USING VIRTUAL REALITY AS AN EDUCATIONAL TOOL FOR DANCE

An Undergraduate Research Scholars Thesis

by

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Approved by
Faculty Research Advisors: Dr. Jinsil Hwaryoung Seo
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RESEARCH COMPLIANCE CERTIFICATION

Research activities involving the use of human subjects, vertebrate animals, and/or biohazards must be reviewed and approved by the appropriate Texas A&M University regulatory research committee (i.e., IRB, IACUC, IBC) before the activity can commence. This requirement applies to activities conducted at Texas A&M and to activities conducted at non-Texas A&M facilities or institutions. In both cases, students are responsible for working with the relevant Texas A&M research compliance program to ensure and document that all Texas A&M compliance obligations are met before the study begins.

I, Kamryn Massey, certify that all research compliance requirements related to this Undergraduate Research Scholars thesis have been addressed with my Research Faculty Advisors prior to the collection of any data used in this final thesis submission.

This project required approval from the Texas A&M University Research Compliance & Biosafety office.

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ABSTRACT

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In the current climate of COVID-19, providing high-quality education for students is difficult, particularly regarding fields that are traditionally reliant on in-person teaching interactions. Studies such as sports or dance rely on mentors being able to demonstrate motions and critique students when they emulate the lessons. As the pandemic makes it either limited or impossible to learn physical skills in a traditional classroom setting, we aim to resolve this problem by providing a virtual setting for students to learn in with appropriate resources. This research project aims to provide Virtual Reality-based educational software that can provide dance students with simulated 360 views of fundamental movements. The software allows students to scrub through movements, rotate the virtual instructor, choose from several different dance options, and change the speed of the currently viewed dance movement. Motion capture was used to provide the initial data for fundamental dance positions, to portray these movements

accurately. A “muscle mode” is also provided in the interface, highlighting key muscle groups used in specific dance positions and providing information about how they are being used and how to train such muscles to better enhance their ability. Our process for producing this program was creating a very simplified version, where the environment was composed of boxes and the teaching model was a simple cube. This allowed us to make sure all the technical aspects of the interactions were completely functioning before beginning to fill out the environment with the final assets. Our environment also changed throughout the designing process as we worked through what makes a dance studio feel like an inviting and positive space to be learning a new skill. This iterative process became the core of our research as we explored how a person would be the most successful when learning in a virtual environment.

DEDICATION

I dedicate this research project to my friends, advisors, and family members who have supported me throughout this extensive and crazy process.

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Contributors

I would like to thank our faculty advisor, Dr. Jinsil Hwaryoung Seo, and our Professor Caleb Kicklighter, for their guidance and support throughout the course of this research. Thank you to Julie Choi for being my partner in leading this project, I certainly would not have made it very far without you. Special thanks must also be extended to Professor Diane Bedford and Julia Oesterreicher for their insight and guidance in the dance education aspects of our project.

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All other work conducted for the thesis was completed by the student independently.

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NOMENCLATURE

COVID-19	Coronavirus Disease 2019
Maya	A 3D computer animation, modeling, simulation, and rendering software.
Oculus	Oculus Quest
PC	Personal Computer
Play Area	The general space needed around a user when using virtual reality software to comfortably interact with the program.
Scrub	To quickly move through a video, usually to locate a specific portion the user wishes to pull up.
UE4	Unreal Engine 4
UI	User interface, a digital method of how the user interacts with the software or electronic device.
UX	User experience, the general experience of the user when interacting with a digital or electronic-based product, whether positive or negative.
VR	Virtual Reality
Zbrush	A 3D computer sculpting software.

1. AESTHETIC MOTIVATION AND RESEARCH QUESTION

1.1 Introduction

This research project is an educational virtual reality game where the user learns fundamental ballet dance movements. The user views the environment through a headset display which will make it appear as though they are standing in a dance studio with a digital teacher who will perform basic dance movements for them. Being within a virtual space offers a deeper level of learning that is closer to the experience of in-person lessons than a video course would be. We wanted to create a program that is a convenient alternative to those who are unable to go learn at a physical studio. This quickly became the centerpiece of the project when the COVID-19 Pandemic began as the world found itself no longer able to attend many things in person. This research project is a continuation of the idea of a previous work; however, my team not only rebuilt that whole program on an entirely different system, but we also decided to add a new anatomical component to the experience. Users will now also be able to look at and understand the muscles active during a movement when they activate muscle mode. During muscle mode the teaching model will have the active muscle highlighted within the model. There will also be a pop-up explaining which muscle is highlighted and how it is being used during the movement. These additions will allow a user to better understand how their body is functioning when performing movements and should then be able to better perform the movement themselves. Our research project offers a new way for someone to experience learning a new skill within the safety and comfort of their own homes.

