

An Overview of Virtual Reality in Education

نظرة عامة على الواقع الافتراضي في التعليم

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Abstract:

VR virtual reality is a computer technology that represents a simulation of reality in which an individual interacts with the surrounding environment using a set of accessories that he wears such as virtual reality glasses, game joysticks, and others. The virtual environment is designed with 3D graphics, providing the individual with an enjoyable experience. Virtual reality is characterized by interaction, attraction, and immersion. In addition, it allows you to safely experience difficult or dangerous situations. This paper presents a literature review on virtual reality technology, its features, and its use. Also, it also focuses on the use of virtual reality technology as an educational tool that helps improve the quality of outputs in general education, medicine, engineering, and other fields.

Keywords:

Virtual Reality, Education, Learning, VR area, VR technology, VR applications, Augmented Reality.

المستخلص:

الواقع الافتراضي (VR) هو تقنية حاسوبية تمثل محاكاة للواقع، حيث يتفاعل الفرد مع البيئة المحيطة باستخدام مجموعة من الملحقات، مثل نظارات الواقع الافتراضي، وأذرع التحكم في الألعاب، وغيرها. صُممت البيئة الافتراضية برسومات ثلاثية الأبعاد، مما يوفر للفرد تجربة ممتعة. يتميز الواقع الافتراضي بالتفاعل والجذب والانغماس، كما يسمح بتجربة مواقف صعبة أو خطيرة بأمان. تُقدم هذه الورقة مراجعةً للأدبيات المتعلقة بتقنية الواقع الافتراضي، وميزاتها، واستخداماتها. كما تُركز على استخدامها كأداة تعليمية تُسهم في تحسين جودة المخرجات في التعليم العام، والطب، والهندسة، وغيرها من المجالات.

الكلمات المفتاحية:

الواقع الافتراضي، التعليم، التعلم، مجالات الواقع الافتراضي، تقنيات الواقع الافتراضي، تطبيقات الواقع الافتراضي.

INTRODUCTION:

Virtual reality or VR is a technology that is not new with an ancient history that began in the eighties AD, and it is not the only technology in the field of the computer graphics industry. Virtual reality technology, since its inception, has been developing, and spreading and has entered most sectors such as education, aviation, industry, engineering, science, medicine, and other fields.

This review aims to identify virtual reality technology, its different types, and the impact of using this technology in various fields of education. This paper is organized as follows. Section 1 is the introduction. Section 2 the concept of virtual reality, its types, advantages, disadvantages, and some of the applications of virtual reality in different fields were clarified. Section 3 presents literary reviews about virtual reality technology as an educational tool in various fields such as medicine, engineering, and sports, ending with the section showing the VR enhance learning. Section 4 some differences between Augmented reality (AR) and VR in education. The conclusion is in section 5.

Virtual Reality:

VR Concept:

We are currently living in a time of a great computer revolution, where we are witnessing the advancement of computers and their applications in various fields. The impact of computer technology is very strong, in our real life as there is no place that doesn't benefit from or apply it. One of the computer applications that has made a quantum leap in various fields is virtual reality technology.

Virtual reality technology aims to create an enjoyable and integrated experience for the person with all his senses by combining graphics technology, multimedia, human-computer interaction, and sound technology to produce an environment that is completely simulated to reality [1].

VR can be defined as "A human-computer interface in which the computer creates a sensory immersing environment that interactively responds to and is controlled by the behavior of the user". This definition is produced by the students of The Human Interface Technology Lab at the University of Washington [2].

Another definition of VR is "implementations by which individuals find themselves in a virtually created environment using various tools and interact with the environment" [3].

VR could be also defined as "experiences in which individuals could walk around in three-dimensional environments, developed with computer technologies, and the environment could be observed from all angles" [4].

There are many concepts of virtual reality, but most agreed that VR is a computer technology that relies on immersion and interaction in a three-dimensional graphical environment that is created to simulate reality with which the person interacts and becomes part of it [5] [6] [7] [8].

Virtual reality applications are increasing day by day, and we find them in many fields such as education, sports, medicine, entertainment, and others. In addition, the increase in the use of virtual reality applications has a great relationship with technological development and its spread. The use of virtual reality applications can be classified into applications by environment and applications by implementation shown in Figure 1 [3].

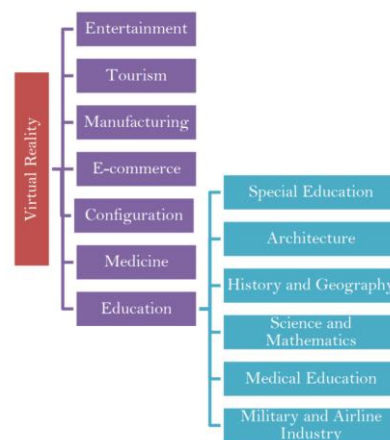


Figure (1): Use areas of VR Technology, taken from [3].

