

3D Simulation Medical Training Using Virtual Reality (VR)

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Abstract:

This paper represents the use of the 3D model simulation of medical training by using virtual reality (VR) technology. The implementation of 3D models in virtual reality helps to enhance the student trainees' experience, cognitive and psychomotor skills, while reducing the risk of medical training errors of students during the training period. VR technology allows the student trainees to practice the complex medical procedures with more interactive and realistic experience by providing a safe and secure environment to the trainees' while developing their skills. This paper also discusses the benefits and the challenges faced while developing the 3D simulation in the medical field. The development of 3D simulation in virtual reality involves multiple phases in that some of the important stages are immersive VR which is used for the development of the environment, Augmented Reality (AR) which is used to converted the VR environment to feel as the real world experience, Haptic feedback is used to improve the experience and real feel of practicing, Collaborative VR which helps to involve multiple trainee to interact at the same time, Last and main stage is gamification involves the game like elements such as levels, badges, and win or lose which will be creating young trainee to spend more time in this. Overall, this method helps to improve the experience of the trainee using the VR in medical training, It also has its own advantages and limitations during the development. Choice of the methods will be selected as per the requirement of medical procedures being simulated. VR is the most popular topic in the technology of latest inventions so, by using this in the medical training it helps the student to spend more time and help them to increase their knowledge and score best results. The use of VR technology in the medical training effect the better outcomes with less cost efficiency compared with the real time training. Training

Keywords: VR technology, Unity engine, 3D simulation.

I. Introduction:

NOW A DAYS Virtual Reality (VR) has been increasing popularly in medical training. It is used to train health care professionals in various medical procedures. It is an effective way to train the medical students, surgical residents, and healthcare professionals on 3d models. There are many benefits of using these VR in medical training.it will reduce costs, improves safety, increasing efficiency, and enhanced learning outcomes. VR can also be used to simulate rare and complex medical scenarios that are difficult to replicate in real-life situations. VR is a technology that creates a 3D environment which improves knowledge of trainees. One of the most used applications of VR in medical education is the simulation of medical procedures using 3D models. Here we are creating organs, tissues, furniture, and medical instruments in a 3d realistic model that helps trainees to practice procedures and interventions in a safe and controlled environment. The use of VR and 3D models in medical training improves the quality, and efficiency of training, it will reduce the risk and cost that are associated with traditional training methods. While trainees can get immediate feedback on their performance this method also helps to improve trainees' skills. Benefits of using 3D models simulation with VR in medical training, Realistic simulations: VR can create realistic simulations that mimic real-life scenarios, and it allows training students in a safe environment and helps to enhance their knowledge. Learning experience: In VR, students can interact with virtual objects and have a live experience in a controlled environment and they can learn from their mistakes with the real-time feedback on their performance, enabling them to improve skills. Cost-effective: Using VR simulations can be more cost-effective than traditional training methods. Medical schools do not have to invest in expensive equipment or cadavers, and students can practice procedures as many times as necessary without any additional costs. These methods help a lot to reduce costs. Improved retention: Studies have shown that students retain information better when they learn through immersive and interactive experiences. VR simulations provide such an experience, allowing students to retain knowledge more effectively. Friendly learning environment: Trainees can practice procedures without the risk of harming real patients. This enhances patient safety and improves the quality of care. For creating this 3D model simulation using VR, a team of developers and medical professionals would typically follow some steps. Gathering data, model creation, VR environment creation, programming, testing. In this simulation the main role will be played by the simulation software called unity engine which helps to import the 3D simulation models into the VR environment. The controllers will be chosen according to the simulation training process, and to run on different platforms we might require different software to be developed. Virtual reality (VR) uses a simulator to immerse users in a real-time 3D virtual world, creating a truly unique experience. Potential customers have the opportunity to interact with your products as if they were actually present. By and large, the 3D model recreation of emergency clinics utilizing VR innovation can possibly revolutionize medical preparing and patient consideration, giving a protected and vivid climate for clinical experts to learn and work on, prompting better quiet results. This innovation permits clinical understudies, residents, and rehearsing doctors to encounter reasonable clinic conditions, communicate with reproduced patients and clinical gear, and practice operations in a protected and controlled setting. The 3D model reproduction empowers the formation of exceptionally practical and exact clinic conditions, with precise representations of clinical hardware, patient rooms, and crisis divisions. This empowers clinical experts to prepare in a protected climate, without the dangers and expenses related with genuine preparation situations. Generally, the 3D model reproduction of clinics utilizing VR innovation can possibly alter clinical preparation by giving a vivid and intelligent climate for clinical experts to learn and work on, prompting better understanding results and further developed medical services by and large. The utilization of Augmented Reality (VR) innovation in clinical preparation is quickly acquiring notoriety, and one application that is reforming the field is the 3D model