1.2 Why Virtual Reality

Virtual Reality, while not new technology, is seeing a new resurgence of interest within the last ten years. VR is the use of a headset that can display a three-hundred-and-sixty-degree digital space as well as the use of two hand controllers that can allow for interactions such as pointing, grabbing, and throwing both with the digital space and objects within the space. Interacting with a completely virtual environment offers a deeper level of immersion that cannot be found with the typical computer screen. This quality of immersion is the driving force of this research. Our research seeks to explore and answer this question. How can virtual reality be used to teach someone a physical skill such as fundamental dance forms? Within the last year education in digital spaces has become a worldwide experiment due to the COVID-19 pandemic. People are having to find ways to teach others new skills when they are oftentimes not even able to be in the same room. Watching videos and reading instructional content will only get one so far in learning because nothing compares to the ability to interact and physically experience learning a skill. Enter virtual reality. VR offers a way for someone to feel like they are in a completely different location while still being at home. This seems like it could be the perfect solution for teaching in a socially distanced manner while still being engaging and isolated from the distractions typically found at home.

1.2.1 Elimination of Distractions

The benefit of learning in a dedicated educational setting whether it be a classroom or in this case a studio, is that one is free from distractions found in homes like television, games, and even other people living within the home. Being within a virtual environment means a person is able to focus completely on what is being taught because, even though they are physically at

home, they perceive themselves to be at whatever learning environment they are viewing from the headset.

1.2.2 Assisting in Teaching Fatigue

Teachers can become exhausted by teaching fatigue, often caused by the number of decisions they have to make as well as the repetitive nature of teaching in the long term. Virtual reality can assist particularly in assisting educators in directing their time and energy towards tasks better suited for their time while still providing students quality education. When teachers provide demonstrations, often students will request for the demonstration to be repeated several times, and the educator will have to undergo the same process in their next classes. With a VR education software, students can elect to repeat and view certain points of the dance movements at their own pace, reducing the time teachers have to spend on more menial tasks and improving their attitude and performance towards education.

1.2.3 Interactivity

The main issue with traditional virtual learning like viewing videos and reading instruction manuals is the lack of interaction between student and teacher. Students are unable to work directly with the teacher, ask for demonstrations, and view them from different angles to better understand the material. Due to our own experiences, we believe the best form of education is when a student can learn at their own pace, specifically targeting sections they are weaker on and repeating skills to better master them. Our educational software will provide the interactivity that current remote education options lack. By being able to manipulate the instructor model to highlight specific muscles and view the model from different views, speeds, and moments, the student will better understand their content and thus gain a better

understanding of the material than what they would have done with traditional videos and textbooks.

1.3 This Research in Relation to Other Works

Research on using VR for educational purposes is not a new area of study. Our research aims to build upon this discussion by exploring these ideas within the context of a global pandemic. Our research project seeks to explore and discover how an environment can be best designed and what interactions are necessary in order to make the user feel as deep a level of learning as possible in a world where traditional methods of learning are impossible.

2. HISTORICAL CONTEXT, DISCIPLINARY PARADIGMS, AND AESTHETIC STANDARDS

2.1 Virtual Learning During COVID-19

The practical application of virtual reality software is particularly valuable in the current COVID-19 pandemic. Since face-to-face instruction is either highly limited or outright banned due to health concerns, many schools are having difficulty in providing adequate education to their students. In comparison, using virtual reality as an educational tool would eliminate the medical dangers of physical contact while maintaining the benefits of interaction that face-to-face instruction offers.

2.1.1 The Effect of COVID-19 on Physical Activity

With the declaration of COVID-19 as a global pandemic in March 2020 and the resulting quarantine on an international scale, one of the first parts of lifestyle immediately affected was an individual's activity level. Quarantine actively encouraged a more sedentary lifestyle as it was highly discouraged to venture outside barring essential trips, so the amount of exercise the average person did went down as a result. An article posted in Annals of Internal Medicine noted studies showcasing a drastic change in activity on average. Looking at collected data of daily steps from 455,404 unique users from 187 unique countries, within only 10 days of the start of the pandemic there was an overall drop of 5.5% in average steps and within 30 days of the start of the pandemic, was a 27.3% decrease in average steps recorded (Tisson). There is some variation in change in average levels of physical activity depending on each country's individual public health policies, but every country overall experienced a general drop in activity.

