

A Review of the Application of VR Technology in Medical Training

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Abstract: As one of the most fashionable technologies, VR(Virtual Reality) technology has the characteristics of high interaction and strong immersion, and has been widely used in medical training and has achieved remarkable results. The virtual simulation environment established by it helps teachers to show students the structure of the human body and organs more intuitively in the teaching process, and its simulation training system helps students practice relevant skills in the virtual environment. The development of future technology will surely solve the shortcomings of VR technology and make it better used in medical training.

Keywords: VR, Medical training, Apply.

1. Introduction

In recent years, with the continuous advancement of science and technology, VR technology and its products have affected all aspects of people's work, learning and life. For example, in terms of medical training, compared with traditional teaching methods, teachers can use VR equipment to intuitively show students human structures and organs, medical students can learn professional techniques such as injection, suture, etc. in the simulation environment created by VR technology and master the operation skills of related tools, while VR equipment can be evaluated according to the students' practice results to help students understand their mastery of knowledge and operational deficiencies. Its flexible training venue, low training cost, strong interactivity and immersion, and remote teaching are deeply loved by teachers and students.

2. VR Overview

2.1. The concept and components of VR

The full name of VR is Virtual Reality, he is based on computer technology, combined with multimedia technology, graphics technology, simulation technology, etc., and with the help of related equipment to produce a virtual world with a variety of sensory experiences such as sight, hearing, smell, etc., in this virtual world, users can walk and interact with objects in the virtual world, so that users have an immersive feeling [1].

VR technology and its equipment mainly consist of two parts: hardware and software. The head-mounted display, also known as the VR headset, is the core part of the hardware, which has one or more sensors that can be used to track the user's head movement and adjust the image that the user can see; VR software creates a three-dimensional environment that interacts with the user. These environments can be completely fictional, like videos and games, or they can be real-world simulations like VR teaching.

2.2. Development of VR technology

As early as 1956, American film special effects artist Morton Heilig invented a device called "Sensorama", as

shown in Figure 1, the device contains 3D display, stereo, vibration seats and other accessories to enhance the user's viewing experience, which can be regarded as the earliest virtual reality equipment. In the late sixties, American computer scientist Ivan Sutherland and his student Bob Sproull invented the "Sword of Damocles", as shown in Figure 2, a head-mounted display device that is considered the originator of virtual reality headsets [2]. VPL Research's founder, Jaron Lanier, first introduced the term "virtual reality" into the public eye in the eighties and developed the first commercially available VR device. At the beginning of the 21st century, with the continuous advancement of computer graphics technology, VR technology gradually became more and more realistic, and VR equipment at this time was mainly used in professional fields, such as military, medical and aviation. Nowadays, VR devices have become more and more common, and the technology has been continuously improved. The application field of VR has also gradually expanded, including entertainment, education, design, training and other fields. Especially during the pandemic, many people started working and studying from home, which further boosted the development of VR.



Figure 1.

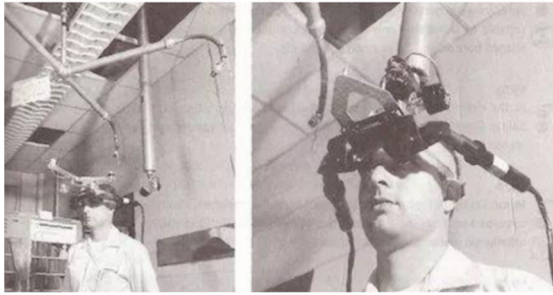


Figure 2.

3. VR Technology and Medical Training

3.1. Advantages of VR technology in medical training

In medical training, VR provides a risk-free, flexible environment that can simulate a variety of complex situations. This environment is difficult to replicate or manufacture in reality. Using VR technology, medical students can practice medical techniques without involving real patients, increasing their familiarity with various situations, and can practice unlimited times until they become technically proficient. VR simulators can provide realistic feedback, enabling medical students to self-assess the accuracy of their operations, while also providing professional assessments and feedback to guide users to improve their techniques. In addition, VR simulators can also simulate various surgical complications and contingencies, enabling medical students to be prepared for real-world unexpected situations. In addition, teachers can use VR technology to show students complex surgical steps and techniques, and students can learn by watching the virtual surgical process. At the same time, VR can also be used for remote teaching, allowing medical students around the world to learn the most advanced medical knowledge.