reproduction of emergency clinics utilizing VR. This innovation gives clinical experts a vivid and intelligent opportunity for growth, permitting them to rehearse strategies, work on their abilities, and gain involved insight in a protected and controlled climate. The 3D model reproduction of clinics permits clinical students to explore through a virtual clinic climate, connect with patients, and work on utilizing clinical hardware, all while getting continuous criticism and direction from experienced teachers. Besides, this innovation considers the production of reasonable situations, empowering students to learn and work on dealing with crisis circumstances, patient consideration, and basic direction, prompting worked on understanding results. Generally speaking, the 3D model reproduction of emergency clinics utilizing VR innovation is an integral asset that is changing clinical preparation, giving a protected and vivid climate for clinical experts to learn and work on, prompting better understanding consideration and results.

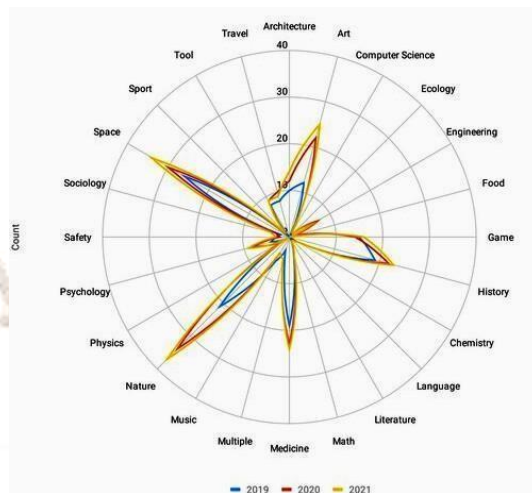


Fig.1 Areas of VR Educational applications

II. Related work:

This technology can create an environment similar to the real world, or it can be a fantastic world, creating an experience that is not possible in conventional physical reality. A three-dimensional environment is simulated by virtual reality headsets or multi-projected environments that incorporate fairly realistic visual and auditory feedback [1]. VR technology is getting popular with the advancements in hardware and software. It assists a surgeon to operate without any harm. During emergency cases, Intensive Care Unit staff can practice the procedure in limited time [2]. By using this technology, students can see 3D objects in the digestive organs that will be applied to mobile devices to create more interactive learning [3]. The demand for healthcare and healthcare professionals is rising around the world. By the year 2030, the global economy is projected to create 40million new healthcare jobs, and yet at present there remains a shortage of 18million healthcare workers. One factor contributing to this shortage has been a lack of effective undergraduate or preregistration medical education, which is defined as any type of initial study that leads to a medical degree that is recognized by relevant governments, and enables entry to the healthcare workforce [4]. evidence). We found no differences between VR training and no training or conventional training for other outcomes. Based on qualitative analysis, we found no significant differences between VR training and other forms of simulation training. VR curricula based in educational theory provided benefit with respect to composite score of competency, compared with unstructured curricula [5]. For instance XR offers the possibility to create interactive interfaces that can facilitate better preoperative planning and enhanced intraoperative navigation and provide patient education and surgical (resident) training. Consequently it is important to explore the potential benefits of XR applications in all these aspects of surgery [6].