VR Types:

There are many widespread technologies that can be used in virtual reality so that they provide the person with a virtual experience to live with various senses, these technologies are diverse according to the style, size, and senses that we aim to convey information through, especially the sense of sight, hearing and touch, which are the following [9]:

Hand-Mounted Display:

Head-mounted display, or HMD for short, is a small stereoscopic display with a tracking system, which allows the user to see the surroundings in 3D with the ability to move the head in any direction and move the person within the environment. The holograms are displayed using two virtual cameras that are included in the software as each eye has a monitor. With the use of gyroscope technology and accelerometers, location recognition is possible [10] [11] [12].



Figure (2): Different types of HDM

HDM technology has become more practical in use due to the significant improvement in the performance of computers, peripherals, and specialized software that is produced, this has led to an increase in consumer virtual reality applications such as entertainment, tourism, films, education, and others [9].

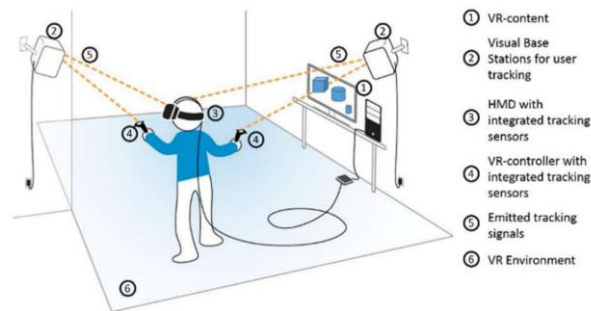


Figure (3): Main components of HDM system, taken from [9].

The Cave:

The Cave is a virtual reality application that offers a fully immersive interactive experience. The cave is a black, cube-shaped darkroom with dimensions of made up of several displays on which scenes are played by mirrors distributed between high-resolution projectors.

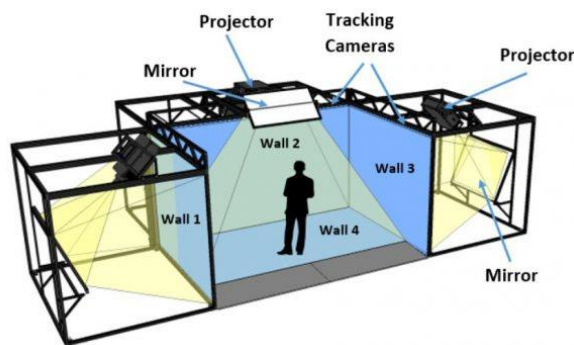


Figure (4): A 4-wall Cave [13].

In order for the user to live a unique experience with the cave, the user needs peripheral devices that can be used so that the viewer sees and hears accompanying sound effects. The user wears a special pair of glasses to see the displayed content and a joystick with several buttons to interact with the system [10] [12] [14].



Figure(5):A StereoGraphics CrystalEyes shutter goggle with the attached InterSense IS-900 wireless head tracker [15].



Figure (6): The InterSense IS-900 wireless wand [15].

ImmersaDesk:

It is a form of Cave-influenced partial immersion virtual reality where the same tools are used but only on one screen. The participant is provided with special glasses to see the contents on the screen, which are two superimposed images of the same content for each eye [10] [12].



Figure (7): An ImmersaDesk [15].

Advantages and Disadvantages of Virtual Reality:

VR technology has many benefits, and it has positively affected several areas, which can be summarized as follows:

- 1- Real world simulation.
- 2- Attractive and interactive.
- 3- Users using this technology can communicate and interact with each other remotely.
- 4- Easy to use.
- 5- Safe experience.

In contrast, VR faces some drawback such as:

- 1- The high cost of establishing, developing, installing and training employees.
- 2- Malfunctions.
- 3- Loss of social skills due to some people's addiction to using virtual reality continuously and incorrectly.

4. Need to rapid improvement.

Application:

Virtual reality can be applied in different fields, and here we show some of these areas:

Military:

One of the areas that benefit most from virtual reality and investment in it is the military. In this field, land vehicles, whether armored or tactical, water and aviation vehicles, are simulated, in addition to simulating submarines. Despite the cost of installing simulators, they are safer and more effective than the cost of real training. Also, soldiers are trained in the use of weapons in the field through head-mounted displays and control levers of firearms [10].

Entertainment:

The entertainment industry has benefited greatly from virtual reality applications. In the world of video games and computer games, virtual reality has been used to make the game more exciting and fun, which made game companies compete with each other to produce, innovate and develop new interactive games. Also in cinemas and televisions that contain stereoscopic technology [10].

