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Medical Learning and Training using VR

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***Abstract:** This paper presents the prototype of Virtual Reality (VR) training for medical students and first responders. The main application is for medical students who in future will be operating on patients. The main aim is to provide extra practice with help of virtual reality for medical education can lead to improvements in the skills of medical students while providing economic incentives for healthcare institutions. For responding to some initial stages like stitches. This employs a three-dimensional animated human body that displays appropriate physical and behavioral responses to injury and/or treatment.*
***Keywords:** VR, Simulation, Surgical Training, Virtual Environment, Virtual Surgery.*

I. INTRODUCTION

Trends in medical education have now drifted from traditional surgical education to surgical education using modern technologies such as Virtual Reality (VR). Virtual Reality simulations nowadays are used in many domains such as heart surgery, laparoscopic surgery and many other domains. This also facilitates students i.e. budding surgeons to learn appropriate way to perform surgeries enhancing surgical performance, and accelerate the surgical skills. 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. Virtual Reality simulations also takes in consideration the patient safety i.e. in virtual reality the surgeries will not be performed on actual patients but will be performed in virtual patients and one single surgery can be performed multiple times which gives students practice. This also makes the practice for students cost efficient which means there is no need to make surgical arrangements every time which actually costs a lot and is not affordable where as on the other hand in the virtual reality environment these arrangements will already be done and even if something goes wrong with just a reset button we can get the same environment every time which is way more cheaper. Also using virtual reality doesn't keep patients life at stake i.e. one wrong move in real surgery can cost student a patient's life which is not at all advisable but in virtual reality just a reset button can set the environment to start which keeps no life at stake also makes students understand their mistakes and help to train and make them learn how to perform surgeries perfectly. 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. In similar manner there are multiple advantages of virtual reality over real world environment which we will understand on the course of this paper.

II. LITERATURE SURVEY

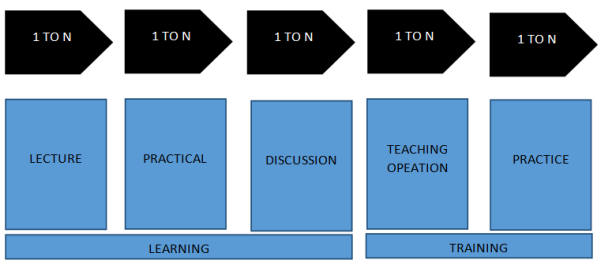
Nowadays, conventional methods of surgical training and planning are carried out in large numbers on living animals as well as dead bodies. Such methods can turn out to be infeasible. The necessary tools and equipments in the training are very scarce, and it is almost impossible and highly inconvenient to repeat the processes on these animals and corpses until the students correctly gain the ability .Thus, with the development of new technology and surgical procedures, virtual surgery simulation comes into existence. Virtual surgery technology can objectively quantify surgical performance and accelerate the acquisition of baseline surgical skills without risk to real patients. Semi-automatic development of a surgical simulator with knowledge contained in surgical manuals based NLP is proposed in [1]. Simulation is optimized with considering system configuration. A framework that combines the Natural Language Processing techniques and the surgical simulation technology together is put forth in [1]. In this, combined with medical ontological technologies, NLP modules are transformed and used to extract surgical information; also XML files were made, which were then used by the simulation modules using a simulation library in different system configurations to generate the final surgery simulator. [2]Presents an approach by creating a 3D interactive computer model of human body that can be used within a virtual environment for all surgical and ATLS (Advanced Trauma Life Support) procedures in order to reduce the loss of animal and human life in trauma management training. Here initially a single training scenario is described and an interactive model is developed for a normal and injured lower limb. Also, algorithms and modeling tools [2] have been proposed so that they can be used on the model of any part of the body which can also be included in different simulation environments.