III. Methods of Development:

Virtual Reality (VR) has revolutionized the field of medical training by providing a safe and realistic environment for trainees to practice procedures and scenarios.

Some of the methods of 3D models simulation using the Virtual Reality in medical training are:

1. Immersive VR: It creates a fully VR environment which is immersive. In this trainees can interact with patients through 3D models using VR controllers and VR headsets. It is in a realistic and interactive way when they receive feedback.
2. Augmented Reality AR: It creates a real-world environment which can be used by mobile devices and AR headsets. It helps trainers or practitioners to practice medical procedures on real objects. In this also they will receive feedback like Immersive VR.
3. VR Surgical simulators: It allows medical students as well as professionals to practice in a safe way and controlled environment. Some of the simulators which are typically involved are VR headset, haptic feedback and surgical instruments that can perform in a wide range of procedures.



Fig.2 VR Based simulation

4. Interactive 3D models: These are created using computer-aided design (CAD) software. Trainees can interact with models in a virtual environment. These models can be used to simulate various procedures such as surgeries, dissections, and medical device implantations. It can be viewed and manipulated in VR. It allows students to explore the body in a way that is not possible with traditional 2D models and diagrams.

5. Gamification: it involves using a game like elements such as rewards, points, badges and leaderboards to encourage and motivate trainees. It makes training more fun and engages people to practice and improve their skills.

6. Haptic feedback: Haptic feedback includes using the specialized gloves and other controllers which provides a force feedback and a tactile sensation. This device is to simulate the sensation of touch. It is particularly used in surgical procedures where the motor skills are used. This method enhances the realistic training experience. This technology is used to simulate the procedures such as suturing, catheterization and endoscopy.



Fig.3 Haptic feedback controller

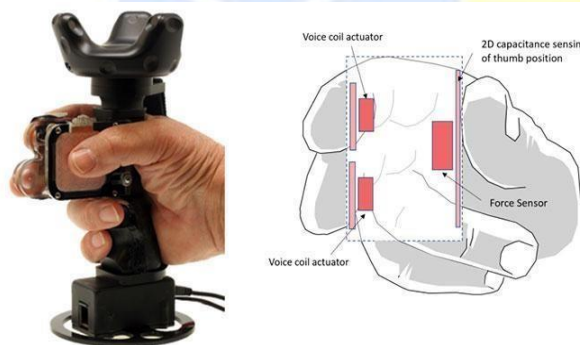


Fig.4 Microsoft developed TORC

7. Collaborative VR: In this it involves a shared virtual environment. In this, multiple trainees can interact with the same 3D model at same time. It allows learning with teamwork which is more useful for medical trainers and practitioners.

8. Medical imaging: Medical image data as Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI) scan and ultrasound images. These are created as 3D models that are viewed in VR. These models can be used to simulate procedures such as Needle insertions, Biopsies, Tumor resections.

9. Remote training: It allows the trainees to make practices and scenarios from anywhere on the internet. This method is especially useful for the trainers those who don't have access to training facilities or experienced mentors.

10. Team-based training: it allows the trainers and professionals to work together in a simulated and immersive environment. It is in an emergency room scenario where multiple medical professionals work together to save a patient's life.

Overall, the uses of Virtual Reality in medical training are to greatly improve the quality of medical education.

11.3D Demonstrating Programming: Clinical experts can make 3D models of organs, bones, and other physical designs utilizing specific programming like Autodesk Maya, 3ds Max, or Blender. These models can be brought into VR programming for vivid preparation.

12. Clinical Imaging Programming: Clinical imaging programming, like CT or X-ray, can be utilized to make 3D models of the patient's life structures. These models can be utilized in VR reproductions to prepare clinical experts on techniques and life systems.

13. Movement Catch: Movement catch innovation can be utilized to catch the developments of operations and make an interpretation of them into VR recreations. This strategy is especially helpful for preparing clinical experts on complex methodology like medical procedures.

