Development of a virtual robotic operating room in healthcare to bring intuitive and immersive learning experiences to students

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Abstract:

We live in a fast-evolving society with emerging technologies shifting the paradigms in various aspects of the world. Specifically, in the field of biomedical engineering, the continuously advancing technologies are improving conventional modern healthcare solutions as well as enabling new ones, benefiting the patients, the healthcare practitioners, and our society as a whole. However, this rapid technological advancement comes with an inconvenient side-effect: The knowledge a student can learn in traditional lectures is no longer sufficient to support the student's career in this fast-evolving field. To address this problem, one of the directions of ongoing curriculum improvement is to diversify the course portfolio to includes hands-on tutorials and site visits to expose students to the cutting-edge technologies that are shaping the real world.

The course BME3104 Robotic Technology in Healthcare is a core course for the undergraduate programme BEngBME. In this course, the Da Vinci Surgical system from Intuitive Inc. is used as a prominent example of the state-of-the-art robots that are currently being employed in healthcare workspace with significant societal and economic impact. Offering the students an opportunity to personally and closely observe such a system will have tremendous benefits for the students. However, considering the price, size, and the availability of this system in Hong Kong, currently it can only be presented as pictures and videos in lectures. To circumvent this limitation, this project aims to develop a virtual robotic operating room that enables students to intuitively and immersively observe a virtual Da Vinci Surgical system in 3D and learn how it works without needing to pay a visit to a real hospital. This developed system will enable more students to have a more personal experience with this widely adopted medical robot system, while not incurring a high cost in teaching.

This project will utilize the augmented reality (AR) capability that is ubiquitous in modern handheld smart devices, such as smartphones and tables. A virtual operating room equipped with a 3D model of the Da Vinci Surgical system will be developed as an application to be installed on students' handheld smart devices. In a virtual tour, the students holding these devices will enter a designated empty room with a set of markers placed on the floor and the walls. The cameras of their smart devices will register these real-world markers with the corresponding reference points of the virtual operating room, superposing the virtual operating room onto the real-world empty room. Then, the students will be able freely walk around inside this room to see details of how the Da Vinci Surgical system is configured and

utilized in a realistic operating room through the screen of the handheld devices. This tour gives the student an opportunity to closely observe the robotic system in a realistic healthcare workspace. And it will encourage the students' curiosity of these medical robotic systems and strengthen their understanding of the real-world relevance of the knowledge they learn from this course.