

Immersive Learning with AI-enhanced Virtual Standardized Patient (VSP) to Improve Dental Student’s Communication Proficiencies

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Abstract— COVID-19’s lockdown policy is causing the dental schools to halt their preclinical curricular and clinical activities, including a learning session with Standardized Patient (SP) to train student’s communication proficiencies. In this project, we developed Virtual Standardized Patient (VSP): an immersive learning with Artificial Intelligence (AI)-enhanced Virtual Standardized Patient to improve dental student’s communication proficiencies. Augmented Reality (AR) was used to immerse the virtual patient into user’s space, user also has an option to switch to Virtual Reality (VR) to fully immerse the user with the digital environment. AI element facilitates a seamless communication between virtual patient and user, and we also added an adaptive storytelling to allow student to explore several discussion’s options.

Keywords-virtual standardized patient; immersive learning; artificial intelligence; adaptive storytelling.

I. INTRODUCTION

Dental practitioners require not only psychomotor skills but also communication skills. Previously, an immersive technology was developed as an alternative solution to drill psychomotor skills in preclinical education [1]. As part of this paper, authors explored faculty perceptions about related project and faculties enjoyed the immersive experiences and suggested that the virtual set-up provides a holistic and realistic view of a dental operatory for students.

Other research group developed a conversational Virtual Standardized Patient to enable students to practice history-taking skills [5]. Their project allowed students to take a history of a VSP, develop a differential diagnosis, and document the encounter in the electronic medical record [5].

In this paper, authors introduced an immersive technology application to increase dental student’s communication proficiencies. Traditionally, dental schools provide a face-to-face sessions between student and Standardized Patient (SP) to mainly focus on improving their communication skills.

SP is a ‘patient-actor’ who has been trained to consistently portray a specific patient role, outlined by a script devised by topic content experts [4]. SPs have been used in dental curricula to address skills in working with tobacco cessation counseling, emergencies, interprofessional

skills, and complete denture treatments [2]. The individualized experience of having a student work with a SP to develop communication skills has been an effective means of teaching communication, data-gathering, promoting interpersonal skills, and cultural sensitivity [7].

Conventionally, this learning sessions take place on-site and required in-person interaction between student and actor. However, lockdown caused by COVID-19 pandemic has forced most of schools to close and suspend their academic activities including the face-to-face session between student and SP. The motivation of this paper is to introduced our project: Virtual Standardized Patient (VSP). VSP is an immersive learning module that utilize an AI-enhanced virtual standardized patient to overcome the limitation of SP’s conventional approach.

This paper will be structured into several sections. Section 1 will cover about project’s introduction. In section 2, authors will discuss about the main project, Virtual Standardized Patient, including assets and the technology behind it such as the AI-Natural Language Processing, immersive technology (AR-VR), and adaptive storytelling feature. In section 3 we will conclude our discussion by discussing about limitations and future plan for this project.

II. VIRTUAL STANDARDIZED PATIENT

To offer a digital simulation that replicates the traditional learning session, VSP project employed an user with the learning modules. We also implemented an AI’s Natural Language Processing (NLP) to facilitate a seamless communication between user and virtual patient. Furthermore, VSP also added an adaptive storytelling approach to allow student to explore different answers and observe difference patient’s responses. Assets (Environment and Virtual Patient)

The discussion between patient and dentist most of the time happened inside the dentist’s room. To replicate this situation, we prepared similar assets that inspired from the real objects starting from the color tone, layout, and others. The assets includes dental room and chair. The room is also completed with supporting objects including cabinets, sink, office desk, computer, and television screen as shown in Figure 1.

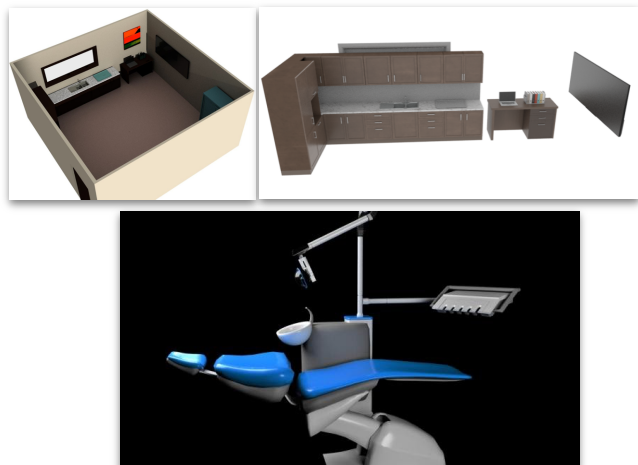


Figure 1. VSP's assets.

A. Virtual Patients

In this project, we included two virtual patients that represent different races and communities, as shown in Figure 2. The virtual patients wear casual dress code and they are rigged and animated following the prepared dialogue.