13.3D Filtering: 3D examining innovation can be utilized to make nitty gritty 3D models of the patient's life systems. These models can be utilized in VR recreations to prepare clinical experts on life structures and strategies.

14. Prior 3D Models: Clinical experts can utilize previous 3D models of physical designs or operations accessible on different stages like Sketchfab, Turbosquid, or CGTrader. These models can be brought into VR programming for vivid preparation.

IV. Installation process:

To install 3D simulation model in the VR required many steps to be followed those are,

1. Choose VR platform: There are many types of platforms in the market to develop VR platforms such Oculus, HTC vive, and Windows. Choose the software depending on the system configuration.
2. Choose software: we require software that helps to convert the 3D models into VR unity engines are the one of the most famous software that will be used to create this kind of VR simulations
3. Import the 3D models: after choosing the software the 3D model should be imported by using the selected software libraries or sketchpad.
4. Create the simulation environment: By using the software the VR environment like hospital room, Operation Theater, or any other environment will be created.
5. Adding interaction features: interaction features mean haptic feedback, pickup objects, interacting with patients, what to do next steps.
6. Testing: the created simulation will be tested and executed to check everything works fine and there are no bugs or glitches present in it simulation based on the feedback we receive the changes will be made.
7. Install the simulation in VR platform: the simulation: once the testing and changes are done in the final phase the simulation will be installed in the VR platform that we are selected for. We can connect the VR headset and controllers to interact with the students or professionals.

V. Creating 3D simulation elements in unity engine:

1. Create a new project in Unity and select the appropriate settings for your project.
2. Import or create 30 models of the elements that make up an operation theater, such as the surgical table, operating lights, anesthesia equipment etc.

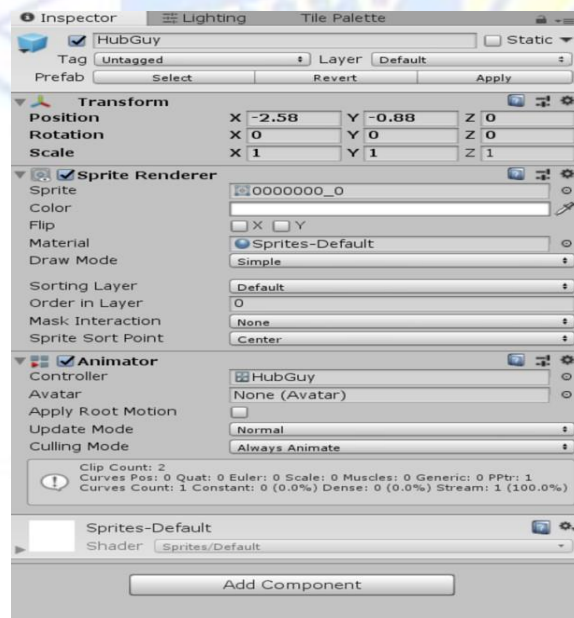


Fig.5 elements resize option table

3. Create a new scene in Unity and drag and drop the 30 models into the scene to create the operation theater layout. Position and scale the models as needed to create a realistic and functional environment.
4. Add lighting to the scene to create a realistic atmosphere. Depending on the time of day and location of the operation theater, you may want to use different lighting effects to create the appropriate mood and ambiance for the trainees.
5. Add interactive elements to the scene, such as doors that open and close drawers that can be pulled out and equipment that can be manipulated
6. Test the operation theater model in Unity's Play mode to ensure that everything is working correctly. Once you're satisfied with the operation theater model, you can export it to your desired VR platforms and use it for medical training.

VI. Conclusion:

Using the latest VR technology in the medical training will help the students to understand the practice more clearly and practice can be performed as per their wish which will result in the providing best outcome from the students and their many advantages by this Technology implementation, such as less cost efficiency compared with the real practice equipment cost. Same as advantages there are some limitations to trainees who might not experience the same physical interaction compared with the VR based interaction. In the end we can conclude that the implementation of VR Technology helps students and training institutes to provide better results in some scenarios.

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