V

Virtual Reality Applications in Education

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Synonyms

HMD: Head-mounted display; VR: Virtual reality

Definition

Virtual Reality (VR) is a three-dimensional simulation environment where users can feel close to real life experiences in an artificial world developed with different devices and visualization equipment, as well as interacting with other objects.

Introduction

According to Gobbetti and Scaneti (1998), virtual reality is possible to create a visible world that is felt, treated, and acted on the basis of virtual reality. Similarly, Deryakulu (1999) states that virtual reality is a technology that users get different experiences from an artificial world created by computer with special technologies worn on their bodies. Sherman and Craig (2003) claim that the virtual reality environment is expressed as interactive computer simulations that allows users to immerse and simulate an environment. In the virtual reality environment, the senses act as if they perceive a physical reality (Sherman et al. 2009). Virtual reality can be characterized as either interactive or noninteractive simulation application which is designed to create a sense of presence in a virtual world created by computer with the help of some wearable technologies and imaging equipment. Human-machine interaction in virtual reality may mislead human emotions. Dede et al. (2017) state that virtual reality focuses on visual or audio stimuli with some haptic devices and it provides sensory immersion.

Features of the Virtual Reality Environment

Three important features of virtual reality are expressed by Piemental and Teixeira (1995) as "three-dimensional graphical world," "being

N. Lee (ed.), *Encyclopedia of Computer Graphics and Games*,
https://doi.org/10.1007/978-3-319-08234-9_166-1

immersed," and "interaction." Sherman and Craig (2003) add "emotional return" to these features. According to Piemental and Teixeira (1995), the main components of virtual reality are model, computer programs, computer, location sensor, and interaction tools. Whyte (2002) states that interaction is the main feature that separates virtual reality from animation and navigation. These features are described in the following text.

Three-dimensional graphical world: Modeling of real environment or imaginary space.
Being immersed: The fact that you are mentally withdrawn from the real world.
Interaction: The response of the environment to the user's commands.
Emotional return: To be sensibly affected by the actions of the observer in the virtual environment.

In addition Burdea and Coiffet (2003) emphasize that virtual reality has three important components ("three I"). These are: immersion, interaction, and imagination. Immersion means creating the feeling of "being there" (presence); interaction means ability of the users to move in the virtual reality environment and to interact with the objects; and imagination means convincing users to believe something even if their representation is unreal.

