. In: Rocha A, Adeli H, Reis L, Costanzo S (eds) Trends and advances in information systems and technologies. World-CIST'18 2018. Advances in intelligent systems and computing, vol 746. Springer, Cham, pp 1345–1356
- Sismondo S (1997) Reality for cybernauts. *Postmod Cult* 8(1). <http://jefferson.village.virginia.edu/pmc/>
- Jha K, Doshi A, Patel P, Shah M (2019) A comprehensive review on automation in agriculture using artificial intelligence. *Artif Intell Agric* 2:1–12
- Jensen L, Konradsen F (2017) A review of the use of virtual reality head mounted displays in education and training. *Educ Inf Technol* 23(4):1515–1529
- Kakkad V, Patel M, Shah M (2019) Biometric authentication and image encryption for image security in cloud framework. *Multiscale Multidiscip Model Exp Des*. <https://doi.org/10.1007/s41939-019-00049-y>
- Bujak KR, Radu I, Catrambone R, Macintyre B, Zheng R, Golubski G (2013) A psychological perspective on augmented reality in the mathematics classroom. *Comput Educ* 68:536–544
- Dalgarno B, Lee MJ (2010) What are the learning affordances of 3-D virtual environments? *Br J Educ Technol* 41(1):10–32
- Pantelidis VS (1993) Virtual reality in the classroom. *Educ Technol* 33(4):23–27
- Barab S, Thomas M, Dodge T, Carteaux R, Tuzun H (2005) Making learning fun: quest atlantis, a game without guns. *Educ Technol Res Dev* 53(1):86–107. <https://doi.org/10.1007/bf02504859>
- Visvizi A, Lytras MD, Daniela L (2018) The future of innovation and technology in education: policies and practices for teaching and learning excellence. Emerald Group Publishing, Bingley, pp 307–319
- Gomes N, Lou Y, Patwardhan V, Moyer T, Vavala V, Barros C (2019) The effects of virtual reality learning environments on improving the retention, comprehension, and motivation of medical school students. In: Ahram T, Taiar R, Colson S, Choplin A (eds) Human interaction and emerging technologies. IHIET 2019. Advances in intelligent systems and computing, vol 1018. Springer, Cham, pp 289–296
- Heim MH (1993) The metaphysics of virtual reality, vol 22(4). Oxford University Press Inc., New York, pp 36–37
- Liu D, Bhagat KK, Gao Y, Chang TW, Huang R (2017) The potentials and trends of virtual reality in education. In: Liu D, Dede C, Huang R, Richards J (eds) Virtual, augmented, and mixed realities in education. Smart computing and intelligence. Springer, Singapore, pp 105–130
- Limniou M, Roberts D, Papadopoulos N (2008) Full immersive virtual environment CAVE TM in chemistry education. *Comput Educ* 51(2):584–593
- Lombard M (2000) Resources for the study of presence: presence explication. Retrieved 3 Sept 2000
- Morehead M, Jones Q, Blatt J, Holcomb P, Schultz J, DeFanti T, Spirou GA (2014) Poster: BrainTrek—an immersive environment for investigating neuronal tissue. In: 2014 IEEE symposium on 3D user interfaces (3DUI). IEEE, pp 157–158
- Cline MS (2005) Power, madness, and immortality: the future of virtual reality. *Computers and civilization*, pp 1–284
- Luan XD, Xie YX, Ling-Da WU, Yu-qiang S, Hai-bin N (2003) Application of virtual reality in military affairs. *Acta Simul Syst Sin* 14(4):604–607
- Mao CC, Chen FY (2019) Augmented reality and 3-D visualization effects to enhance battlefield situational awareness. In: Ahram T, Taiar R, Colson S, Choplin A (eds) Human interaction and emerging technologies. IHIET 2019. Advances in intelligent systems and computing, vol 1018. Springer, Cham, pp 303–309
- Briggs RO, Adkins M, Kruse J, Nunamaker JF Jr (1999) Lessons learned using a technology transition model with the US navy. In: Proceedings of the 32nd annual hawaii international conference on systems sciences, HICSS-32. p 10
- Kim YJ, Hoffmann CM (2003) Enhanced battlefield visualization for situation awareness. *Comput Graph* 27:873–885
- Sun C, Peng Z-L (2014) How to improve military decision making process for system thinking. *WHAMPOA Interdiscip J* 66:89–108
- Mao CC, Sun CC, Chen CH (2017) Evaluate learner's acceptance of augmented reality based military decision making process training system. In: Proceedings of the 2017 5th international conference on information and education technology. ACM, pp 73–77
- Mao CC, Chen C-H, Sun C-C (2017) Impact of an augmented reality system on learning for army military decision-making process (MDMP) course. In: Advances in intelligent systems and computing. https://doi.org/10.1007/978-3-319-41685-4_58
- Nicolau S, Soler L, Mutter D, Marescaux J (2011) Augmented reality in laparoscopic surgical oncology. *Surg Oncol* 20:189–201
- Chang HY, Wu HK, Hsu YS (2013) Integrating a mobile augmented reality activity to contextualize student learning of a socioscientific issue. *Br J Educ Technol* 44:E95–E99
- Chen C-H, Chou Y-Y, Huang C-Y (2016) An augmented-reality-based concept map to support mobile learning for science. *Asia-Pacific Edu Res* 25(4):567–578
- Herrero P, Antonio D (2005) Intelligent virtual agents keeping watch in the battlefield. *Virtual Real* 8(3):185–193
- Strickland J (2010) How virtual reality military applications work. <http://science.howstuffworks.com/virtual-military.htm/printable>. Accessed 13 July 2019
- Yin Y, Sun X, Zhang X, Liu X, Ren H, Zhang X, Jin Y (2010) Application of virtual reality in marine search and rescue simulator. *Int J Virtual Real* 9(3):19–26
- Wong V (2010) Flight simulation: an application of virtual reality. http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol11/kwc2/article1.html. Accessed 3 Aug 2019
- Meng Z, Lutie X, Weibo Y, Hongbo L (2017) Research on high-tech ammunition training system based on virtual reality technology. *Matec Web Conf* 128:01012

34. Haar RT (2005) Virtual reality in the military: present and future. In: 3rd twente student conference on IT, Enschede June, 2005, University of Twente, Faculty of Electrical Engineering, Mathematics and Computer Science, pp 1–5
35. Hightower J, Borriello G (2001) Location systems for ubiquitous computing. *Computer* 34(8):57–66
36. Youshuang W, Xianglong Y, Fei W (2004) Virtual reality and simulation. Defence Industry Press, Beijing
37. Fuming G (2007) Research on simulated modeling body motion by computer. *Chengdu Sports Univ J* 33(3):90–99
38. Hongyu W (2007) VRT application in simulated sports training. *Jilin Phys Univ J* 23(2):61–62
39. Gungyun Y, Xiaoping L (2011) The future of sports science technology—virtual reality technology. *China Sport Sci Technol* 31(12):59

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