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A Real time virtual reality wound care assistance system for Clinical Nursing Education: A initial investigation

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Abstract - When it comes to wound care, dressing changes are a vital part of the process. Compliance with aseptic procedures and methods is critical to reducing the risk of infection in the healthcare setting. The ability to master the talents may be achieved via practise. Virtual reality is presented in this research as a means of increasing practise opportunities. In order to better understand the process of changing a basic wound dressing, an immersive virtual environment has been created. A preliminary user research on usability with an experienced nurse and an undergraduate nursing student yielded positive results. The simulation will undergo a thorough examination in order to enhance it even more.

Keywords: Virtual reality, wound care, dressing change, nursing education.

I. Introduction

Many clinical skills in nursing need physical dexterity. Acquiring the abilities, developing competency, and reducing mistakes all need enough practise. Because of its training advantages, virtual reality (VR) technology has the potential to provide new methods for increasing practise time. Virtual reality (VR) has been used for training in CPR, urinary catheterization, and nasogastric tube

installation [6,7]. When it comes to wound care, appropriate wound dressing changes are critical to ensuring aseptic processing. Traditionally, lectures and video demonstrations are used, as well as simulations with rubber mannequins and real-world dressing materials and equipment. Despite this, virtual reality (VR) is widely used as a method of pain diversion during wound care [4]. For wound care decision-making, an online simulator has recently been created that uses augmented reality technologies and tablets to enhance observation and analysis [5]. The use of virtual reality (VR) for wound dressing training is discussed in this research. Students practise aseptic technique and cognitive and motor abilities by simulating the process of changing a basic wound dressing.

II. Methods

As a first step in realising the proposed idea, it is necessary to learn about wound care and the procedures for changing a wound dressing by consulting relevant texts and instructional videos, and also by consulting clinical experts regarding the procedures and techniques in real practise, as well as the training approaches. Before everything else, resources and VR technology dictate the extent, depth of detail, and complexity that may be included in a simulation. Following the iterative design cycle, feedback from clinical specialists is solicited in order to enhance the design and the system on an ongoing basis.

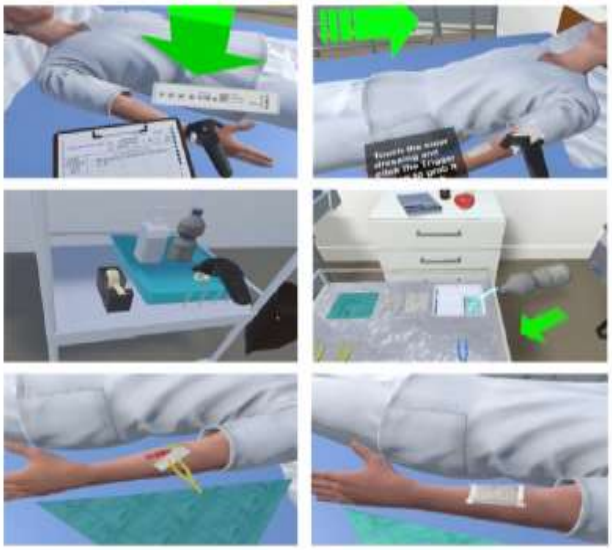

Figure 1: Virtual scenarios of wound dressing change.

A *Hardware and Software*

The cross-platform game engine Unity Pro was used to create the suggested VR teaching system. Hardware used in this investigation is HTC's VIVE virtual reality system. This game has a set of vibrotactile haptic controllers. A multi-function trackpad, grip buttons, a dual-stage trigger, a system button, and a menu button are all included on each controller. There is no need for a trigger in this

research since the trainees may concentrate on the simulated processes and the virtual information instead. In the virtual world, the user's hands are simulated using a pair of controllers.