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[3]Proposes the development of a prototype VR system "MediSim" which incorporates an immersive, multi-modal UI and a dynamic casualty model that both change over time and respond to the actions of the medical first responder. The main focus is on training the medical personnel in providing medical emergency services on the battlefields. [4]Provides a Virtual Environment for training and assessing the surgical teams. Collaborative Virtual Environments (CVEs) can improve the conventional way in which remote users communicate with each other while learning and training skills on a particular given task. It proposes the use of these CVEs as a tool for the processing of training and assessment of team skills in health. An architecture of a generic CVE that is used as a tool for the processing of training and assessment of team skills in health , coupled to the VR simulator is presented in [4] which involves a series of steps for development such as the system requirements, assessment module, network module and graphical modules. An application “BioSimMER” has been implemented to help and train the medical first responders in chaotic scenarios like bio-terrorism. It also aims to promote user acceptance of VR as a training tool.[5]. The proposed system which is fully immersive and multi-modal, in [5]supports manipulation of the virtual objects thus allowing the user to act upon the environment in the most natural way. It presents the design and implementation of a distributed VR platform which can support number of users that perform complex operations in a collaborative environment. 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”. Development and implementation of a system "MedSim" which extends virtual environment technology to allow medical personnel to interact with and train on simulated casualties is presented in [6]. MediSim works to eradicate the difficulties associated with the battlefield simulations that use actual human beings and military equipments. For general casualty management and medical decision-making, a clear description of the current interface for casualty-medic simulations is given in [6]. [7] Presents a VR tool that allows healthcare professionals to visualize large complex datasets in a VR space and have discussed various features such as 3D scatterplots, hand recognition, and smart watch interface. This paper emphasizes on the design and development of a tool called "VRvisu" in order to visualize huge and complex medical datasets by using VR and to assist healthcare professionals in visual data analysis. 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. [8]Stresses on the design and implementation of a Virtual Surgical Environment (VSE) for training the newbies in an orthopaedic surgical process called Less Invasive Stabilization System (LISS) surgery discussed to addressed fractures. It will also provide an outlook to study, propose and compare alternative ways to surgically respond to a specific medical condition. Discussions have been put forth about the validation activities, which stresses on the effectiveness of the VSE for teaching medical residents and trainees. A prototype called “Serenity” has been presented in [9] which is a mobile smartphone-based VR, cancer coping intervention which incorporates the use of distraction therapy that includes mindfulness training, restorative environments as well as VR interventions to help lessen the severity of the symptoms of cancer coping. It aims to 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. The prime objective in[9] is to develop ways to address the need to improve cancer coping which is crucial as it can result in improvement of the quality of life for both- the patient as well as their families. Approach used here is through using an emerging mass- market, low-cost virtual reality technology. [10] Focuses on a VR simulation platform designed to provide a cost effective alternative to collocated team training. This paper further elaborates the details about the design and development methodology associated with a VR simulator for ACLS (advanced cardiac life support), a time critical, team-based medical scenario. Also, the results of a usability study through a survey coming from various care providers which was conducted to understand the impact of the features of the simulator is presented here.

III. ARCHITECTURE

A. *Existing System*



EXISTING MEDICAL LEARNING AND TRAINING SYSTEM

Fig.1 Existing System

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In existing medical learning and training, there is an imbalance between the teachers and students. Association relationship between teachers and students is one to many i.e. 1 TO N. In other words, one teacher has to co-ordinate with number of students. Learning section is composed of 3 parts, namely – Lecture, Practical and Discussion. During lecture one teacher teaches a whole class of students. During practical one teacher teaches a batch of students. During discussion, also, one teacher answers the queries of multiple students. Training section is composed of two sections, namely – Teaching Operation and Practice. While teaching operations to the students, only single live or dead body is used to teach the use of various instruments and procedures. Whereas in case of practice, groups of students practice all that they have learnt in the previous sub-sections on a single dead body.

B. Implemented System

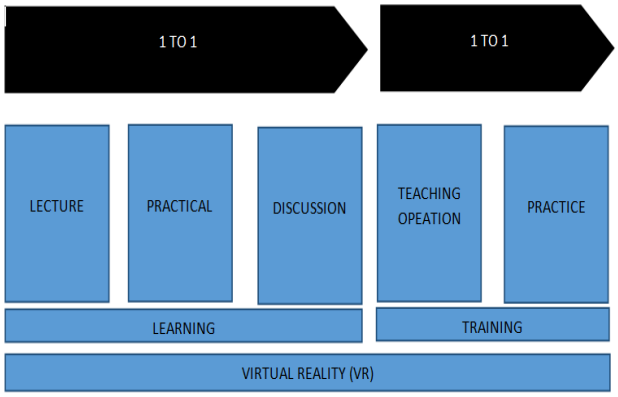


Fig.2 Implemented System

In implemented medical learning and training, the balance between teachers and students is maintained. Association relationship between teachers and students is one to one i.e. 1 TO 1. In other words, each and every student gets his/her personal teacher. This association of 1 to 1 has become possible due to the introduction of Virtual Reality (VR) layer.
Lecture, Practical and Discussion which when abstracted represents Learning section has virtual teacher present for every student. Training, whichis an abstraction of Teaching Operation and Practice,gets their personal live body to perform and practice operations on. Introduction of VR layer makes the whole process of learning and training more efficient.

C. Methodologies Used

1) *Algorithm for Starting:* Once the user opens the project, he will be redirected to the screen where he/she'll have to select from the two available options. These two options are – Learning and Training. Selecting any one option will open the project according to the selected perspective i.e. either Learning or Training.