Physical education was affected as a result of both this phenomenon and the difficulty involved with teaching a class with traditionally more personal interactions between coaches and students than other subjects. Without proper instruction and a general discouragement from physical activity, students in sports and dance are receiving a lower quality in education compared to before the beginning of the pandemic. Currently, educators are exploring options such as VR to compensate for this issue.

2.2 VR for Education in COVID-19

During the beginning of the COVID-19 pandemic in America, medical centers like the Cedars-Sinai Medical Center in Los Angeles took advantage of VR to train their newly hired residents (Cohen). Training included new COVID-19 guidelines and basic instruction that could be done at home using Virti, a tech startup associated with the medical center specializing in VR and AR. It is still too early to tell the long-term results, but it has been noted that earlier in 2020, a randomized study showed that 92% of healthcare workers had adequate understanding of their training after completing the VR education in comparison to 12% who received traditional training. Virtual reality can be harnessed to educate students in physical skills such as performing arts in situations preventing face-to-face instruction without depletion in quality of education.

2.2.1 VR Learning and Dance

Studies have shown that teaching through this software is significantly more beneficial to the student than just videos, particularly in physical skills and activities like dancing (Patel, 2006). There have been advancements in virtual reality learning, however, the effectiveness of the visual feedback is limited. A Hong Kong research developer included several interactions such as a visual feedback reference checking the correctness of a user's executions of the pose

and providing the user the ability to change the speed of the performance in order to further study a performance at a more comprehensive level (Chan, 2011). Unfortunately, the user is not able to directly interact with the virtual avatar, as it is merely projected onto a screen, and the user would have difficulty accessing this project as the researchers used a professional motion-capture suit to obtain the user's movement data, equipment that is very difficult for the average user to obtain (Chan, 2011).

2.3 Our Research Project and Its Changes

Our research project provides a realistic digital studio environment as well as a UI that is meant to emulate the experience of being in a real dance studio. The user is able to study demonstrations of dances performed by a virtual teaching avatar and choose from a variety of interactions to enhance their learning such as changing the speed, pausing, and quickly moving through the animation to target specific sections the student wants to repeat. These options aid in the user's understanding of the movement as they have full control over the instructor. The previous iteration of our research provided a purely virtual studio environment for the user, which allows for greater user interactions such as the ability to rotate the virtual instructor and observe the current move at different speeds. The expansion on this project we added is a "muscle" mode vs "normal" mode where the user can choose to activate a viewing mode that points out the muscles involved in a movement to aid in understanding the structure of the target pose. Descriptions are given about the highlighted muscles, which explain the importance of these muscles working together to perform the dance as well as how to strengthen and improve them for better dancing skills. We also moved the project from the Unity Engine to UE4 for a cleaner game and better-quality aesthetics, as well as relying on the Oculus Quest instead of the VIVE headset used in the past. Despite sacrificing some accuracy in tracking user movement,

this will increase accessibility and improve the UX as the Oculus Quest has a more affordable alternative and will allow users to more easily access our software via the Oculus Store. With the current expansion on our project, we have created an easily accessible, virtual reality-based modern dance education software.

2.4 Issues During the Process

The main issues we ran into over the course of this project were mostly technical issues with the software or coordinating conversations about the material. As this project was required to be remote, we had to install Perforce, a cloud-based file-sharing platform similar to the Google File Stream specifically geared towards games. As we were unfamiliar with the software, we ran into several problems related to syncing files back and forth between computers and administrative accesses. These issues were eventually handled after consulting outside parties, and the program was fairly stable to work with. Other technical issues involved importing in the dance animations due to file corruption and non-quadratic polygons in the dancer mesh for the muscle simulations. The solution to this was removing all unnecessary muscles and volumes used to simulate the animation and only keeping muscles we wished to focus on for the movement. It was also necessary to run a mesh clean-up function in Autodesk Maya where the mesh is analyzed for polygons exceeding four sides then tessellated into quads and triangles. UI was originally a hassle since we were hoping to not be forced to script the interface from scratch. Fortunately, the Unreal Engine marketplace provides multiple plugins for different functionalities, so we are using a tool that provides the general UI interface which we can replace with more visually cohesive UI assets to make the game more appealing.