Medical training is a very long process, training a good doctor requires a lot of time and financial resources, and the use of VR technology can greatly shorten the training cycle. Dr. Zhang Qiang, a well-known vascular surgeon, believes that in the learning of anatomy, the introduction of VR technology can shorten the training time by 80% [3]. Shorter training times also mean lower training costs. Traditional medical training requires the human body or a large number of small animals for medical students to practice, which inevitably causes harm to small animals, while VR technology can simulate human organs for medical students to practice better [4].

3.2. Development and application of VR technology in medical training

3.2.1. The development of VR technology in medical training

The development of VR technology in medical training can be traced back to 1985, when Colorado State University College of Medicine used CT and MR scans to make two bodies of different genders into "visual humans" that medical students could dissect on a computer. In 1992, the University of North Carolina acquired ultrasound scans in real time and transmitted them to a doctor's head-mounted display. In 1995, "virtual frog anatomy" appeared on the Internet to allow users to perform a virtual dissection on the screen and observe the muscle and bone structure of frogs [5].

Subsequently, in the rapid development of the computer field, VR technology was applied to medical training.

3.2.2. Application of VR technology in medical training at home and abroad

In 2012, Jack Choi presented the Anatomage virtual anatomy table to the audience at TED, as shown in Figure 3. The virtual dissection table was developed by the Virtual Reality Center in California, USA. On this virtual dissection table, medical students can change the size of a part of the body with the touch of their fingers to observe the details of that part. Medical students can also choose the cutting mode, simulating the cut with their fingers, allowing them to observe the cross-section of the organ and its internal structure. Both the body and organs can be rotated, making it easy for students to observe learning from all angles [2].



Figure 3.

In 2016, Professor Mark Grisward showed the world his three-dimensional anatomical hologram, which can first show a complete human model, and then show the parts needed for teaching, such as the kidneys, heart, lungs and other organs, which will also retain their position in the human body. Teachers can also add labels where needed to help students highlight and strengthen memory [2].

In 2016, doctors at the Royal London Hospital used VR technology to broadcast the process of performing tumor removal surgery on a patient to the world for medical students to study and learn [2].

In addition to learning for students, VR technology also plays a big role in practical training. In oral training at Osaka University, students develop their ability to drill teeth by simulating tooth structure and tissue. The School of Stomatology, King's College London, helps students practice professional skills such as fine needle injection and cavity refilling through multi-function and precise tactile simulation; Peking University Stomatology Hospital and Beihang University use multi-point force feedback and deformation simulation technology to train students in periodontal exploration, subgingival curettage and root surface planning [6].

In orthopedic surgery training, interactive orthopedic surgery simulator can simulate a variety of complex orthopedic operations, such as arthroplasty, joint dissection surgery, fracture reduction and reduction, etc. Arthroscopy simulator can simulate normal knee anatomy or similar pathological conditions such as meniscal tear and joint cartilage defect, and can be used to cultivate students' ability to knee joint examination and torn meniscal resection [7].

In the clinical training of burns, VR technology can realistically simulate the surgical skin grafting, venipuncture catheterization and other environments after burns, which are used for related skills training, and provide feedback on hearing, touch and vision, and evaluate and correct the user's operation, helping the user form a correct and standardized

operation memory [8].

4. Summary and Outlook

The application of VR technology to medical training has greatly improved the efficiency of medical students and solved some situations of insufficient resources. Although VR technology and its products are not mature, due to the high price of equipment, only a small number of experimental classes use VR technology for medical training, insufficient resolution of image processing makes it easy to produce dizziness and other problems during use, but it has occupied a place in medical training and achieved satisfactory results. With the continuous advancement of science and technology, such as 5G technology's large traffic and low latency can improve the smoothness of VR pictures, and more and more technology companies such as Apple see the development prospects of VR technology after the development of VR equipment, the price of VR equipment will be reduced, and eventually become a common electronic device in life. At that time, VR medical training will become a very common training method, and its training objects can not only face medical students, but also provide non-medical students with appropriate first aid common sense training, such as Heimlich first aid method, cardiopulmonary resuscitation compression position and strength, etc.

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