Virtual reality simulation streamlines medical training for dental healthcare professionals in oral and maxillofacial radiology

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Basic Research

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Abstract

A novel system aiming to disrupt the healthcare training industry with the first Virtual Reality (VR) Oral Radiology training solution is introduced. This training tool generates a radiation-free, fail-safe, realistic environment for dentists to master and extend their skills in obtaining state-of-the-art intraoral radiographic images in an affordable and portable solution. An educational tool for dental professionals to enhance the learning procedure with gamification elements, advanced interactability and cooperative features in an immersive VR operating theatre is delivered. The proposed training tool is based on a fully customizable platform able to generate educational VR simulations with minimal adaptations.

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Introduction

According to World Health Organization our planet will need more than 40 million new doctors, nurses, frontline healthcare workers and other healthcare professionals by the year 2030, which is double the current medical workforce; thus resulting in a worldwide net shortage of 15 million health workers (1). Since the beginning of surgical education, there has not been much improvement on the apprenticeship-training model; cadaver models are used to train apprentice surgeons in addition to books, videos and on-the-job learning. In addition to the commonly used training mediums, the current course of a training surgeon requires the transfer of knowledge and skills from a master surgeon through tasks during a real surgery. This teaching method involves high learning-on-the-job demands (2). The existing training model might be unable to meet the level of healthcare professionals needed.

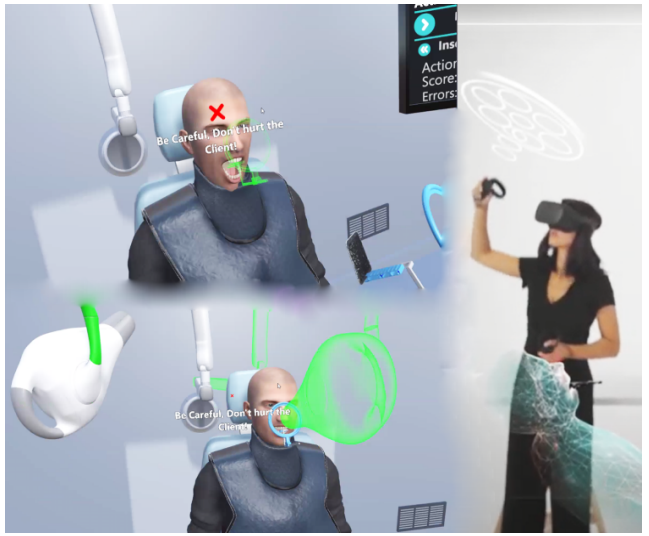
VR represents an artificial environment by software resembling or being completely different from the real world. VR technology allows users to interact with a computer-simulated environment. Empirical evidence from other industries clearly demonstrates VR technology is an effective and efficient way of improving training. VR implementation in medicine focuses on the rapid acceleration of human learning in medical training. It aims to provide technology for medical staff to reskill and upskill more effectively, without a large time investment. The combination of cognitive training in an experience-based learning virtual environment enabled by advanced VR software and hardware provides several advantages: unrestricted training time and increased training access during Covid-19 restrictions, remote training access facing growing demand for health professionals in countries with less developed infrastructure, competency evaluations for residents during simulated training. In recent decades, robotic simulations have been introduced to enhance surgical training by offering alternative solutions. However, due to the cost of such simulators it is difficult for independent surgeons to afford them on a large scale resulting in the use of solutions including AR/VR platforms for advanced training (3). The novel dental training tool introduced offers a great supplementary tool for VR dental training; prototyping and delivering a variety of simulated dental operations in a fail-safe environment due to a fully customizable platform is feasible.

Materials & Methods

The main 'recipe' to build a solid virtual reality application is the correct and detailed medical scenario involving the necessary try & error steps for the end user. A well experienced technical team is laying the foundation for every section of the construction pipeline. Initially every 3d model needs to be created in the scene. Then developers start working on every step of the medical procedure according to the storyboard. It is of utmost importance to generate an artificial environment that looks realistic, thus boosting interactivity and user friendliness and providing an optimal training experience.

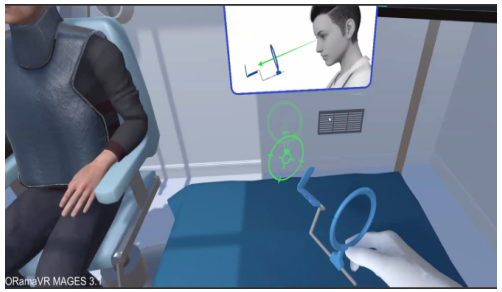
Results

Training in a virtual environment results in increased trainee engagement and knowledge retention (70%), compared to videos (10%) or lecturing (5%) (4). Additionally, training in VR results in decreased training time and decreased training costs (2). Our methodology transforms dental training to a cost-effective, easily and broadly accessible process. The latter is accomplished by prototyping the learning pipeline into structured, independent and reusable segments, which are used to generate more complex behaviours.



Conclusion

The main aim of current medical VR simulators is primarily to provide psychomotor training, and secondary focus on the cognitive educational factor(5). Training refers to the acquisition of skills whereas education refers to the acquisition of knowledge and information. VR-simulation is now proven in clinical trials to improve surgical skills; it is thus anticipated that VR simulation will become an indispensable part of surgical and medical education in general (6). The introduced dental radiology training tool integrates an educational curriculum to enhance knowledge and skills. Gamification elements linked with narration are also integrated for additional challenges as a key motivational factor for users to repeat their training. An intelligent VR training simulation for dental healthcare professionals results in a proven skills transfer and embodied cognition in a fail-safe environment, in scalable training with low-cost and on-demand VR software, as well as in progress achieved through learning curricula faster, at lower cost and at highest fidelity.



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Keywords: virtual reality, surgical training, psychomotor simulation, knowledge retention, skill transfer, simulated training