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Medical Learning and Training using VR

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Abstract - *The use of virtual reality (VR) training tools for medical education can lead to improvements in the skills of medical students while providing economic incentives for healthcare institutions. The usage of VR tools can also lessen some of the drawbacks currently associated with providing medical training in a traditional environment such as scheduling conflicts and the need for specialized equipment (e.g., high-fidelity manikins). In this survey, it is explained how the system extends virtual environment technology to allow medical personnel to interact with and train on simulated emergencies. This model employs a three-dimensional animated human body that displays appropriate physical and behavioral responses to injury and/or treatment.*

Key Words: **VR, Simulation, Surgical Training, Virtual Environment, Virtual Surgery**

1. INTRODUCTION

Traditional Surgical training is carried out on patients, or dead bodies. These methods bring lot of problems. All the needed material for this training is not always available and making it available makes it expensive, also it is impossible to repeat the process on the objects as often as necessary until the trainees correctly learn them. So, with the development of new technology, virtual surgery simulation becomes into reality. Virtual surgery technology helps in enhancing surgical performance, and accelerate the surgical skills without risk to real patients. With the virtual reality environments, the budding surgeons can repeatedly practice a surgical chore until it's correctly learnt. This method may largely reduce real surgery interventions' costs and risks.

Virtual Reality (VR) nowadays is gaining popularity on a large scale in medical fields. It is being used in medical schools and other healthcare setups for instructing and educating purposes. Medical students now get a more interactive technique to learn and understand human body and its systems, within the VR environment. From a student's point of view, the possibilities are endless, as trainees can perform operations in a controlled and safe environment. Trainees can afford to make mistakes and learn from it in the VR setup where there is literally no risk at all; both patients and trainees are in a safe zone. By interacting with virtual patients, students can learn new skills which they later use in the real world. The added features in this learning and training process are that users are now able to study surgeries and other diseases briefly. So, this presents a prototype virtual reality (VR) system for training medical trainees. The system consists of a learning and a training model.

1.1 RELATED WORK

Nowadays, traditional methods of surgical training and planning are carried out in large numbers on living animals and corpses. These methods bring in a lot of difficulties. The required tools and materials in the training are very rare, and it is impossible to repeat the process on these animals and corpses more often until the students correctly learn the ability. So, with the development of new technology and surgical procedures, virtual surgery simulation comes to reality.

In order to create an effective medical training environment and to reduce the risk of loss of human and animal life for trauma management training, a generalized framework has been developed which facilitates development of simulators for all surgical procedures in [2]. Also, algorithms and modelling tools [2] have been proposed so that they can be used on model of any part of the body which can also be incorporated into different simulation environments. Users will be able to use the simulator numerous times on different injuries using ATLS (Advanced Trauma Life Support) procedures hence accurately and efficiently representing the human anatomy.

A framework in which the use of the NLP technology in order to extract the information contained in surgery manuals, such as, the anatomical objects and surgical procedures and XML files are made, which then be utilized by simulation modules to generate the final surgery simulator can be seen in [1].

[3] Presents a prototype virtual reality (VR) system for training medical trainees using a system consisting of an immersive, multi-modal UI and a dynamic casualty model that both change over time and responds to the actions of the trainee.

Collaborative Virtual Environments (CVEs) can improve the way remote users interact with each other while learning as well as training skills on a given task. One possibility of CVE to the health area is the simulation of medical procedures in which a group of remote users can train and make interactions simultaneously. The CVE architecture for training and joint evaluation of a team of trainees constituting as a surgery team is elaborated in [4] which involves a series of steps for development such as the system requirements, assessment module, network module and graphical modules.

The proposed system in [5] supports manipulation of virtual objects thus allowing the user to act upon the environment in a natural way. An application "BioSimMER" has been

implemented to help and train the trainees in chaotic scenarios like bio-terrorism and to promote user acceptance of VR as a training tool. [5]. Also demonstrates the design and implementation of "World Engine (WE)" which makes the user interactions with virtual world as realistic as possible which includes set of entities called "Smart Objects". MediSim works to eradicate the difficulties associated with the battlefield simulations that use actual human beings and military equipment. For general casualty management and medical decision-making, a clear description of the current interface for casualty-medic simulations is given in [6]. Then, they have described the underlying physiological model for our human casualties. Next, they have discussed the dynamics module in order to enhance the physical realism in simulations and the penetrating path module which helps in identifying the injuries that correlate with visible wounds. [6]. The feasibility of training military medical trainees in a virtual battlefield environment is demonstrated by MediSim system. This system allows medic first responders to examine and treat simulated casualties with realistic patho-physiological behaviors. [7]Emphasizes on the design and development of a tool called VRvisu in order to visualize huge and complex medical datasets by using VR. Further research focuses on creation of 3D images of tumors from real-world medical datasets and displays them in a VR environment in a meaningful way. In [8], the prime focus is on the creation of a VR-based simulation environment for orthopedic surgeries where Less Invasive Stabilization System (LISS) surgery is discussed to address fractures. The proposed system will help us to provide a perspective to study, propose and compare alternative ways to surgically respond to a specific medical condition. A prototype called "Serenity" has been presented in [9] which is a mobile smartphone-based VR, cancer coping intervention informed by distraction therapy to help lessen the severity of the symptoms of coping and promote patient empowerment which helps to prevent the increased risk of depression, drastically reducing quality of life and potential treatment non-adherence and prolonged hospital stays. [10] Emphasizes on a VR simulation platform which is designed to provide a cost effective alternative to the collocated team training elaborating Advanced Cardiac Life Support (ACLS): A protocol that provides proper guidance on the clinical interventions that need to be provided during various medical emergencies like cardiac arrests and respiratory failures. This paper also puts forth details of the framework and the development methodologies associated with VR-based training simulator for advanced cardiac life support, a time critical, team-based medical scenario.