B *Procedure of Changing Wound Dressing*

The principles of wound dressing techniques are to maintain asepsis throughout the process and minimize exposure of the wound, and to ensure proper hand decontamination and effective application of aseptic techniques, where patient comfort is also essential in the process [2]. The dressing procedures includes the removal of old dressing, wound cleansing, application of new dressing, and post-dressing processing, i.e., clean-up, documentation and follow-up [3]. In this study, the steps involved in changing a simple wound dressing are only concerned, whereas preparatory steps in performing hand hygiene and putting on gloves are not included. The simulated procedures are divided into five stages, namely, patient preparation and inspection, equipment and materials preparation, sterile field preparation, wound cleansing, and finally, new dressing application and clean-up. The setting and environment, the maneuvers as well as the interactions in each step, are simulated in fine details with immersive VR, as illustrated with the snapshots shown in Fig. 1. Visual cues such as pop-up texts attached to the controllers (invoked on-demand by users by pressing the menu button), green arrows and flashing objects are provided interactively to guide the user.

III. Initial User Study

The HTC VIVE VR system is used to recreate the preceding section's description of changing a tiny wound dressing. An experienced registered nurse and an undergraduate student who have previously learnt how to change wound dressing from a standard nursing therapeutics topic are assessed in an initial user research on the usability of the system. They are able to finish the virtual procedures in 15 minutes and are usually pleased with the usage of VR for learning them. Detailed discussion of their post-use impressions will be provided in the next section.

IV. Discussion

People who have taken virtual training have said that it's both engaging and useful. The suggested virtual training simulator is more realistic, interactive, and fun than the more conventional method of teaching clinical skills: viewing training movies. The virtual hands-on practise it provides is preferable to that of instructional DVDs. A majority of users believe that the system is capable of simulating the fundamental processes in changing wound dressing and might possibly speed up the learning curve in real-world scenarios.

The present prototype system is constrained in various ways, despite the fact that the immersive virtual world and simulation have been described as realistic. The HTC VIVE controllers, on the other hand, are unable to replicate the tiny movements of the human hand. Simulated interactions are thus streamlined to accommodate the controllers' limited flexibility. This means that rather than improving clinical dexterity in executing manual activities, VR training is more suited to giving a cognitive walkthrough for procedural instruction.

Due to counter-intuitive operations, this constraint has its own set of problems. Simplified actions, such as holding an item in place with forceps with the thumb and index finger of each hand, are commonplace. Pulling and holding the trigger button on the controller is the only way to simulate it in virtual reality. There is evidence that users are unable to tell the difference between genuine and simulated behaviours. The last step requires some explanation and experience in the virtual world.

Furthermore, in certain virtual environments, the proximity threshold for detecting collisions between items is set excessively tight, making it impossible for users to pick up or place things in specific areas. As an example, the surgical adhesive tape strips must be moved as near to the gauze's edge as possible for the simulator to perceive the motion as one of adhesion. Users are frustrated by the requirement for several efforts to perform activities because of the severe proximity checking, which makes the interactions counterintuitive and difficult to understand.

Only the vibration of the controllers provides haptic signals and feedback in the virtual training. Virtual interactions can't provide a true physical experience unless you use these vibrations. Changing a wound dressing in a virtual environment is like "playing with air," despite the simulator's realistic visual input. Due to the lack of a true hardware user interface, the simulation's ability to display accurate haptic sensations and reproduce fine movements is severely limited.

V. Conclusion

In an immersive virtual environment, the stages of changing a basic wound dressing are simulated for the aim of wound care training, which is presented in the study. As a kind of interactive guidance, images and text are shown to the user. The virtual and autonomous nature of the simulation means that the suggested method may allow for self-paced learning while also saving on wound dressing supplies. The dressing process has been carefully simulated to ensure aseptic processing, but more research is needed to improve simulation accuracy and realism by learning the procedures from nursing experts in-depth and improving user interface devices and interaction approaches. This will be done in the future (e.g. data gloves, vision-based or infrared proximity sensing methods). The suggested wound dressing training simulator's usability and training efficacy, i.e. the transfer of virtual learning experience to actual practise, will be thoroughly evaluated.

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