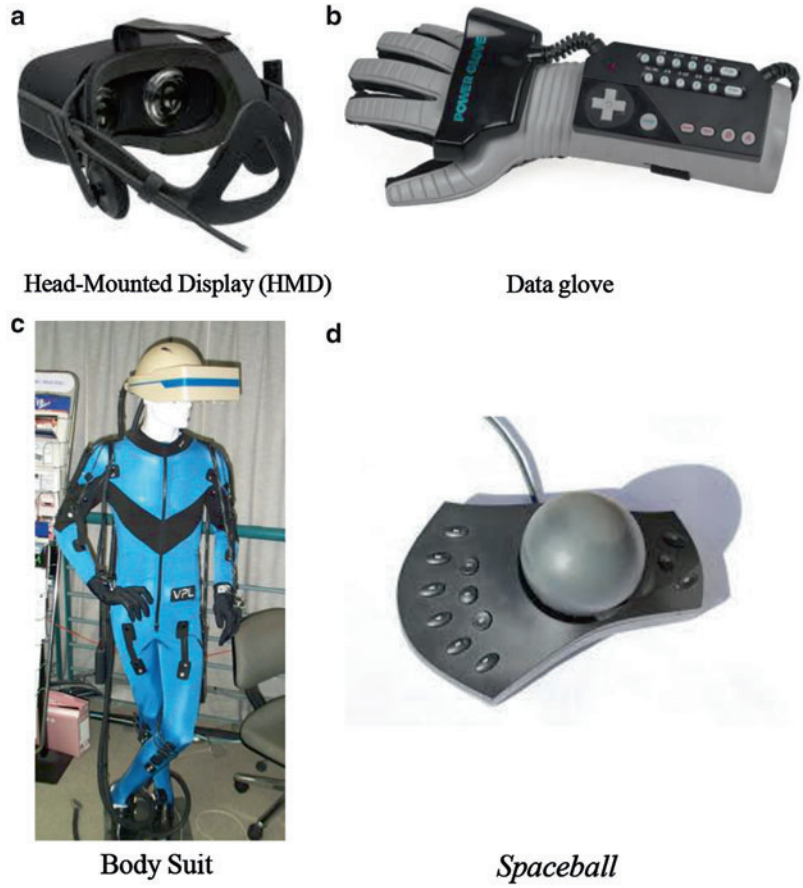
Types of Virtual Reality

McLellan (1996) deals with types of virtual reality under nine titles. These are defined in the following text.

- *Immersive First-Person:* The user is positioned within the view. Constant interfaces and a BOOM imager are used to simulate the experience of going through virtual space. The BOOM viewer attaches to the front of the viewer.
- *Augmented Reality:* It is an information processing technology that combines real-world images with computer-generated encoded data.
- *Desktop VR:* It is the easiest one in virtual reality. The biggest disadvantage is that the user does not feel like being immersed. This reduces the feeling of being in the environment (presence).
- *Mirror World:* This system uses video cameras as input devices. The user sees his or her own image as adapted to the screen.
- *Waldo World:* In Waldo world, user is connected to real time by a remote control mechanic router. The user controls an image of the computer animation placed on a robot or image in real time by wearing an electronic mask or body suit plugged a sensor detecting movements.
- *Chamber World:* The virtual world in this environment is defined as a room surrounded by walls and ceilings. The observer enters this place and fully adapts to the virtual world by wearing three-dimensional special goggles. This interactive virtual reality environment, potentially consisting of many users, can be used effectively in collaborative projects. The CAVE system is an example of systems installed with ceilings, floors, and screens with four walls mounted.
- *Cabin Simulator Environment:* It requires environments that are connected to computers, designed in the same way as reality. It allows the real environment to reflect on the screen and to interact with the user.
- *Cyberspace:* It is possible that anything can be found anywhere and anytime in cyberspace. Any person at any point in this world can be found in the same environment at the same time.
- *Telepresence/Teleoperation:* The individual feels that she/he is in a different place than the place where she/he is physically present.

Interactive Devices Used in Virtual Reality

Interactive devices used in virtual reality can vary according to their purpose. Some of these interaction devices are introduced below. Figure 1 shows some interaction devices used in virtual reality.



Virtual Reality Applications in Education, Fig. 1 Some interactive devices used in virtual reality. (**a**) *HMD*: In these systems, the position can be continuously measured with motion sensors. Once attached to the head, the current image can be viewed through the optical system. The user can easily navigate around the virtual environment (Beier 2008). (**b**) *Data Glove:* The data glove is an input device which provides data entry to computer with hand movements and specific positions. (**c**) *Body Suit:* By entering these clothes equipped with special sensors, users' movements can be perceived and user movements can be transferred to digital environment. (**d**) *Spaceball:* These devices are joystick-like and can be used by pressure in desired direction. Spaceball is also used in motion analysis

