Development of a Software Solution for User Access and Authentication in Vital XR's AR/VR Environment

Sponsor Company: Vital XR

Ruha Javed, Wei Kang, Jett Penner, Afshin Rahman, Hunter Reboul, Harrison Sparrow

Capstone Project Category: Software & Electrical Engineering

Introduction

Our project aims to provide the base platform and functionality for a start-up company, Vital XR. Vital XR is focused on creating virtual reality and augmented reality (XR) surgical scenarios for surgical training. By implementing surgical solutions in the XR environment, surgical procedures can be more accessible, affordable, and accurate compared to existing surgical training methods.

From a training perspective, surgeons and surgeons-to-be can practice critical procedures outside of a real model, improving confidence and performance without the risk of live operation. Students can practice surgeries in classroom environments, and surgeons can touch-up before uncommon, critical surgeries.

From an evaluation perspective, implementing surgery simulation enables accurate, real-time performance measurement metrics. Evaluation can be performed after a surgery simulation to showcase surgeon accuracy and mistakes, helping improve their skill for critical moments.

Our team was brought on to help develop the baseline virtual reality (VR) environment - setting up the environment, implementing inside-out hand-tracking, and providing a base platform to scale Vital XR after their integration of surgery simulation scripts.

Problem

The problem our project aimed to solve was the creation of a baseline virtual reality platform for surgical training, which would allow medical professionals to improve their skills and techniques through realistic scenarios, with emphasis on a user-friendly design. Our team was further tasked to properly authenticate users using strict concurrency rules and develop a customer management system for Vital XR's future users.

Requirements

- The VR environment must implement inside-out hand-tracking in Unity.
- User-friendly and secure login page in the VR environment.
- Development of a platform for Vital XR personnel to dynamically view, add, modify, and delete organizations.
- Development of a platform for organizations to dynamically view, add, modify and delete users and their own organization.
- Authentication must be accurate and fast, ensuring no duplicate system entries from the same user, and limiting the number of entries by the organization's plan.

Methodology

Our team took advantage of agile methodologies for the majority of our development over the last year. The early stages of the capstone project involved frequent conversations with the sponsor company to clearly define the outcomes of the project. The following weeks involved multiple meetings to gather additional information, showcase components, and continue to gather validation.

Our team took advantage of scrums, where we had one- or two-week development cycles, depending on task complexity. All problems were subdivided into smaller, concrete tasks, and given to team members. Each sprint focused on one or two main features, and each main feature of the project was managed by one member of the group - this approach enabled each of us to take a management role and become an expert on specific aspects of the project, while supporting each other and gaining a general understanding of the system as a whole. This process greatly enhanced team cohesion and facilitated integration between components.

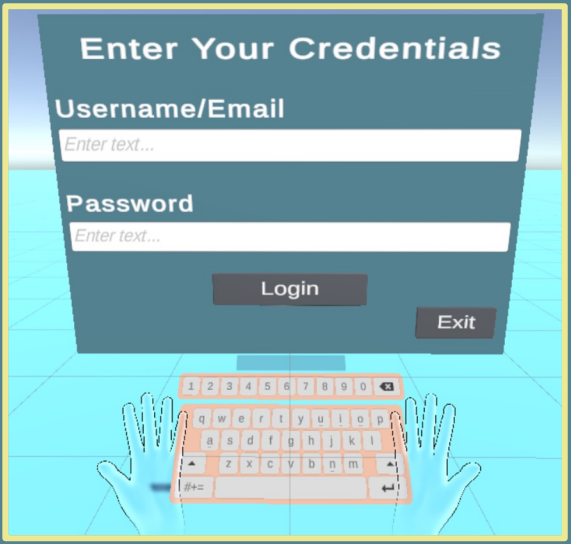
Finally, our team was in active communication with various mentors and support staff in the AWS, Unity, and Varjo communities; helping us make sound technical decisions and minimize the learning curve for these environments.

Results

We were successful in creating a solution appropriate for Vital XR's needs. Our team developed a baseline virtual reality platform in Unity, implementing inside-out hand-tracking using the Varjo XR-3 system. Upon loading into the environment, users are greeted by our created login interface, connected to a hand-tracking keyboard. Implementing a hand-tracking keyboard enables users to circumvent the traditional point-and-click virtual reality (VR) field inputs, helping provide a more user-friendly experience. Furthermore, this solution minimizes needed hardware for users. Initial validation tests show our solution being more practical than other solutions, such as voice prompts, which requires saying passwords aloud, and biometrics, requiring specialized equipment and interrupting the VR workflow.

The authentication is done through Amazon Cognito, which tracks active tokens, and accesses the database to perform required concurrency verification. All information is stored in an Amazon Web Services (AWS) database. Upon authentication, users are routed to a landing page in the VR environment, where they can launch surgical scripts when developed by Vital XR.

Finally, our team created a website and implemented a user portal, developing three portals for Vital XR personnel, organization administration, and individual users, providing functionality to add, modify, view, and delete organizations and their users as appropriate. These features sum to accomplish the goals of the capstone project, but, as Vital XR is still in their start-up phase and without a user pool, user validation is not possible at this time.



Challenges

The majority of our challenges were centered on the required development platforms.

Inside-out hand-tracking is state-of-the-art, implemented in few headset models, including Varjo's newly-developed XR-3. Varjo's XR-3 lacked reference code and further support tools available in more long-standing languages. In addition, our team was limited to one VR headset, bottlenecking production.

The used Amazon environment had an additional learning curve, specifically in the use of AWS SDK for Unity and integrating SAM templates with existing resources. Furthermore, AWS's plethora of available resources required extensive research for optimal utilization.

Unity's learning curve revolved around the implemented keyboard and input/output detection, where our team reworked the button event mechanisms to fit our project. A further Unity challenge was the implementation of Ultra Leap Hand-Tracking in the environment, again with novelty as the issue.

Project Manager Contact: jett.penner@ucalgary.ca