Summer 2020 @ METEOR

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August 2020

1 Introduction

I joined METEOR Studio's Augmented Fluidity team in June 2020. In the past few months, I've had the opportunity to help build out the future of an online experience under the guidance of Dr. Robert LiKamWa and my PhD student-mentor Frank Liu. The work-in-progress paper to which I contributed, titled "Titration Experiment: Virtual Reality Chemistry Lab with Haptic Burette", is a research project hoping to utilize the lab's SWISH technology and VR to create an immersive, online experience for chemistry labs.

The purpose of this document is to serve as an outline of the work I have completed for this paper during my time at METEOR Studio.

2 Timeline

The first half of my time at the lab was focused on both learning my role within the team as well as creating plans for what a UI/UX would look like for the VR chemistry lab. The following half was comprised of bringing these ideas into fruition, as well as building out and keeping in mind a greater future for what online chemistry could look like with our technology. All in all, my work was focused on **building the experience** for the user.

2.1 Learning

When it comes to software for developing these experiences, the choice for METEOR Studio is Unity. Without prior knowledge/experience in using Unity let alone any game engine, my first task was to familiarize myself with the software, as well as the language that came with it, C#.

To this end, I spent the majority of my first two weeks practicing self-guided learning. While tutorials and walkthroughs aided in obtaining a general knowledge of the tools available to me, simply playing around with the software turned out to be the most beneficial in becoming comfortable with Unity.

Although technical skills were undoubtedly important in me being able to perform my duties, it was also emphasized to me that softer skills were just as important. Being able to expose myself to literature (Fig. 1) with regards to both VR/education research as well as UI foundations were important in creating a broader vision for not only the project but also myself.

Date Registered	Conference / Journal / Book	Type	Source	Color	Rank (1-5)	Keywords	Comments
7/30/2020		The Benefits of Virtual Reality in Education- A comparision Study	Source			Mobile apps (Google cardboard), 2D vs 3D, Testing	Lots of text = 2D, simulation = 3D, **AUDIO IS IMPORTANT**
7/30/2020		Teaching Colleges with virtual reality	Source			Learning with VR, virtual experience of learning, virtual in-person learning, virtual reality for education, 360 degree videos	Use of VR in this study follows the "bystander" approach in which the user does not interact with the environment but is immersed and allowed to examine surroundings
7/31/2020		VR for Paramedic Education	Source			Virtual Reality, Simulation, Paramedicine education, Heutagogy	Provide paramedic students with the context of a situation before practicing on a manikin (ie car crash, fire, etc)

Figure 1: Excel sheet for documenting readings.

2.2 Ideation

After getting my bearings with Unity and the basics of UI principles, it was time for me to begin drafting ideas for a user experience based on the prior research I had performed.

This process involved brainstorming, sketching, and revising. After providing initial storyboards, questions were always asked not only on my end but also other team members. These guiding questions were critical in creating an experience that tied in with the project's goal of providing immersion, as well as meeting guidelines for what an in-person chemistry lab should entail. An early draft of these storyboards can be seen below in Fig. 2.

Although new to me, taking the time to carefully draft out ideas and continuously iterate on visions for this project turned out to be a rewarding experience. The upfront time we took turned out to be well-worth it as I progressed into actually developing the UI.

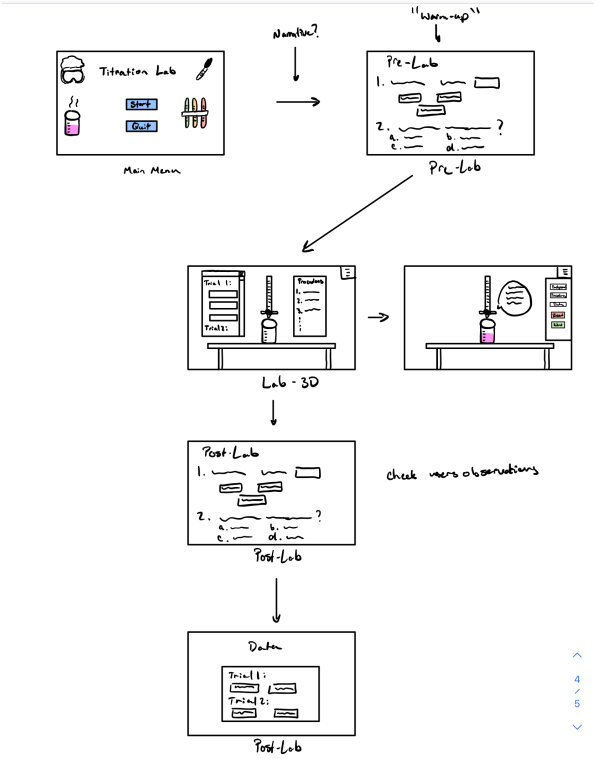

Figure 2: Storyboard for user experience flow.

2.3 Creating

Following the process of ideation, I had decided on the basic blueprint of the experience to be as follows:

1. Main menu
2. Narrative
3. Pre-lab questions
4. Lab
5. Post-lab questions
6. Conclusion of narrative
7. Ending scene including data

I incorporated the necessary scenes to provide a better flow aside from just the standalone lab scene. Satisfied with the structure of the experience, I went on to overhaul the lab scene with elements we believed were necessary in emulating

an in-person lab. To this end, I developed a dropdown UI element that enabled the user to expand and collapse a list of resources they might need: background information, procedures, data collection table, reset button, and submit button.