2.4.1 Communication with Outside Sources During COVID-19

Communicating with dance resources was also an issue due to COVID restrictions. As it is not recommended to gather multiple people together for extended periods of time, we had to work around both distance and scheduling limitations to inquire about the accuracy of our dance animations. As a result, we reached out to both dance instructors and former dance students to virtually review our content and provide feedback in return as a result. They provided a detailed insight to how to best portray fundamental movements with accurate posture and speed, as well as information on the kinesiological side of the material. For the information focused on in the slides used during muscle mode we consulted with Julia Oesterreicher, a long-time dancer. She was able to go through each of our movements and identify the muscles groups that an instructor would typically focus on during a lesson, and then further explain how they are being engaged during the movements. We believe these explanations will enhance the educational experience of the student as they will understand how the dance movement is performed from an anatomical level.

3. EXPLANATION OF EXHIBIT

3.1 Exhibit Space

The ideal exhibit venue of this project would be a room that is a replica of the environment within the digital software that also contains the ability to charge electronic equipment and has access to the internet. This would be a room of similar size and dimensions, as well as containing traditional equipment and features of a dance studio, such as dance barres, mirrors, and lighting. The main "play area" must be completely clear and be roughly 2 meters by 2 meters by 2 meters in cubic space, so the student will not be impeded by any miscellaneous items around them, which is a potential safety hazard. If this ideal exhibit venue is not feasible, it is preferred to have an empty room that can provide the recommended play area dimensions mentioned earlier. By providing this format, the student will feel immersed in the education software, making the experience more realistic and believable. For the best experience for the user, it is recommended that the general audio level of the audience is kept at minimum in order to provide the least amount of distractions.

3.2 Equipment of Exhibit

Required technical equipment is a PC unit capable of running VR software, a mouse for starting and navigating the computer, a table for the electronic equipment to rest upon, a VR headset (ideally the Oculus Quest), and handheld controllers. The VR headset is required in order to view the project and the controllers are needed to interact with the interface. Ideally in the future, the project will be published on the Oculus Store which would allow the user to directly download the app onto their Oculus Quest at their convenience. As a result, this would negate the need for the PC unit and cords to connect the VR headset to the computer, providing a more

immersive experience for the student. A large monitor hung on a wall will mirror the view seen by the user and can be viewed by passing bystanders of the exhibit. The monitor should be minimum 42” and should be at eye level to the average viewer.

3.3 Explanation of Application

Because our research information will at times be read without the actual application readily available the following paragraph has a detailed explanation of the program as well as included imagery for easy understanding. Upon the launch of the application the user will see the darkened dance studio environment with a pop-up title screen window locked to the front of the view. It is assumed the user will know the basic interactions used in virtual reality such as pointing and selecting something with the pointer finger trigger located on the back of the hand controller. The user will have the option to immediately enter the studio by choosing “Play” or look at a brief slideshow tutorial for instructions on how to interact with the application. The tutorial will consist of a PowerPoint-type slideshow with explanations of the application’s UI located around the virtual dance instructor avatar. When selecting the “Play” option the pop-up window will disappear, and the lights will turn on within the studio environment. The instructor avatar will fade into his location within the studio; it was decided he would not be idle within the dark environment due to the possibility of the user feeling a sense of unease with what is essentially a stranger in a dimmed unfamiliar environment. When the instructor is not actively set to demonstrate a dance movement, he will have a looping idle animation where he is in a relaxed state but appears ready to perform when needed. This relaxed animation is also intended to give a sense of relaxation and comfort to the user as opposed to the default t-pose of a character rig (see fig. 3.1).