Education:

One of the areas that have greatly benefited from virtual reality is education and training, as they have made education more interesting and enjoyable. In addition, it provides the possibility of implementing some situations that are difficult to implement in reality, either because of the danger, the difficulty or high cost of the experience. The application of virtual reality can be used in general education to teach science or mathematics, in medicine to improve the skills of medical students, in engineering to prepare students for real situations and facilitate the design process and make it better, and in other applications [10] [16].

Literature Review on VR in Education:

Education and technology are closely related. Over time, and with the introduction of technologies in education, methods used in teaching students changed, after the student was a recipient, the user became involved in the educational process [16].

VR as a tool in education:

Undoubtedly, some students face some problems in education, such as difficulty understanding some subjects as in science, math, and others. This is due to their complexity and that some concepts are not tangible. Other subjects that carry a practical aspect in them and cannot be applied either because of the lack of tools or the difficulty of implementation or high cost. Education faces some problems that can be solved if virtual reality is used as a tool that contributes to supporting and facilitating the teaching and learning process due to its strength and ability to make a positive change for students. "Cooper and Thong highlight four distinctive

elements of VR as an educational tool: (1) Experiencing as the ability of students to respond physically and emotionally to a range of stimuli, (2) Engagement as the multisensory experience that may enhance student's engagement, (3) Equitability as ways of responding to sameness and differences in schools and (4) Everywhere as offering exciting possibilities in relation to location, timeliness and how the learning process emerge." [17].

Virtual reality can be used as a teaching tool in many fields as [18] [19]:

- Architecture and civil engineering.
- Chemistry
- Machine engineering
- Medicine and Biology
- Physics and Astronomy
- Business
- Entertainment
- Fashion
- Media
- Military
- Scientific Visualization
- Sports
- Engineering, etc.

VR in medical education

In "An Overview of Virtual and Augmented Reality in Dental Education" by Mihaela Dută and others [20]. They used a general literature collection of studies and abstracts published during the period from 2000, to 2011, using the search terms "virtual reality", and "dental education". Check out the review of VR applications that have been created and developed in the past 11 years such as DentSim [21], Virtual Dental Patient [22], Virtual Reality Dental Training System [23], HapTEL [24], and others. Other have been approved for use on augmented and virtual reality in various dental forms such as head and neck surgeries, and in pain relief. The study began in that period, and that the use of technology has the potential to improve the quality of students' skills. Other studies discuss the advantages and disadvantages of using virtual reality and augmented reality in dental education [20].

VR in Engineering Education:

The paper "A Critical Review of the Use of Virtual Reality in Construction Engineering Education and Training" by Peng Wang and others [25], is a comprehensive

review related to virtual reality in construction engineering education and training was presented in terms of identifying technologies related to virtual reality, its applications, areas of implementation, determining future research directions and potential benefits from them. The research design relied on 3 stages, retrieval of scientific papers related to engineering and construction education research, then analyzing them based on the type of techniques and their application, and finally summarizing the results and making suggestions. The study showed that the techniques have benefits for many topics of education and training in the field of construction engineering, such as architectural design, construction health and safety, equipment operation, and structural analysis. Also, the study showed that virtual reality and augmented reality technologies have tremendous potential to increase student participation, interaction and motivation, as it helps students to define the building in detail and enhance students' understanding of spatial spaces, as it leads to the reversal of learning patterns from teacher-centered learning to student-centered learning. The study indicated some limitations related to the use of virtual reality applications in building engineering education, training, and future research. It showed that virtual reality applications do not cover all areas related to building engineering education and training, and in terms of future research, it was clear that the technology has not been fully tested, so it must be ensured that it is compatible with educational models emerging engineering [25].

VR in Sport Education:

An article entitled Application Expectation of Virtual Reality in Basketball Teaching was published in 2011 and written by Hua-ping Yao and others in which the authors used literature and information method to explain the concept and features of virtual reality and the essential role it plays in teaching basketball. Students from the risk of injury, raise the level of students moving and tactical skills, compensate for the deficiency when training is not possible, and enhance the students' cognitive aspect of basketball [1].