Once these basic aspects of the lab were implemented, my mentor and I began thinking about high-level UI schematics that we wanted to implement that could also be passed on to future labs. The hope in this was to make the experience **modular**.

The high-level UI elements added were a walking scene upon entering to allow the user to roam the lab, a basic click-through tutorial, and the ability to detect which objects can be interacted with by highlighting when being hovered over. All in all, this allows us to create a reusable design language for future chemistry lab experiences.

To wrap-up the lab scene, some final touches were added: a magnetic stir bar, a toggle to switch and view the meniscus up-close, and arrow-key functionality to turn the stopcock of the burette. Below in Fig. 3, you can view these features.

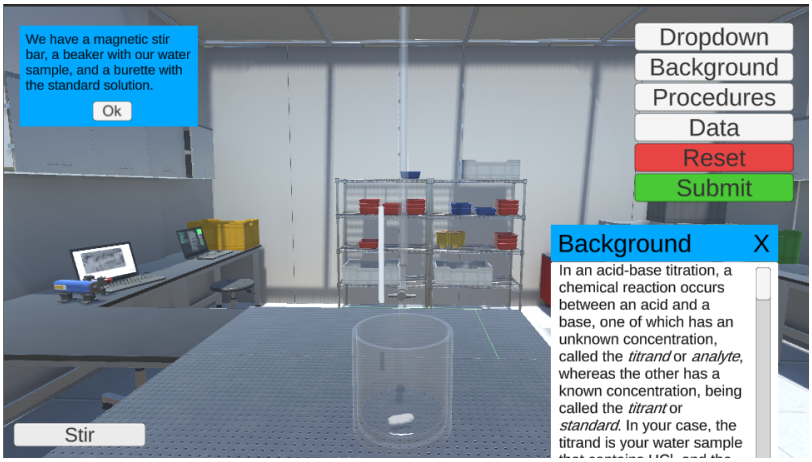

Figure 3: UI Features in the lab scene.

Another critical component of the experience outside of the lab scene was the creation of the user flow for pre/post-lab questions. I created a website where teachers could upload files that followed a particular format which would then be pulled down from Firebase to the project by the student who simply had to type in the name of the file. This feature allows instructors to provide their own questions for the lab. The diagram of the workflow is as seen below:

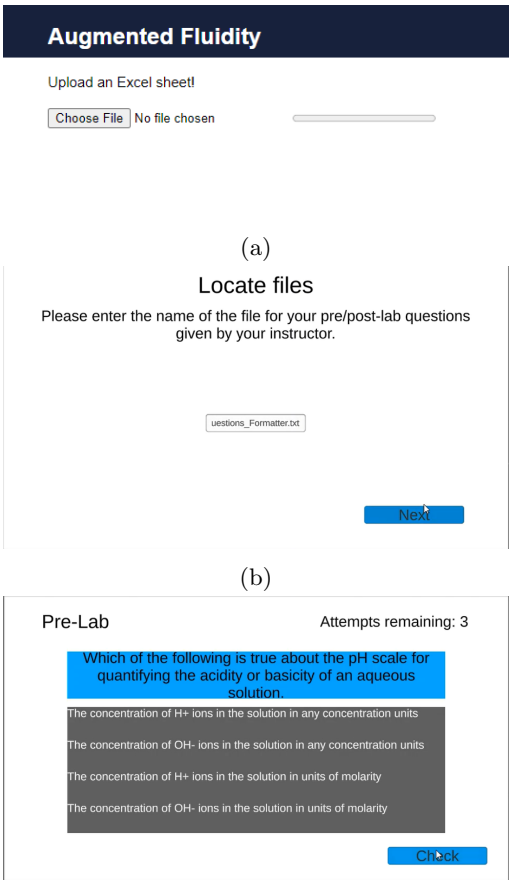

Figure 4: (a) Website for uploading files (b) User types in name of file to be downloaded (c) Questions loaded

2.4 Envisioning

Although working on creating a basic outline for this experience was a primary goal for this summer, it was also imperative that we always kept the "big picture" in mind. This was a guiding principle as mentioned during ideation. However, to concretely express these ideas, I created a presentation for what I saw this project could be, entitled "Vision for Learning @ METEOR Studio". The three main components of this vision were:

1. A web portal for instructors
    (a) Upload questions
    (b) Monitor student progress
    (c) Hold virtual lab times for synchronous learning
2. Modular labs
    (a) Same UX and high-level UI interactions
    (b) Simply swap out lab component
3. SWISH technology
    (a) Send out 3D printed kits for lab equipment

The basic functionality of all these features were implemented this summer, but the end vision is that this project will help transform remote learning. A primary case in which we feel this would be implemented perfectly is ASU's online chemistry degree. Currently, students enrolled in this program fly-in from across the country to perform all the labs in one week. This project would be able to remedy this by allowing these students to perform labs at home with a VR headset and 3D printed lab equipment. Rather than spending time and resources for a rushed week of labs, students will be able to experience the lab at a traditional pace that will emulate the in-person experience.

At a time where online education is clearly becoming a viable option, we want to be able to bring the lab to any student while providing a truly immersive experience.

3 Conclusion

My time at METEOR Studio this past summer was a rewarding learning experience. Apart from gaining technical skills in Unity/C#, I was also able to learn and grow in my skills when creating a product. Keeping in mind a vision, continuously asking questions, and not being afraid to fail are skills I will keep in mind in my future endeavors.