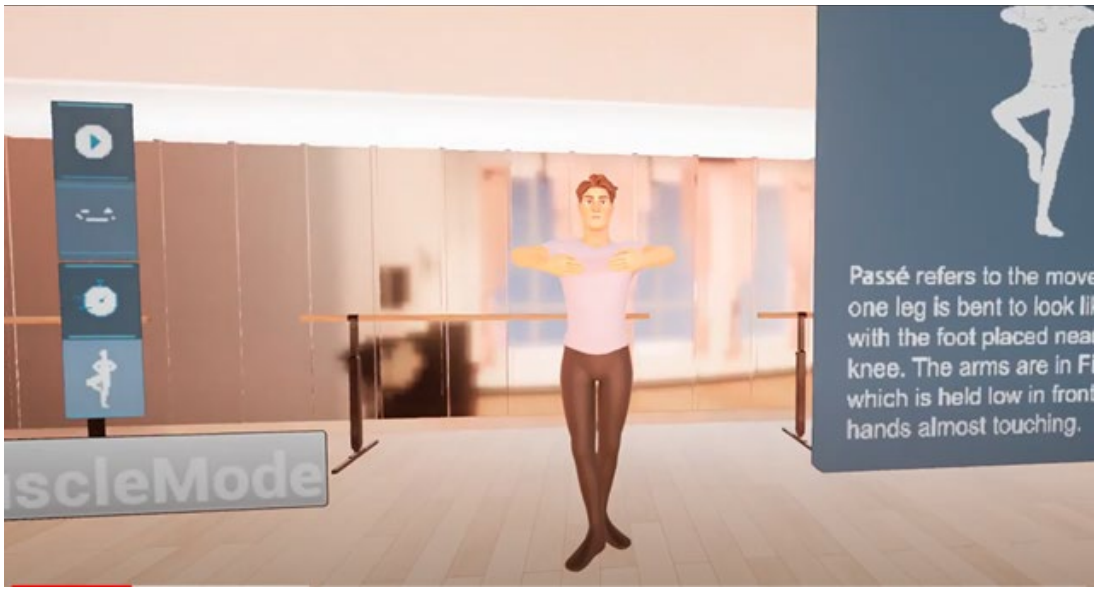

Figure 3.1: Image of the dance instructor avatar within the virtual studio

3.3.1 User Interactions

Located around the dancer is a permanent UI toolbar with options for playing and pausing the movement, adjusting the speed of the movement to 1x, .5x, and .25x speeds, rotating the instructor model, selecting the movement to be performed, and turning on "muscle mode" (see fig. 3.2). The movements to choose from are Port de Bras, First Position Passé, Fifth Position Passé, and a Tilt. These are all basic dance movement forms that are an excellent starting point for beginner dancers, with the exception of the Tilt which is a contemporary movement that is also a little more advanced (see fig. 3.3). The movement can continually be repeated as many times as the user wants and they can interact with the instructor using the elements of the UI for pausing, speed, and rotation.

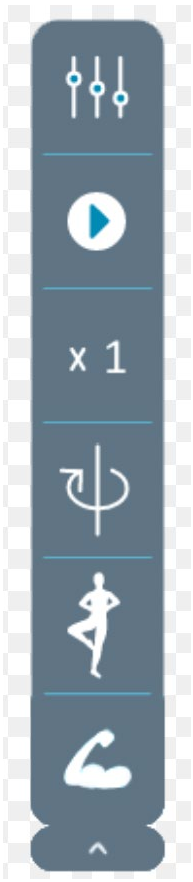

Figure 3.2: Image of UI with buttons for Menu, Play, Speed, Rotation, Movement, and Muscle Mode

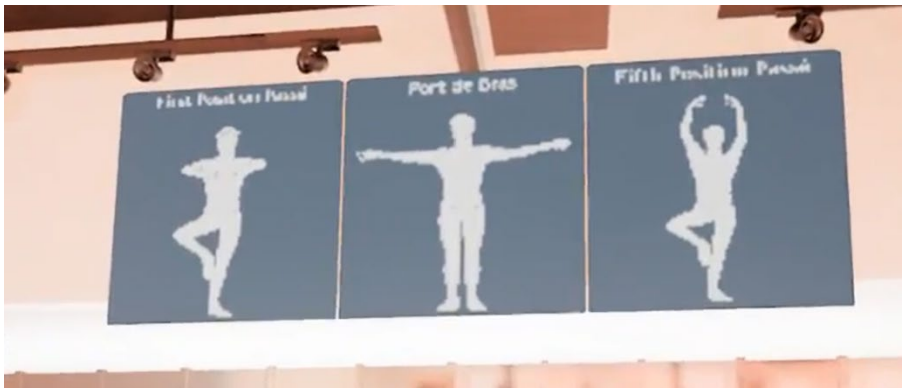

Figure 3.3: Image of movement selections for First Position Passe, Port de Bras, and Fifth Position Passé

3.3.2 Muscle Mode

When activating muscle mode for a particular movement the user will still be able to see the complete model for the instructor, but there will be the added component of the muscle visible as an outlined object underneath the skin of the model (see fig. 3.4). It was decided to give the muscles a stylized appearance because we wanted to make sure they were not something that was visually disturbing. Having the model switch out to a completely skeletal version could be seen as an alarming transition or having realistic completely visible muscles underneath the skin could be seen as grotesque and invasive. We looked at examples for how other game applications presented an x-ray mode, but it was ultimately our game engine UE4 that helped us determine the final look. When building an application within UE4 an object is highlighted with an outline that changes depending on the angle of view when the object is selected. We decided to use a similar outline with the muscles, so the user is able to see the shape outlined from any angle underneath the model in the correct location without feeling like they are viewing a realistic image from a medical textbook. We chose the outline to be blue so as to match the rest of the application's UI, but also to further distance the muscles from the appearance of fleshy tissue. This stylized view of the muscles allows the user to focus on learning how they are being used without being distracted by something that could be seen as disturbing due to it being too accurate and representational. The muscles visible during the selected movement will only be the muscles most important for performing that movement. Having the user view an entire muscle system could be overwhelming and confusing even with key muscles highlighted, so we decided to present a reduced version the user can focus on in their studies. On the right side of the instructor a new window UI will appear with a written explanation as to what muscles are being

used in the movement and why. This dual presentation of information will allow the user to have a deeper understanding of the movement.

