Motion Controls for a Natural Experience in a Virtual Learning Environment

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***Abstract*—The current state of virtual classrooms lacks user participation and doesn't utilize natural motion controls. Our goal was to have students be able to interact and feel immersed in the virtual classroom so that learning becomes the priority. Over the course of 4 months, we planned, conducted a bodystorming process, and had a user testing process so we could effectively implement motion controls into a Virtual Reality (VR) classroom with the goal of increasing student participation in online classrooms. We found that incorporating hand raise, nodding, and head shake functions have been found to improve the student's immersion and simplify the controls for the user. Over the process, our prototype received multiple updates and was reworked to adapt and improve by utilizing user feedback. We also recorded multiple feedback sessions, which helped us discover what specific events are required to create the classroom setting and which portions of our VR integration will need further improvements.**

***Index Terms*—Virtual Reality, Motion Controls, User Experience, Virtual Classroom**

I. Introduction

When looking into the future of virtual learning a natural next step from screen-based instruction is to add a dimension and utilize virtual reality to increase immersion. Reference [1] shows the effects of virtual reality in the teaching and learning environment have had positive effects on both the achievement and engagement of students. Simple and effective ways to teach in more interactive ways are becoming more readily available to the public, with things like a focus on webcams and projectors [2]. Motion tracking in a virtual classroom setting has some prior research implications. We believed that students would benefit from utilizing motion controls in a virtual classroom setting. In our early stages, we plotted concepts for our idea and found research supporting the use of learning in VR classrooms. Our next step was to bodystorm. During the bodystorming process, our goal was to visualize key interactions and ideas that we believed would help immerse and keep students more engaged in the VR classroom. The main idea that we tested around was a hand-raising function that would allow the student to physically raise their hand. We also worked with the idea of a head-leaning answering system allowing kids to respond with head movement. We then went on to create a basic prototype. Using that prototype we were able to enter our user testing phase and get crucial user feedback. Using that information we aimed to optimize our final product bringing us to what we have today.

II. Methods

In terms of our bodystorming, the first thing that was worked on was creating a use case diagram (**Fig. 1**) and a target persona (**Fig. 2**). We needed a better idea of what our needs and wants are for the completion of the project. The first situation we bodystormed was how a student is expected to learn and participate in a virtual classroom. Our first actor Emma was tasked with creating two possible scenarios that could come from participation in a virtual learning environment with Roy in charge of observing. Emma decided on engaging the student and having the student be in a presentation. The second situation was if a student was writing a quiz or test in a VR classroom setting. Both situations were made up of things like a mock desk/classroom setting, toilet paper rolls as controllers, and sticky notes representing pop-up action confirmations (**Fig. 3**). The observer sitting across from the actor simulates the teacher. The mock students would simulate the content and interactions that they would be viewed by participating in a VR quiz, raising hands to discuss, and asking questions. We finally made a VR prototype of the project to put some of our findings to the test and address some of our issues. We created a simple scene involving the hand raise functions and questions answering functions. We then got both actors to test out our scene and recorded feedback.

During the custom user interface stage, we utilized many different questionnaires to obtain data. System usability scales, NASA TLX, presence questionnaires, and other more open-ended response-based feedback were all ways to gain valuable data discussing how to proceed with the future of this prototype. Our goal for our prototype was to refine it with each stage that we entered, tweaking and adjusting it where necessary to create motion controls that work and keep the user engaged.

III. Results

From our bodystorming process, we found that after students initially join the meet, student involvement rapidly declines. Students only had to say ”Here” to gain their attendance check at the beginning of the lecture and for many. Students are not required to use microphones or cameras and this gave the feeling of distance between the students and the professor. When we conducted our first two phases of bodystorming we received feedback that the hand raise was found to be very natural and easy to do and the head shake component was engaging. In terms of issues, we needed a way to toggle the hand being raised to avoid fatigue as well as some worry about headset fatigue. We designed our prototype with this feedback in mind and found that the hand toggle system helps avoid fatigue while keeping engagement. We initially designed our head lean system to avoid the ability to shake off the headset. As well discuss in later feedback people preferred a head shake over a head lean to feel more natural.

Our user testing on our prototype provided critical feedback that we used to help finalize our design. We had a total of 6 participants try our prototype and provide feedback. Regarding our SuS results, we achieved 85.4 percent (**Fig. 4**). The areas we lost points in were our cumbersome design and the fact that this system wouldn't be used often by the participant. In terms of our NASA TLX evaluation, we reached similar results(**Fig. 5**). It was found that our product was at the lower end of mental demand, it was cumbersome and physically demanding, had a strong performance with limited frustration and had mixed reviews on the effort required. Our PQ results provided very similar answers with our main problem being focused on the quality of the interface with almost everyone commenting that the head lean was too much(**Fig. 6**). It was found that the interaction was very positive overall with an 85 percent score. Some of the most important feedback we received was the open question period that we had with our users. From talking with them users further discussed some of their main concerns. Those concerns were the weight of the headset and how the head lean feature was awkward. This was great to hear because an overlooked feature was how cumbersome the headset is to wear. We heard loud and clear that the leaning feature was not only heavy but also felt slightly unnatural. Many suggested replacing it with a head shake and nod. Some other concerns were expressed with the text accessibility. It was stated that some backgrounds and fonts used were hard to read. The final concern brought up was the lack of a confirm action button. Many believed that this feature is needed to let users be able to stay in control of their actions.