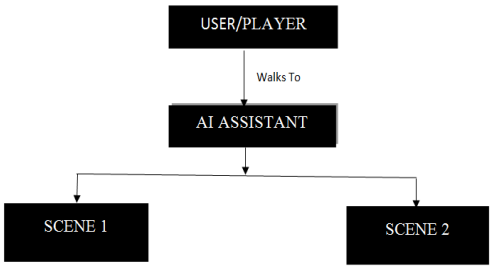


Fig.3 player UI

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2) *Algorithm for Learning:* When user selects the Learning option he is redirected to the SCENE 1. User is presented with different domains of areas from the medical field. The user will have to choose which domain he wishes to learn. Selecting first domain will shift the camera location to Camera 1, selecting second domain will shift the camera location to camera 2 and so on.

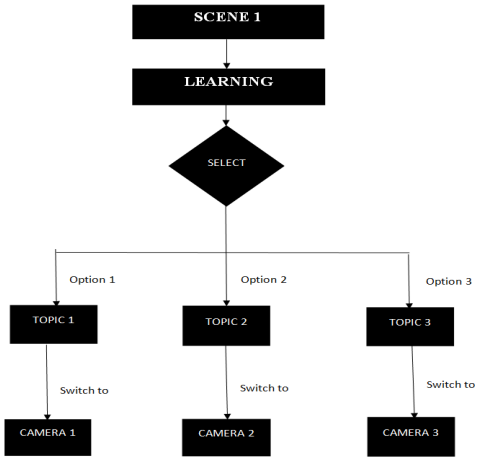


Fig.4 Scene1

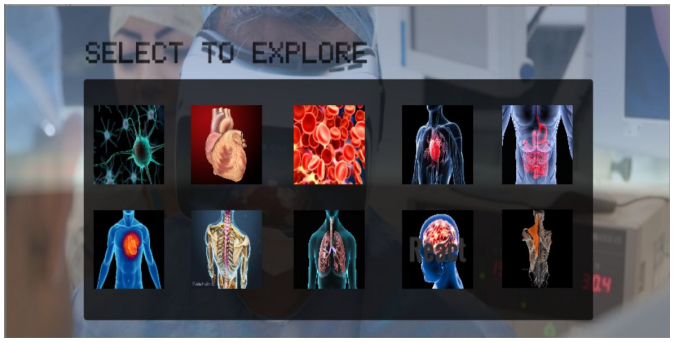


Fig.5 view for learning

3) *Algorithm for Training:* When user selects the second option i.e. Training, he is redirected to the Scene 2. This is the Training section. Here user will be presented with the live patient who needs to be operated. An AI assistant will help the user throughout the procedure.

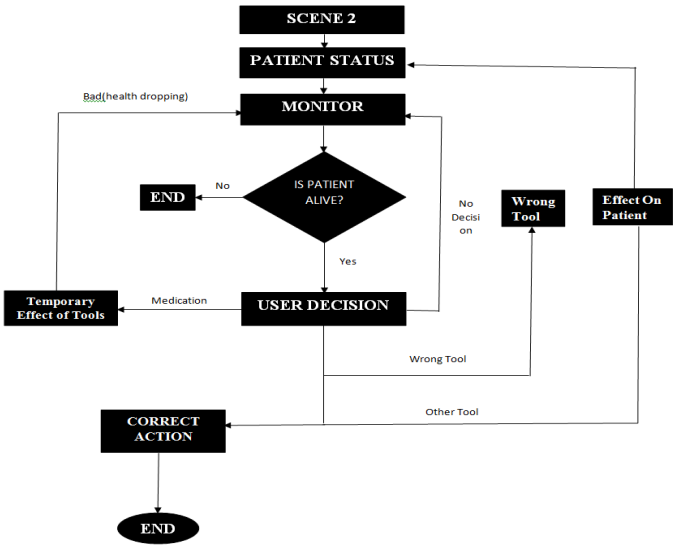


Fig.6 Scene2

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Fig.7 view for user

4) *Algorithm to Monitor Patient Status:* When user starts his training, first task is to check whether the patient is alive or dead? For this one monitor is provided which constantly displays patient's health on its screen. User can check status of patient from the monitor and decide whether to proceed or not. Health = 0% (Patient is Dead). 0% < Health <= 100% (Patient is Alive)
5) *Algorithm for Treatment:* When user ensures that the patient is alive and can be treated, he has to decide which type of treatment needs to be applied depending on the patient's malady. According to the treatment user is expected to select the required tools from available option. Selecting the correct tool will improve the patient's health and its temporary effect can be reviewed from the monitor. Example Selecting correct tool will improve patient's health and conversely, selecting wrong tool will have bad effects on patient's health.
6) *Algorithm for Negation Handling:* If user selects the wrong tool, the message "WRONG TOOL" is displayed on the screen. AI assistant will help the user in selection of proper tools.
7) *Algorithm for Termination:* When user selects the other tool suggested by AI assistant, the patient's health is again checked with the help of monitor. If the health's improved as per the expectations the algorithm is terminated.