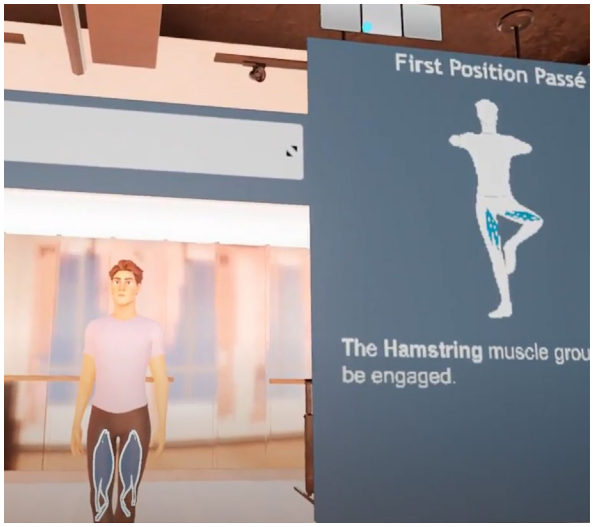

Figure 3.4: Image of instructor avatar with the hamstring muscle group visible

3.4 Application Creation Process

Initially our application was based on the previous research of another former Undergraduate Research Scholar, Carmen Sims, and it was expected that we would build upon this version using the original base files. However, during the summer of 2020 after much evaluation it was decided we would attempt to rebuild the application, which had originally been built in Unity, to our new game engine Unreal Engine 4. We initially thought this would be as simple as moving assets like the instructor and studio into the new engine, but we found ourselves to be unsatisfied with how things were appearing within the application. This led to almost every asset being recreated for our new version within UE4.

3.4.1 The Environment

Originally the studio environment for the application was very minimalist. The room consisted of white walls, windows to the right, a few dance bars around the edges of the room,

and a stereo located across from the instructor model (see fig. 3.5). The room was meant to have a focus on simplification and stylization, so it was able to run smoothly. Because of this stylization the environment unintentionally lost the sense of welcomeness typically found within a dance studio. To remedy this, the environment was completely redesigned to include more windows with curtains to add a sense of warmth and provide an airy atmosphere, chairs were added to fill in the space, and the stereo is now placed on top of a shelf with cubby holes inside of which are items like ballet shoes and water bottles. During the asset creation process, we considered other potential props such as musical instruments, air conditioning units, and other miscellaneous items to make the environment feel more realistic, but certain ideas were discarded as ultimately, we were aiming for a relatively modern dance studio without too many urban elements to overly bulk up the environment. All these details work together to create an environment that feels lived in, and this feeling allows the user to become more immersed within the space (see fig. 3.6).