In terms of our prototype evolution, we had large changes at each major stage of our project. Our initial ideas in the body storming stage helped create the basis for our project. We were able to test features and pivot when creating our first real prototype. From there we were able to conduct our actual user testing which helped further clarify what works and what needed to be changed. Our current prototype encapsulates the final changes that users asked for and we feel that it is a great proof of concept for motion controls to be further implemented into a virtual learning environment.

IV. Discussion and Conclusion

To finalize the project, the features we were able to implement have been shown to increase student engagement through our own research and other research from academically reviewed sources. This proves that interactive VR classrooms have the potential to be further studied and optimized as shown by this simple prototype built here. Many iterations were required for the project to be where it is now and a large portion of that is thanks to the feedback we have received from the different stages of testers who have used this prototype.

While we did feel like the overall project was a success, we do feel that it can be further optimized for the classroom setting. That leads into our first of the future goals that would feature a teacher-side to the VR classroom implementation. As previously mentioned, having teachers being able to answer questions, talk to specific students in private, and present in a more natural online environment are all ways to increase the engagement of the students. The next portion after the teacher additions that could become more effective would be to transform this from a prototype to a fully-fledged program. This would require a lot of resources but the end goal would feature a downloadable VR program for students and teachers to create a more seamless virtual learning experience.

While working on the semester project, we learned many skills that will help us in future work. Originally we thought that creating an entire VR immersive and functional space may be outside of the scope of students who have never worked in VR before. This turned out to be far from the truth as the project was completed and even had some functionality that could have been easily replicated with the Wizard of Oz technique.

References

[1] R. Liu, L. Wang, J. Lei, Q. Wang, and Y. Ren, "Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons," British Journal of Educational Technology, vol. 51, no. 6, pp. 2034–2049, 2020.

[2] B. Hariharan, S. Padmini, and U. Gopalakrishnan, "Gesture recognition using Kinect in a virtual classroom environment," 2014 Fourth International Conference on Digital Information and Communication Technology and its Applications (DICTAP), 2014.

V. Appendices

GitHub Link: Repo LINK
Notes from Bodystorming: Bodystorming Notes LINK
Our Survey: Survey LINK
Our Excel Data: OntarioTech Login REQUIRED

