PathoGenius VR: VR Medical Training

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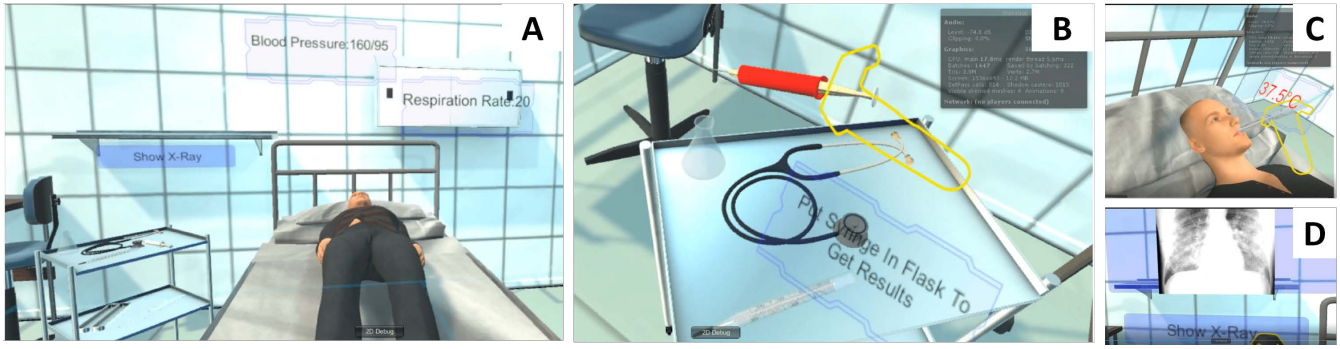

Figure 1: Screenshots from our system *PathogeniusVR* to train physicians via a gamified platform in virtual reality. A) shows an overview of the environment and the available actions. B) shows a the metaphorical objects to instantiate the interaction such as a syringe. C) shows the temperature of the patient and D) shows his X-ray.

ABSTRACT

Extensive training is mandatory for medical students during their academic studies. However, the shortage of training personnel, patients' safety, scarcity of equipment are the key limitations that hinder the training process. To address these challenges, we built *PathogeniusVR*, a virtual reality application for training physicians to interact and diagnose patients. We also conducted a preliminary study on 8 participants to collect their initial feedback about our prototype. Our results suggest that *PathogeniusVR* is immersive and more entertaining than case study diagnosing.

CCS CONCEPTS

• **Human-centered computing** → *Human computer interaction (HCI).*

KEYWORDS

virtual reality, gamification, serious games, medical training

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1 INTRODUCTION AND RELATED WORK

In 1999, ninety eight thousands deaths were caused by preventable medical errors [1]. Therefore, refining the medical training process is pivotal in saving thousands of lives. However, patient's safety and training staff shortage significantly hinder medical student's practical training.

Technological interventions using Serious Games or Virtual Reality (VR) applications became a popular aid in supporting medical training. Virtual reality training is an attractive practical training method, as it provides the practical know-how and simultaneously minimizes the risks on patients and students associated with the real training [3] as well as enables students to observe rare use cases. Consequently, Reiner et al. highlighted the pillars of VR in medical training by building a simulator for several diseases such amnesia and joint problems [3]. On the other hand, prior work (e.g. [1, 2]) shows that digital and non-digital serious games significantly enhance the students' knowledge by adding entertainment to the training process.

To combine the best of both worlds, we present in this paper *PathogeniusVR* , dynamic virtual reality simulation that gamifies the

diagnosis process for medical students. We conducted a preliminary evaluation (N=8) of the prototype to gather initial feedback about the system. *PathogeniusVR* is part of an interdisciplinary project between computer scientists, pharmacists, physicians and educators to design digital solutions that leverages medical education. For example, [1] is one of our earlier blocks in this series.