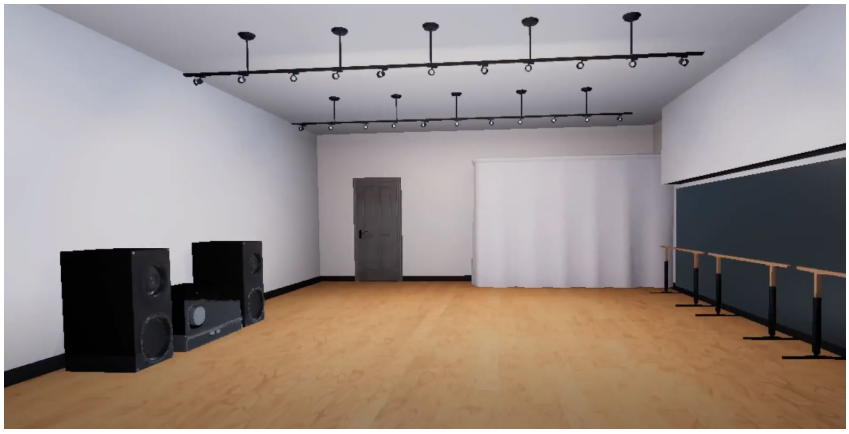

Figure 3.5: Previous application's version of the virtual dance studio

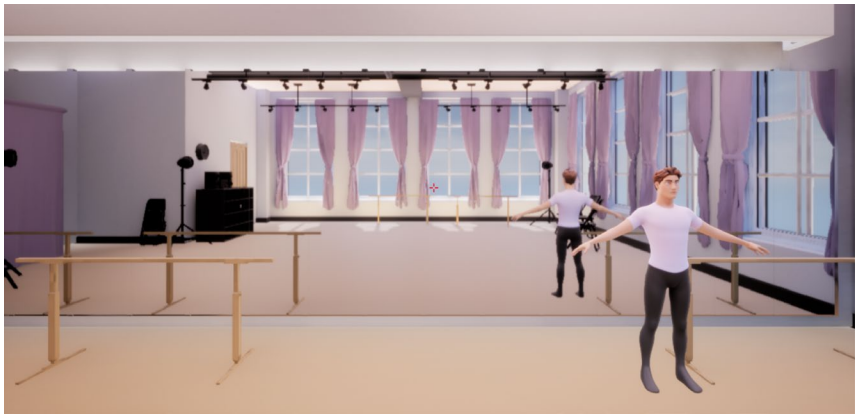

Figure 3.6: Current version of the virtual studio environment

3.4.2 The Lighting

Lighting in Unreal Engine 4 was a challenge as none of the team was particularly experienced in lighting in a game engine with real-time rendering. As a result, there was a learning curve in understanding the software enough to obtain the lighting we desired. We had a goal in mind when it came to lighting our environment. We wanted the scene to be a bright environment that was easy to see and move in without feeling cold and sterile. We considered different hours of the day such as early morning, noon and sunset, but these periods of time were removed from consideration as they were either too dramatic for the atmosphere we intended or wouldn't optimally light the environment evenly. In the end, we settled on early afternoon, for late morning, to be late enough in the day to have the sun be able to naturally light the room while not being too late that the warmer light associated with the afternoon would not encourage the student to feel sleepy and lethargic. With these details in lighting, the student will feel immersed in the environment and be encouraged to be motivated to learn.

3.4.3 The Instructor

The model for the instructor was one of the earliest things we knew we wanted to completely redo from scratch. The previous version appeared to be older and, due to the drooped

eye shape, appeared to have an almost bored or uninterested expression. The slicked-back ponytail also gave the model an almost cold presence in the environment, which was not helped by the stark white skin color (see fig. 3.7). We wanted the new version to be much younger with a boyish quality and to have the appearance that he is also a student still learning, albeit advanced enough to be teaching beginner lessons (see fig. 3.8). His expression is supposed the focus but still relaxed so he feels approachable. We decided to change the collected professional appearance of the previous instructor by removing the ponytail and giving the new instructor a short and fluffy haircut, which further highlights his younger appearance. The previous version of the model was created to be reminiscent of the Wii Fit instructor with more exaggerated proportions and stylized colorization. The need to change the colorization was because it did not fit our more realistic environment, but the need to change the proportions was due to the muscle system we were using.

Figure 3.7: Previous version of instructor avatar

Figure 3.8: Current version of instructor avatar

3.4.4 Ziva Dynamics

In order to create accurate muscle animations, we used the Maya plug-in tool Ziva Dynamics which is a professional-level software that specializes in muscle simulation. The educational license for the software includes the use of a fully set-up human muscle system, but in order to use these muscles we had to make sure the proportions of our instructor model matched the proportions of the muscle system. This was done by importing the muscle geometry into Zbrush then sculpting the instructor model to fit the proportions. To simulate the muscles the animations were first created with the instructor's full body rig. The animation was then transferred to an identical rig that was fitted to a skeleton. Once the animation is transferred to the skeleton the animated would then be baked onto the skeleton geometry and exported as an

alembic file. This alembic file would then be used to drive the muscle simulation in much the same was our own skeletons drive our muscle systems. We were then able to delete any unnecessary muscle geometry for the movement, and the remaining muscles would be ready to be imported into the game.

3.4.5 UI Design

The previous iteration of the UI design from the original project was very primitive in design and aesthetic due to the lack of a dedicated UI designer. It was functional but lacked color and design choices. This year we had a UI artist on our team who provided us interface assets custom-designed for our project. A bright blue color palette was selected to be simultaneously calming yet energetic, which matches our general atmosphere for the project. The white font and simplified icons emulate the designs of other physical training apps, particularly the design choices of ones used on IOS mobile products. We chose to have this minimalistic, modern aesthetic as it feels futuristic and matches virtual reality and the simple look will not be distracting to the student. Muscle mode has similar design choices in both color palette and typography choices. For the highlighting portion of the feature, the same bright blue is used to be cohesive and indicate to the user that they can interact with the muscles just like how they can interact with the rest of the UI interface (see fig. 3.9).