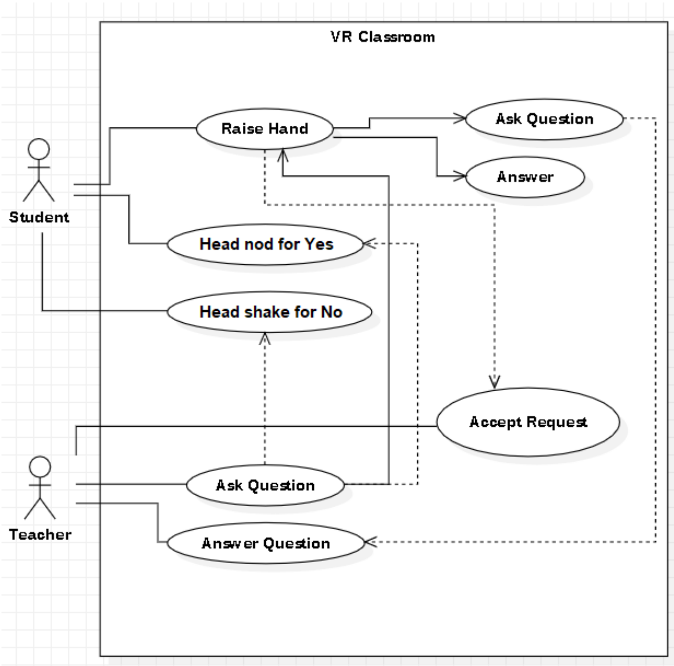

Fig. 1. Updated Use Case Diagram

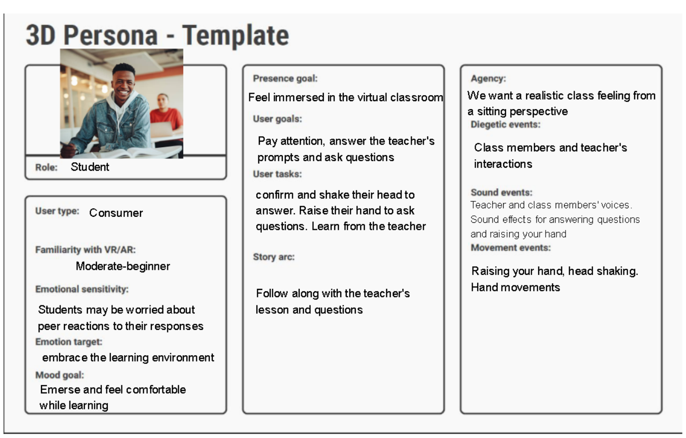

Fig. 2. Target Persona

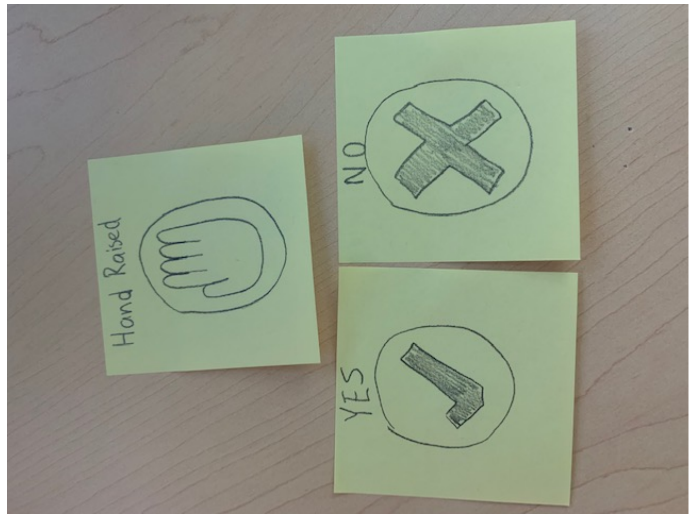

Fig. 3. Pop up assets

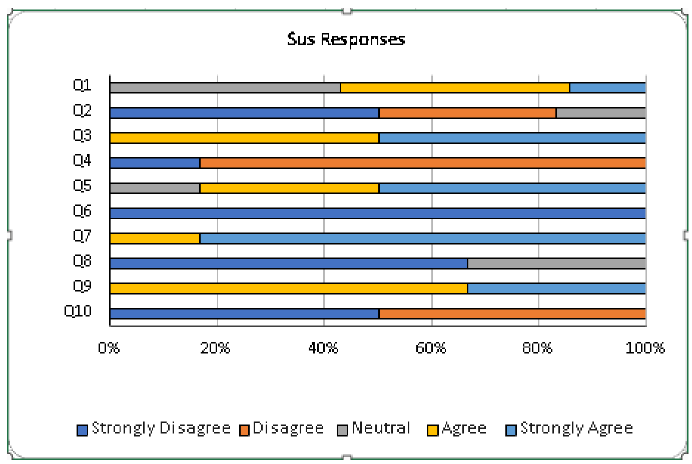

Fig. 4. Sus Responses

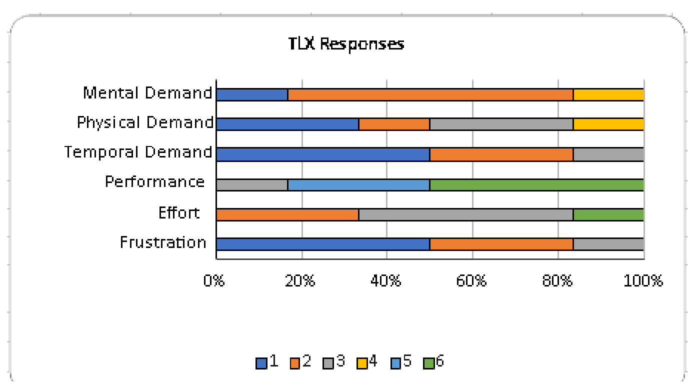

Fig. 5. NASA TLX evaluation

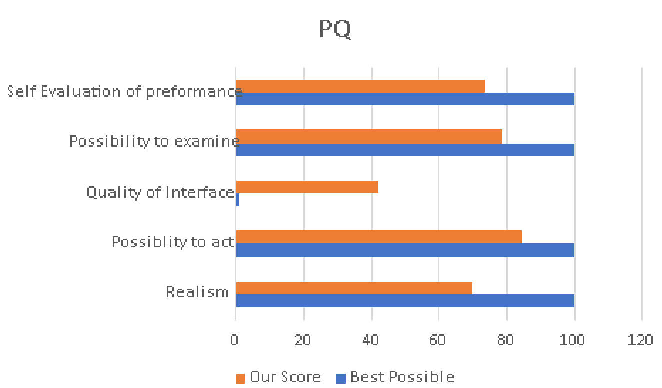

Fig. 6. PQ Results