2 SYSTEM DESIGN

PathogeniusVR is an educational VR solution for practical medical training that emulates any medical case inputted by an instructor. We used a HTC Vive to implement our system. The design supports the needs of two stakeholders:

Instructor Interface enables the instructor to enter the necessary data that generates dynamically the virtual environment (VE) that emulates the required medical case/scenario. The VE is an exam room where a patient enters to get a proper diagnosis for his/her ailment.

Student Interface shows the student the VE that the instructor emulated and allows the student to administer the necessary test that aids in the diagnosis. The student interface is the focal point of the project. Thus, we focus on simulating the examination process in a way that is similar to that of a real-life exam room. Figure 1 shows sample screenshots of some features in the system. The students can obtain the patient's vitals, such as body temperature, heart rate and blood pressure. Additionally, they can administer tests such as X-rays and blood tests and require instructions for them. Students navigate in the environment via teleporting.

The virtual training process begins with the instructor interface. The instructor defines the medical case using a script that generates a dynamic environment. Afterwards, the student can start by viewing both the patient and case info that are displayed on a clipboard, by the end of the patient's bed. The patient info is comprised of demographics and the complaint. Afterwards, the student measures the patient's vitals like heart rate (using virtual stethoscope) and temperature (using virtual thermometer). Based on the patient's info, complaint, and vitals, the student builds a prognosis to determine whether further tests should be conducted, if any. For example, if the patient's blood pressure is low and they complain about fainting, then an initial prognosis is Anemia. Therefore, the student decides that a blood test (using a virtual syringe) is required to validate the anemia prognosis, as shown in Figure 1-B. The information acquired throughout the examination process can be viewed at any time. Once the student is ready, they provide their prognosis in an open-ended question and receive feedback instantly.

3 EVALUATION AND RESULTS

A preliminary study (N=8) was conducted to evaluate the adequacy of our solution. Participants were invited to the lab individually. The session started by collecting the demographics and prior experiences with VR. Afterwards, the participants wore the head-mounted display and entered the virtual environment. The task was to solve one case study entered by the experimenters. Case studies were chosen as their written version is commonly used to evaluate students. After finalizing the diagnosis, the participants filled the Immersion and Presence Questionnaire (IPQ), and reported their impression about the overall VR experience.

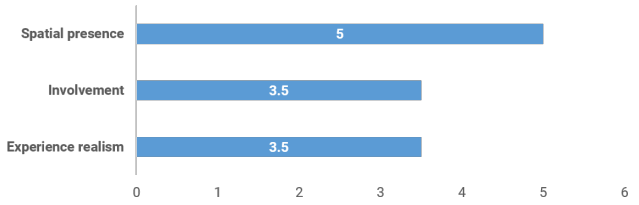

Figure 2: The IPQ Scores show high spatial presence and adequate involvement and realism. Thus, we envision that *PathogeniusVR* can support medical education in virtual reality environments.

Participants and Recruitment. We had 8 undergraduate participants (5 females, 3 males) between 20 and 23 years old. They studied at the Faculty of Pharmacy and Biotechnology. Only two out of eight participants had a previous experience in VR. The session took 20 minutes in average. We recruited the participants via personal invitations.

Results. The results reveal a high spatial presence rate (score= 5), and adequate involvement and experience realism rates (both scores = 3.5), as shown in Figure 2. Moreover, when given a choice, students stated that they would prefer *PathogeniusVR* over the written case diagnosis, as *PathogeniusVR* is more immersive and entertaining than written case diagnosis.

4 CONCLUSION AND FUTURE WORK

The preliminary results reveal that our solution is immersive. Moreover, participants' reports show their willingness to use our solution over traditional theoretical case diagnosis. Consequently, we envision using our system to (1) support interactive education and training for medical personnel, (2) aid high school students studying biology, or (3) provide initial training for prospective emergency response agents. We plan to extend this work by conducting a comparative study between earlier gamified project blocks such as [1] and our system to evaluate the effect of using virtual reality on student's learning rate and involvement in medical training.

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