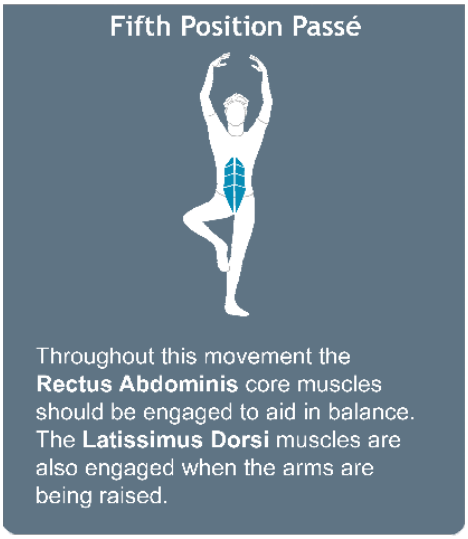

Figure 3.9: One of the muscle mode informational cards

3.5 Public Presentation

Our public presentation was done as a part of the Texas A&M Virtual Undergraduate Research Scholars Symposium. Due to the COVID-19 pandemic we were unable to make any sort of traditional in-person presentation, this meant we would not be presenting with the same level of interaction one would have with an audience. The virtual symposium was formatted as a pre-recorded video that reviewers would then critique. Because nothing would be done live, we had to plan to explain our research to viewers most likely unfamiliar with our topics and processes all within the allotted time limit. This became a unique opportunity to find ways of explaining our research in more accessible terms all while formatting our presentation in a fun and attention keeping manner. While it was disappointing to not have any feedback during the presentation, the virtual format provided its own fun and unique challenges. We received feedback from reviewers, which largely was on our presentation skills; however, there was the suggestion of creating multiple instructor avatars in the future for more diversity. There is not the

time to include this change immediately due to the complexity of creating a single character, but it is something we would like to take into consideration as the project continues in the future.

3.6 Public Showcase and Q&A Session

We will be presenting this research project for the Viz-A-GoGo28 Research symposium, which will be a live presentation with an interactive audience. This will allow us to get immediate feedback from professors and industry professionals that work within the gaming and interactive design industry, as well as gain experience presenting our research in person. We also would like to have a showcase in the Visualization VIRL Lab Space with the Texas A&M School of Dance in order to gather feedback from users who would be most likely to interact with this type of software.

4. REFLECTION

When first approaching this project, our original target audience were prospective dance students with limited access to traditional teaching methods. We hoped to create an educational VR experience that can provide students with a more well-rounded education than simply reading or watching videos. As a result, we aimed for features that would be useful to the user to learn, particularly the ability to replay material, choose between material, and enhance their training by learning about the muscles behind the fundamental dance movements. With the ability to take control of their own experience, students can learn at their own pace, repeat portions they do not understand, and feel more motivated to complete the course as they are immersed in the digital dance studio environment. As no one on the team is an expert in dance education, we consulted dance educators and former dancers to gain a better understanding of the material we wish to teach the audience.

One surprising benefit from consulting such people was the insight on how our software could assist not just students, but educators as well. As the virtual instructor can infinitely repeat demonstrations of movements and the student can control the entirety of viewing the instructor in a three-dimensional space, this frees human instructors from having to constantly repeat demonstrations for their students. This alleviates teaching fatigue, which can stem from repetition of menial tasks, as well as freeing up the educators' time to focus on activities more valuable to their students such as providing more advanced content or having one-on-one sessions with their students to provide critical feedback. As a result, both the student and a potential human instructor can customize their educational experience on both ends to maximize each other's time and receive the best experience possible catered to their needs. In all, this

project was designed to help provide alternative approaches to physical education, and it is promising in its future potential.

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APPENDIX: CREATIVE ARTIFACT

Creative Artifact Video

Description

A Video demoing *Balletic* within the virtual studio environment, as well as the ways the user can interact with the model. The video begins in the dance studio environment facing the instructor avatar which is surrounded by blue UI elements. The video then turns a full circle to look at the environment. The video showcases the interactive functions for Play/Pause, Rotation of the instructor avatar, changing the Playback Speed, choosing between three movements, turning on Muscle Mode, and switching the Movement Informational Cards.

File Name

Balletic_PlaythroughDemo.mp4