CREATING INTERACTIVE DANCE PERFORMANCE INTEGRATING

VISUALIZATION TECHNOLOGIES

An Undergraduate Research Scholars Thesis

by

MADISON CALVEZ[1], TERRA FIEDLER[2], CALLYSTA HALL[3], ELIZA MILNER[4],

BRENNA STREET[5], ANNIE RABEL[6]

Submitted to the LAUNCH: Undergraduate Research office at
Texas A&M University
in partial fulfillment of requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
Faculty Research Advisors:

Christine Bergeron
Dr. Jinsil Hwaryoung Seo
Jennifer Petuch

May 2023

Majors:

Kinesiology - Dance Science[2, 3, 4, 5, 6]
University Studies - Dance Concentration[1]

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.

We, Madison Calvez[1], Terra Fiedler[2], Callysta Hall[3], Brenna Street[4], Eliza Milner[5], Annie Rabel[6], certify that all research compliance requirements related to this Undergraduate Research Scholars thesis have been addressed with our Faculty Research Advisors prior to the collection of any data used in this final thesis submission.

This project did not require approval from the Texas A&M University Research Compliance & Biosafety office.

TABLE OF CONTENTS

Page

ABSTRACT

Creating Interactive Dance Performance Integrated Visualization Technologies

Madison Calvez[2], Terra Fiedler[1], Callysta Hall[1], Eliza Milner[1], Brenna Street[1], Annie Rabel[1]
Department of Performance, Visualization, & Fine Arts[1, 2]
Texas A&M University

Research Faculty Advisor: Christine Bergeron
Department of Performance, Visualization, & Fine Arts
Texas A&M University

Research Faculty Advisor: Dr. Jinsil Hwaryoung Seo
Department of Performance, Visualization, & Fine Arts
Texas A&M University

Research Faculty Advisor: Jennifer Petuch
Department of Performance, Visualization, & Fine Arts
Texas A&M University

Technology is becoming increasingly more advanced daily; new generations are constantly breaking out of existing fields and creating new connections to the world around them. Technology has become so integral in everyone's lives that many could not imagine performing daily tasks without it. It has also produced a lasting impact on how many connect and interact with others. In the current climate, people can reap the benefits of prior technological achievements while continuously experiencing growth in this field. As more is explored into what appears to be endless possibilities, it is essential to keep artistic endeavors relevant in the realm of technology.

With the immense potential in the technological field, there are a plethora of opportunities for applying it in performing arts. In many cultures and styles of dance, this art form has always been used as an outlet used to portray stories or various themes through movement. With the implementation of interactive technology, the artist can bring a new level of connection to the audience. This unique combination can also increase the depth of impact by making the performances more accessible and understandable to different groups of people. Dance is already known as a universal language, but this statement will only become more and more accurate with the addition of specific technological improvements.

The groundwork of this project consisted of researching within the realm of interactive technology to show how visualization techniques can be incorporated into a dance performance. The students wondered if this could help artists explore creating work that might have a more powerful and lasting effect on an audience. The group chose a topic anyone could relate to–basic human connections and the impact of these relationships–and from there created a unique, artistic exhibition for a live audience. After deciding to utilize Kinect motion sensing software, the students dove into this new choreographic process, figuring out how to implement the unique visual aspects into their movement creation. The group was also presented with the opportunity to use the Exxon Mobil Igloo Dome as a performance space for the project, adding the exciting ability to have full 360-degree coverage of the performance space. These technological additions aided the thematic aspects of the performance, making it more of an all-encompassing experience for the audience.

ACKNOWLEDGEMENTS

Contributors

The student research team would like to thank the faculty advisors, Christine Bergeron, Dr. Jinsil Hwaryoung Seo, and Jennifer Petuch, for their guidance and support throughout this research. They would also like to extend a special thank you to John Alberse for his work on the software elements of this project.

Thank you to the friends, colleagues, department faculty, and staff for making this time at Texas A&M University a great experience.

Funding Sources

This project did not receive any outside funding for this research and thus has no financial acknowledgments.

1.   AESTHETIC MOTIVATION AND RESEARCH QUESTION

Fusing dance and technology can bring new and unique ways to create within this physical art form. The most challenging part of this process is blurring the separation between the performers and specialized visual elements; when done well, those elements do not outshine the live performance but enhance it. An arrangement was done by the company Alaoui in June 2019 incorporating sound and visualization in dance as "an art project to create sensorial interaction between technology and the dancers' embodied inner experiences." This performance is a perfect example of how research within the technology field can impact a dance performance and make it a more interactive experience for both the dancers and the audience. This concept inspired this undergraduate research project to create a performance linking technology and dance in a way that can demonstrate meaningful connections between humans and show the power they can have over each other's lives through art.