Some New Virtual Reality Technologies

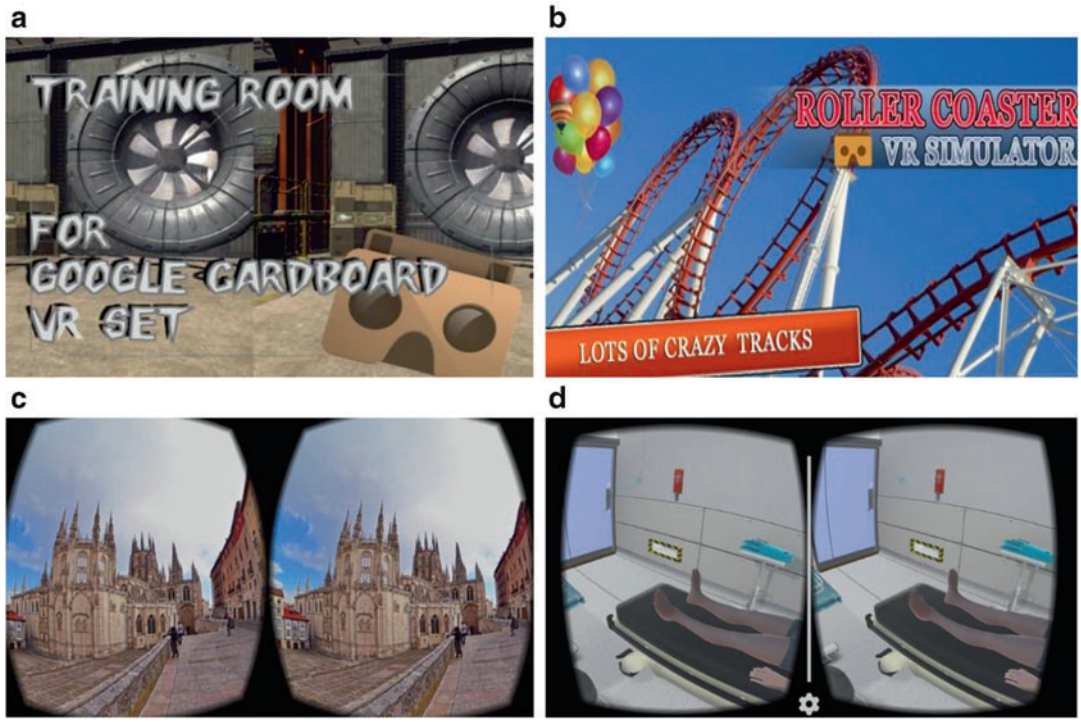
The high cost of virtual reality devices, the limited access to facilities, requiring expertise in the adaptation into the education sector, and long-term use leading to health problems are disadvantages of virtual reality applications. Although virtual reality applications were seen as an expensive technology, virtual reality experience has been sought after and desired by everyone recently. Increased interest to virtual reality attracted attention of mobile technology companies, and this caused the development of numerous new mobile equipment and applications including components of virtual reality. Especially, by decreasing the cost of virtual reality goggles, virtual reality applications for mobile operating systems became accessible and practical. Many free downloadable virtual reality applications in Play Store or App Store, for example cheap Cardboard goggle (Fig. 2) developed by Google Company, became easily accessible for users.

Detailed information about Cardboard is available at https://www.google.com/get/cardboard/. With Cardboard applications, users can feel

different experiences. This virtual reality goggle can be used for games (Fig. 3a), entertainment (Fig. 3b), nature trips (Fig. 3c), and medical training (Fig. 3d).

Virtual Reality Applications in Education, Fig. 2 Cardboard goggle

Another new trend in virtual reality is forming videos by jump camera system (Fig. 4). This technology offers to users the opportunity to watch 360° videos. Jump camera system consists of 16 camera modules placed in a circular pattern. Length of this setting and positions of these cameras were optimized to work with Jump compiler program. Jump compiler program converts video images consisting of 16 pieces to stereoscopic virtual reality videos. Thanks to its high-resolution stereoscopic vision technology nearby objects are perceived as nearby, while distant objects are perceived as far. In these devices, 3D alignment method specially developed and integrated into the system is used in order to obtain a seamless and panoramic image. Thus, the combination locations where the camera images from each camera come together are not recognized. Designed 3D videos are equivalent to super high-resolution images at least five 4 K image. This technology is expected to reveal a new trend in cinema and gaming industry.



Virtual Reality Applications in Education, Fig. 3 (**a**) Game, (**b**) entertainment, (**c**) nature trip, and (**d**) medical experiences

Virtual Reality Applications in Education, Fig. 4 Jump camera setting

Virtual Reality Applications in Education, Fig. 5 Google spotlight stories

Another new technology "Google Spotlight Stories" interactive videos (Fig. 5) were designed by Google for smart phones. In these applications when sensors for videos located in certain regions were stimulated, video passes to the other stage through the sensors on smartphones. Each scene is part of the whole videos scenes and so continuity is provided in the video. Users can feel themselves in an interactive virtual reality scenario when they use it with Cardboard goggles. Today, while this application is supported by only some Android devices, support for numerous mobile devices has been recently expressed by the manufacturer.