Figure 2. VSP's Virtual Patients

B. Markerless-AR & VR session

VSP project is an immersive learning platform that employed both AR and VR technology. AR is a technology that allow user to see the real worlds, with virtual objects superimposed upon or composited with the real world [4]. Furthermore, AR is a system that have the following three characteristics: combines real and virtual, interactive in real time and registered in 3D [6]. For VSP's AR session, we applied a markerless experience powered by Google ARCore Software Development Kit (SDK). With ARCore, user could scan their room, place the virtual patient on the designated spot, and the virtual patient will be immersed onto user's real space without any printed marker as shown in Figure 3.



Figure 3. VSP's Markerless AR session.

VR is defined as a computer-generated digital environment that can be experienced with as if that environment was real [3]. In VSP project, user has an option to switch from AR to VR mode. In this session, they will be fully immersed into the dentist room and interact with the virtual patient there as shown in Figure 4.



Figure 4. VSP's VR session.

C. Seamless Communication & Adaptive Storytelling

Improving user or student's communication skills is the main objective of VSP project therefore it is critical for them to be able to communicate verbally with the virtual patient. To facilitate a well-flow verbal communication, we implemented AI's NLP service provided by IBM Watson. NLP is the set of methods for making human language accessible to computers [3]. The speech recognition in NLP will convert an audio signal to text [3]; therefore, it will facilitate a verbal communication between the dental student and virtual patient.

Compared to the basic speech recognition, NLP allow the system to identify the appropriate word, phrase or response by using context clues and this feature is essential in VSP to offer a smooth communication flow between user and virtual SP. In this project, we trained the AI system to detect user response and give an appropriate feedback including the ability to understand several phrases and detect it as 'greeting'.

Virtual simulation allow us to offer many scenarios that sometime could not be offered in conventional learning sessions. In VSP project, we implemented an adaptive storytelling to allow student to explore several answers to observe possible patient's responses therefore they could be more prepared when they handle the real patient. Figure 5 showed the diagram of VSP's adaptive storytelling.

III. CONCLUSION

Real time speech interaction in immersive environment between real user and virtual character has been implemented including for Human Resource (HR) training purposes and for general medical student training. However, our VSP project that mainly focus for the dental student is a novel application of immersive learning platform. COVID-19 lockdown mandate also shows a demand for dental learning module that mobile and less site-dependent. VSP could be a key breakthrough as an alternative solution that overcome the existing learning tool's limitation. Even though there were several VSP projects previously developed for the medical education, our project is novel since it explores the application of VSP for the dentistry education direction.

For current progress, VSP is still limited to one scenario: handling an angry patient and in the future we are planning to expand to another scenarios including delivering news to the young or child patient, educating senior patient about certain procedure, and others. We also plan to add supervision features both a real time supervision by faculty and including an AI-based supervisor. Our team also plan to run a quantitative study with potential user to learn about their perception about this project.

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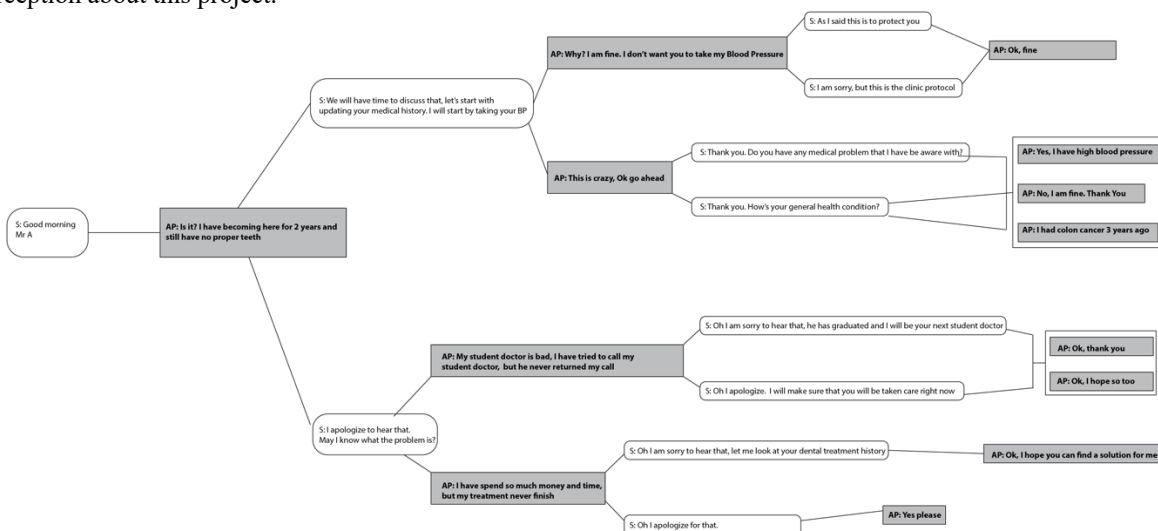


Figure 5. VSP's Adaptive Storytelling Diagram.