The primary motivation behind this research question was to find a way to connect technology and dance. Throughout the project, a significant focus on which technological aspects would function best to create new work, as well as making sure these aspects did not surpass the dance component. Few research studies have been done on this topic, allowing projects like this to pave the way for future technology and dance research. The outcome of the group's research question will be shown through their creative artifact by demonstrating the work put in throughout the year. One exciting characteristic of any artistic endeavor is its ability to grow and change continuously: while this performance, or creative artifact, will mark a stopping point in this specific project, it will not be the end of this sector in dance technology research. Each of the students will take what they have learned into their future careers in the industry, and by

documenting the process and outcome, they will be able to influence other creatives already in the field.

This research is vital to the field of dance and technology because it opens up the door to endless possibilities and poses the question of what other exciting factors could be combined with dance in the future. This documentation could act as a catalyst in dance choreography, allowing these students and other researchers to explore more ways to connect with the general public through dance. For example, many of these students are interested in how they can integrate the process of dance on film into what they have already learned from this project. This is a relatively small-scale version of the possibilities of integrating dance and technology. It demonstrates the capability of undergraduate dance students to bring new and exciting ideas like this to life.

1.1 How Can Fundamental Human Connections Be Demonstrated Through the Combined Use of Interactive Technology and Dance?

This project demonstrates the exploration of technology and creative movement in the same space while also challenging the principles of human connection through art. The students curated the choreography to show how fundamental human connections can be expressed through dance and enhanced by the power of technology and projection. The movement wouldn't always include physical touch, but the projections met in the middle and connected the dancers. When the dancers used physical contact and danced together, the projections merged into one color. The group indulged in the possibilities that were created when combining an expressive art form like a dance with the everlasting and enhancing features of technology. The group strived to use technology to highlight and deepen the interpersonal relationships and connections they focused on in the choreography.

With many technological limitations in mind, the group ebbed and flowed between

creating the visual elements and dance choreography throughout the process. The outcome

brought together the integration of technology and dance exploration. The main idea was to

assign different colors to represent a person or specific influence that affects someone else's life.

One dancer starts on stage with the projection of one singular color around them–this would

represent them, or their aura, in a way. As each new character enters with their color, it becomes

integrated into part of another dancer's aura. Each dancer will have their color to represent how

everyone experiences a diverse range of influences in their lifetime. This physically represented

the way people can leave a lasting impression on those around them, whether positive or

negative. Every color has two meanings to reflect that further. For example, yellow represents

joy as well as anxiety.

The group wanted the show to focus on something more than just the highlights of

interdisciplinary curriculum, which displays a story of the daily mundane interactions humans

have. Technology has played such an integral role for the current generations in their

development, advancement, and interactions with one another. The team deduced that their

concept of how human connection affects people would allow the public to relate to the research

to its fullest potential. This means that even someone who is not knowledgeable of the creative

arts or technology would be able to understand and appreciate the purpose of this research.

1.1.1   *How Can Technology Help Implement the Theme Into a Comprehensible Story and Enhance the Dance Choreography and Movement Styles?*

Dance is a form of communication that allows dancers to convey stories using their

bodies in a very human and honest way that words often cannot. Part of a choreographer's job is

to make the movement digestible, enabling the audience to form their own connections and

overall understanding of the piece. Many members of the research group have intensely studied choreography in Dance Composition I, II, and III classes that are offered by the TAMU dance program. Those classes have served as an academic resource for them while in the choreographic process. The students have been able to delve into their individual "toolkits" of choreographic skills and devices to express the message to the audience, combining their styles to create visually interesting work.

One of the significant aspects the team members wanted to focus on was movement quality because they believed it is the most visible way to separate the dancers into their roles in the storyline. Each dancer had a solo moment and a duet moment. This allowed the audience to see the dancers move individually in their color and then move with another dancer to create another color. Within the solos, each dancer had a specific intention behind the movement. Movement quality and dynamics are hard to explain and easier to perceive, but they can be described as different types of energy put into moving. For example, the character portraying red was given very hard-hitting, percussive movements to exhibit attributes such as boldness and aggression. This contrasts and separates them from the more flowy and soft movement quality of the blue character. All six members have extensive and unique backgrounds in dance, enabling them to contribute a variety of ideas while growing their repertoire in the process. Collaborating extends the possibilities of each movement's quality. In addition, because the dancers are very limited spatially by the motion sensing parameters, emphasis on the dynamics of movement and how they relate to each character was even more critical choreographically. The projection behind each dancer had the same flowy effect to help with any seams in the projection screens. If the projections were different textures, they wouldn't have also flowed together on the screens. There was a small space where the dancer could move, so having a very flowy aura around the

dancer helped open up the space. The movement itself had different qualities but it was being portrayed the same on the screen. That's where dance and technology intertwine because the audience had to look at the color being projected and then watch the dancer to see the emotion being portrayed.