VR Enhance learning:

Studies have been conducted on the use of virtual reality and its impact in various fields. The possibilities of virtual reality of immersion, interaction, and surrounding environment, provide a saturated experience for the senses for any individual who uses virtual reality anywhere. Moreover, its use with its tools in teaching, learning, and training has a significant positive impact, as the opportunity to present the traditional classroom as a virtual classroom makes the student feel comfortable, and increases the Motivation, the interest in lessons and continuity. In addition, it gets rid of boring traditional educational methods, makes the lesson more fun and interesting, enhances the learning process, engages students in the educational process, improves students' performance in exams, draws students' attention to

lessons and clarifies ideas that are difficult to understand. Virtual reality develops the spirit of cooperation and participation among students, encourages self-learning, and stimulates the search for knowledge. Virtual reality makes the students' sense of presence much stronger, increases the opportunity for experiential learning and the discovery of errors, as well as the formation of positive attitudes toward virtual learning environments. Presenting realistic experiences as a virtual reality that contributes to discovering and refining students' skills and motivating them to be creative and innovative, and has a positive impact on students' identities and personal development. Virtual reality facilitates the presentation of situations that are difficult to perform because of their danger or difficulty [3] [11] [16] [26] [27] [28] [29] [30].

In terms of learning styles, the integration of virtual reality with teaching methods meets the needs of individuals and reaches all types of learners, auditory, visual or tactile, and focuses on targeting learning levels from the lowest level which is remembering to the highest level which is evaluation [8] [30].

AR vs. VR in Education:

In a study published in 2022 entitled (Augmented Reality and Virtual Reality in Dentistry: Highlights from the Current Research) conducted by Sidra Fahim and others [31], they mentioned that in a recent study conducted on a group of dental students, augmented reality technology was used with traditional methods (lectures and corpses) in teaching a group of students, while the traditional method (textbooks / two-dimensional images) was adopted on another group (the control group), The study showed an improvement in understanding and a positive effect on the retention of anatomical knowledge in students compared to the control group. Virtual reality technology has also been used to increase dental students' knowledge as virtual reality allows students to view oral treatments as live participants [31].

Another study published in 2019 entitled (Augmented Versus Virtual Reality in Education: An Exploratory Study Examining Science Knowledge Retention When Using Augmented Reality/Virtual Reality Mobile Applications) conducted by (Kuo-Ting Huang and others) [32], study's goal is to answer two questions: First, what are some of the possible psychological and cognitive mechanisms that might explain any potential differences between AR and VR in an educational context? Second, is AR or VR a more effective tool/medium for educating students about science? Therefore, they assumed three hypotheses and then collected a sample of students who study at the university, their average age is 20.5 years, and the percentage of females is 74. As for the tools of the experiment, it is the solar system application that was downloaded into the Samsung mobile and displayed with augmented reality and virtual reality technology with the same quality and sound. The

difference was in the way of navigating the menu, as in the augmented reality technology, it was necessary to touch the screen, while in the virtual reality technology they used pupil identification, and to reduce the difference, the researchers moved the menus to the participants. Group using augmented reality technology each participant held a mobile device in front of their face and viewed the content as a non-interactive layer on top of the image of the physical environment fed by the phone's camera. Group using virtual reality Participants held a phone-based VR headset in front of their eyes and watched the content displayed against a white background. In both modes, participants could turn the device 360 degrees to look around at the content.

The experiment was initially, the participants were asked 10 pretests about the general information taken from the program, then 10 protests were asked after, 5 questions from audio digital content and 5 questions about digital visual content.

The results of the study demonstrate that virtual reality is more immersive and attractive than augmented reality, especially with regard to spatial presence. In terms of transmitting audio information, the results showed that augmented reality is more effective compared to virtual reality through the spatial presence path. Therefore, when designing educational content, visual methods should be combined with virtual reality and auditory methods with augmented reality [32].

Conclusion:

Virtual reality technology has revolutionized the computer world. There is no doubt that the use of computers and its technologies has a great impact on improving and developing the educational process. especially the twenty-first century, in which we are witnessing a great and rapid development in various types of computers, technologies, programs and applications used. So that hardly a month passes without seeing or hearing about new innovations and advanced technologies. Virtual reality technology is one of the technologies that must be invested on a large and correct way in the education sector and in its various fields. Virtual reality improves the educational process and makes it attractive and interactive.

Virtual reality technology has revolutionized the computer world. There is no doubt that the use of computers and its technologies has a significant impact on improving and developing the educational process. Especially the twenty-first century, in which we are witnessing a great and rapid development in various types of computers, technologies, software and applications used. So that hardly a month goes by without seeing or hearing new innovations and advanced technologies. Virtual reality technology is one of the technologies that must be invested more properly in the education sector and in its various fields. Virtual reality technology has contributed to improving education in many ways, making it a more attractive

and comfortable environment. In addition, it developed the students' skills and raised the level of their performance in some difficult subjects. It also facilitated the implementation of dangerous situations and made them safer. Virtual reality can be used as a means to reach all types of learners. Virtual reality has brought about a change in the method of teaching from traditional to modern, which transfers the student's level from the lowest level - remembering to the highest level – knowledge.

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