IV. CONCLUSION

Use of Virtual Reality (VR) has proved to be a boon for many health care setups, medical schools and institutes as it provides a more interactive method of educating the trainees by helping them to understand the human anatomy in depth within a VR environment. Also since VR simulations can be less expensive to build, operate, and maintain in the long term, we aim to provide this controlled and safe environment for medical students which will enhance their knowledge and also surgical skills.

V. ACKNOWLEDGEMENT

It gives us pleasure to present the project paper on 'Medical Learning and Training Using VR'. We would like to take this opportunity to thank our guide Prof . Ashish P Ramdasi for his co-operation, timely and precious guidance without which this implementation wouldn't have been possible.

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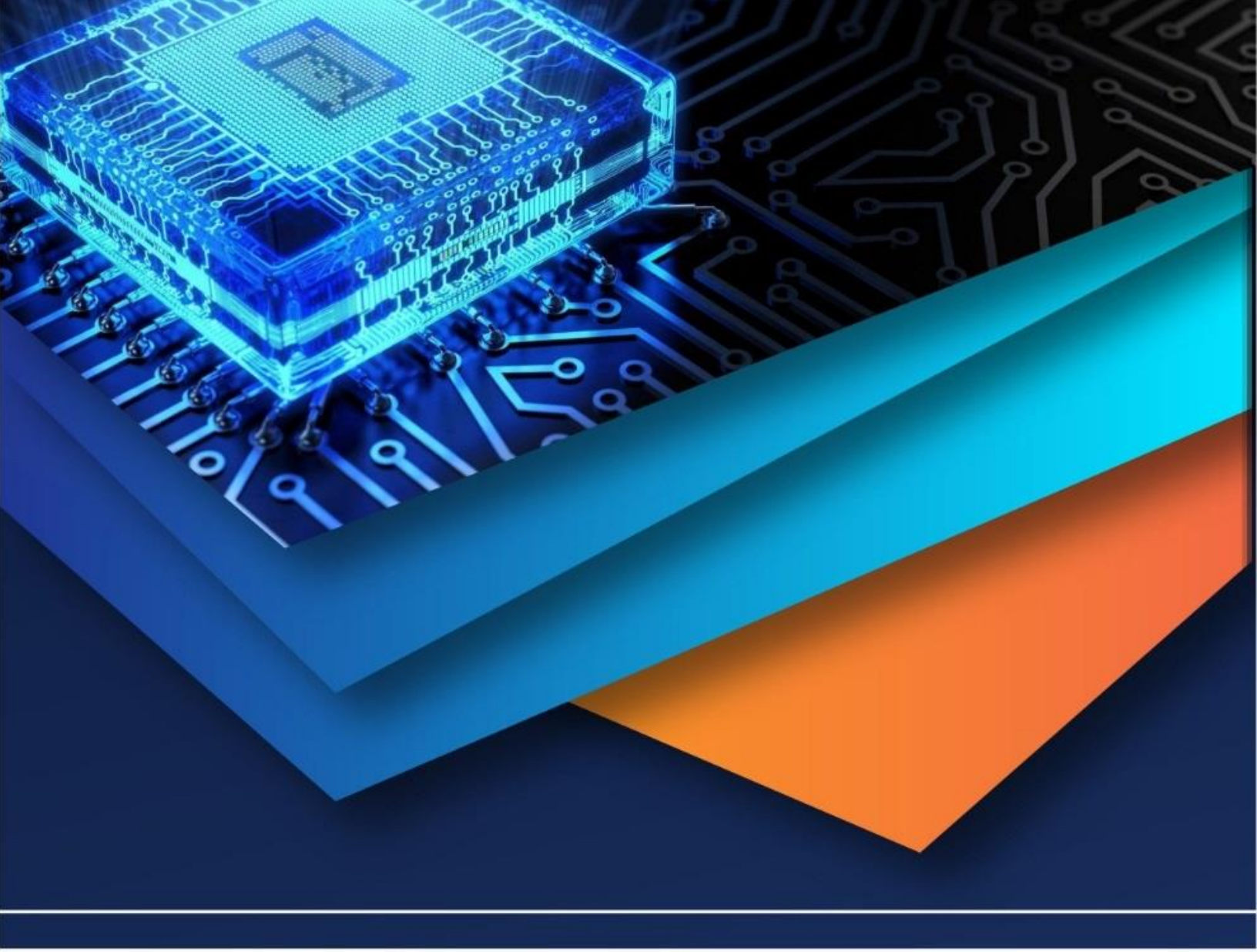
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