2. OVERVIEW OF THE SYSTEM

Developing 3D modules in the simulator is an important step to build the simulation. Every simulation has several major scenes to construct. In a surgical scene, organ objects are located in a 3D environment and surgical manipulations are conducted with the objects. Hence, surgical organ objects and the manipulations are the key information to build a virtual surgery environment.

Medical science contains information about what and how to perform surgeries. The key information about how to operate on which organ is all present in different manuals and books in medical science.

Goal of our system is to develop a tool which will translate the real world operation scenes into virtual environment which allows trainees to make mistakes. The system will have two choices of learning and training. Learning module will be an informative module which will have information of different organs of human body. The training module will helps us simulate different surgeries with the help of which, students can have hands-on sessions before actually performing operations on patients.

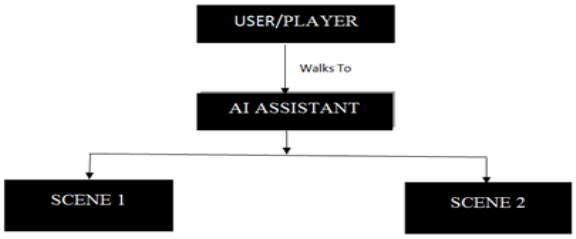

Fig (1) user choice

As we start the simulations, we experience a 3D environment in which we have an AI assistant for our support. As the player walks to AI assistant, he provides us with 2 choices scene 1 and scene 2 which basically are the Learning module and Training Module.

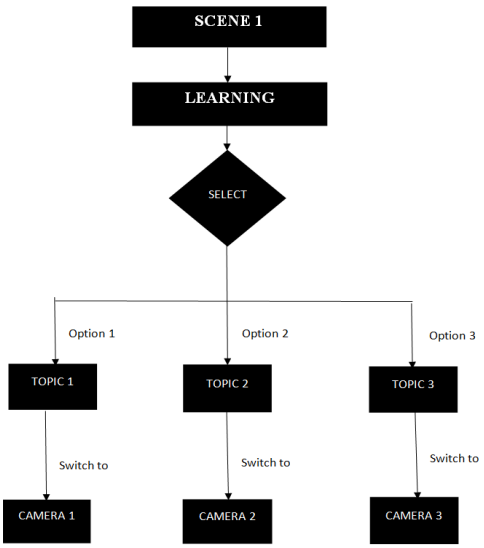

Fig (2) scene 1

After user chooses the learning module, he will get a few choices of different organs. Then he has to choose an organ that he wants to learn about; as soon as he makes his choice the view will change, user will be in a different room where he will receive all the information about that specific body part.

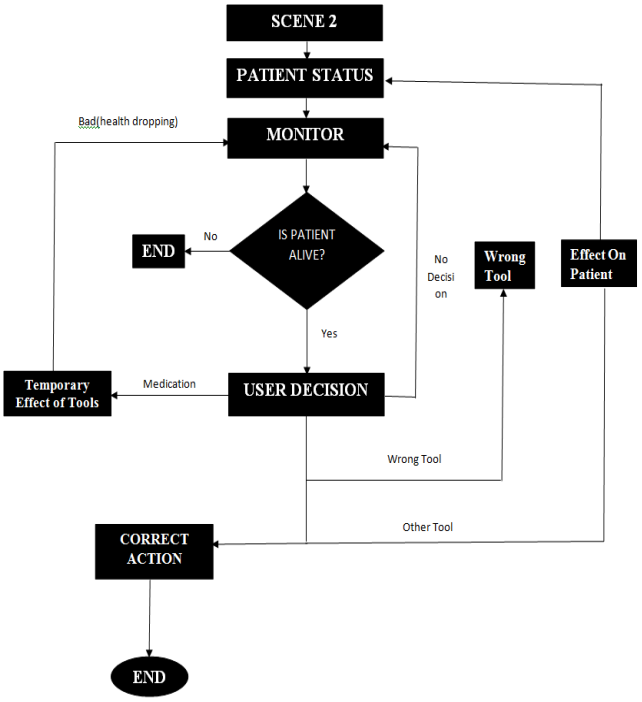

Fig (3) scene 2

When the user selects scene 2 i.e. the training module he will get to know the patient's status and health of the patient will be displayed on the monitor. If the patient will not be alive, then his training will end there itself. But if he is alive, then the user has to take proper decisions and messages will be displayed on the screen if the user takes wrong decisions such as if he picks up a wrong tool etc.

3. 3D SCENE GENERATION

Developing simulation modules takes much effort for developers, because the technical background of VR-based surgical simulation ranges extremely on a large scale (computer graphics, physics, real-time simulation, etc.) Recently, several research groups have provided open source and simulation libraries. Thus, such simulation modules can be used for efficient and high quality development of simulators.

In this phase, 3D generation we use software like 'Unity' and 'Blender'. These will help us develop 3D modules and render the whole simulation after it is completed.

4. CONCLUSION

Virtual Reality (VR) is being used in medical schools and other healthcare setups for instructing and educating students. Medical students now have more interactive methods to learn and understand the human body and its systems, within the VR environment. From a learner's point of view, there are endless possibilities, as trainees can perform 'hands on' operations in a controlled and safe environment. Trainees can afford to make mistakes and learn from it in the VR setup where there is literally no risk at all.

We aim to provide this controlled and safe environment for medical students which will enhance their knowledge and also surgical skills

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