Educational Uses and Potential Advantages of Virtual Reality Applications

Virtual reality applications can be found in the areas of entertainment, tourism, e-commerce, medicine, defense, construction, manufacturing, and education. Sala (2016) also mentioned virtual reality can be used in medical applications, foreign language acquisition, engineering training, education, field of architecture, and interior design. Students can conduct educational trips with virtual reality applications. Thus, they experience a sense of being there (presence), and they virtually go to and can hear voices of objects there. Virtual reality applications have been used in military education as defense and attack with support of simulation. In medical education, students can study on virtual cadavers or living human body and experience realistic situations. Students might have a chance to perform dangerous and costly experiments repeatedly in virtual realistic labs. Virtual reality can be effectively used to teach intangible concepts in mathematics, for better understanding of historical phenomena in history, or to teach surface formations in geography. It can also be used in the context of interacting with people in different countries for language teaching. Every user can see each other in same virtual environment and communicate and interact by using different virtual reality devices with the help online multiuser virtual reality applications. Three-Dimensional Virtual Worlds (3DVWs) are known as desktop virtual reality environments. 3DVWs can be used for educational purposes in higher education as simulation, field trip, gaming, discussion, and virtual lecturing (Ghanbarzadeh and Ghapanchi 2016). Augmented reality is an extension of virtual reality. As in virtual reality, augmented reality applications are also used for educational purposes. Augmented reality applications can

foster effective and efficient learning (Uluyol and Şahin 2016). These kinds of applications provide the fulfillment of effective collaborative work activities. Ip and Li (2015) state that virtual reality technology brings new opportunities and challenges to teaching and learning. In addition, virtual-reality-based learning environments incorporate instructional design for educational purposes.

There are some limitations of virtual reality. The costs of virtual reality applications are high, the accessibility is limited, and the expertise required for the education sector is troublesome. It is not easy to use for learners and technical information is needed. Fowler (2014) emphasizes that one of the challenges of virtual reality is understanding the pedagogical design and use of virtual reality systems. Further, virtual reality can lead to health problems during longtime usage (such as headache and eye pain). But these limitations can be overcome as the time passes and the following benefits of virtual reality applications in education may be embraced:

- Virtual reality may directly contribute to the development of students' complex ideas and skills (Roussou 2004).
- Virtual reality may offer personnel learning strategies and didactic paths that privilege an intuitive approach (Sala 2016).
- It may enhance motivation and learning (Dede et al. 2017).
- It may facilitate learning, support abstract concept learning, implement paradigms, support vocational training, support decision-making, support realization, and enhance learning process (Mellet-d'Huart 2009).
- It may be abstracted from external factors, allowing it to selectively focus on the information that is being studied.
- Virtual reality may provide a strong environment for students to understand the lesson.
- Virtual reality may enhance students' creativity and self-confidence.
- Virtual reality may provide facilities for learners when examining places where learners have no opportunity to explore.
- It may provide practice environments where it is not possible for students to experience it in real life.
- Learners may learn more effectively by joining as many applications as they want at their own pace.
- Learners may experience virtual reality by participating in applications independently of time and place.
- Students may have the opportunity to perform a task that requires physical effort and to explore as if in real life environments, without fatiguing at the computer.
- Because virtual reality environments require interaction and active participation, it may shift learners from passive to active.
- With virtual reality applications, the ability of students to use different virtual reality hardware may increase.
- Learners may learn by doing through self-discovery in virtual reality environments.
- Virtual reality environments may overcome the risk factors that can be encountered during real life events.
- Individuals with disabilities who have no chance to participate in experiments and learning environments may have access to learning experiences with virtual reality environments.
- With virtual reality applications, individuals who are far away and have common interests may come together for common projects and gain different experiences.

Cross-References

▶ Everyday Virtual Reality
▶ Virtual Reality as New Media
▶ Virtual Reality Systems, Tools and Frameworks

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