As mentioned above, the performance incorporated the projection of individual colors into the connection concept to bridge those movement qualities and their associated character traits. The character who was given hard-hitting, harsh movements had the color red because it has connections to extreme and powerful emotions, ranging from love to war and anger (Yu, 2014). While the idea theoretically could have been conveyed purely through movement and space, adding these visual features helps further the audience's perception of the underlying meaning behind the action. The dancers wanted the addition of visualization techniques to enhance their movement and the theme, not overpower or hinder it.

Another way to deepen the understanding and individualization of each incoming character for audience members is the choreographic devices of theme and variation. By giving each individual their own motifs or repetitive movements, the audience can link those movements to that character. By first allowing the audience to make that connection, it was easier to visualize the theme as these movements affect the characters they encounter. The variation then allows the audience to distinguish each character from one another. In this way, the team could visibly bring human connections to life. These can be essentially thought of as a dramatization of mirroring or when humans subconsciously imitate those around them, but it is also just a visual representation of human relationships.

Another important factor the dancers incorporated into the choreography was spatial content, including pathways, formations, directions, and transition patterns. The dance was

performed in a thirty-foot diameter dome with two Kinects in the center directed to opposite sides of the space. The dancers had to adjust their choreography to not only be able to dance in the dome within the ranges of the two Kinects but also for an audience to sit and watch from a comfortable distance. The Kinects could only detect a specific range of motion to create the body image silhouette, so the team measured the floor space and put down tape to practice staying within the boundaries of the sensors. The dancers had a hard time creating diverse formations with only two dancers on stage at a time, so they had to rely on the patterning and transitions to keep the audience engaged. One way that added excitement to the piece was by having some dancers transition straight from a seat in the audience to the stage space. It shows the audience that they, too, are part of the illustrated human connections and will be influenced by the performers.

Dancers who have taken Composition III experienced assembling an entire show from top to bottom, including all of the production and outreach aspects. Producing a show benefitted them immensely concerning the performance portion of this project. Lighting, music, and costuming were just a few of the production considerations in this choreographic process. They communicated with the visualization advisors so that these elements were well thought out in relation to the projection technology aspects. The dancers also created posters, flyers, and social media content to spread the word about the final performance date and times.

1.1.2 How Can the Performers Break the Barriers Between the Audience and the Dance to Expand Upon the Theme?

Dance is often performed for the audience and used to tell a story and emit emotions internally or externally to get the audience thinking. Making a connection with the audience was the team's priority from the beginning. The project incorporated the audience into the story and

allowed them to explore the technology. The researchers allowed the audience to try the Kinect sensors after the performance to better understand how the performance was put together. By allowing them to explore the projections, the experience became immersive for the guests.

As mentioned previously, the dancers were trying to show human emotions or personalities using colors that were projected onto their bodies and the walls behind them. To develop the idea of what each color signified, each dancer was assigned a color, and choreographed their movements in a way that helped them embody that specific color. With this, the audience could start forming their theories or ideas of the theme for the performance. Being an interactive experience, the group also wanted members of the audience to share their thoughts about the performance and how individuals connected to each color. The group hoped that the audience was inspired by the performance and sparked creativity from being immersed in visualization and dance.

1.2   Limitations

The biggest challenge faced was the communication between the team as a whole. With this large team and wide range of backgrounds, there was some troubleshooting to be done when communicating ideas and understanding of how to proceed with the research. It was difficult for the dancers to visualize how technology could bring their ideas to life as they all had little to no experience with the software. They were often stuck moving between the limitations of the technology and what aspects of the concept they could turn into a reality.

Another challenge they faced was scheduling meeting times due to the busy schedules of everyone involved. This greatly impacted progress and plans, creating a later start to the project than initially planned. It was also a time-consuming process to experiment with the technology available in the visualization department. Because the team did not apply for any funding, they

had to rely on resources from the school and the faculty advisors rather than using funds to buy or rent more technology to experiment with. This caused the dancers to do further in-person research focused on executing the performance, requiring a lot more planning with those in the visualization department. Overall, these challenges allowed the dancers and advisors to learn how to communicate better and work as a team rather than two different departments on entirely separate sides of campus.

Due to the time it takes to develop software and its specific demands, the team was further limited by the technology being used to complete it. This, coupled with the busy schedules, left little time for planning or working on the project. At the start of the Fall semester of the 2022-2023 school year, the group started discussing ideas within technology they could integrate into a dance performance. None of the choreographers had background knowledge with technology and dance, so they had to experiment with how dance would work best with various technologies. During this portion of the research, the choreographers became interested in motion sensing and began creating ideas for a performance that implemented the technological aspects of motion tracking.

It wasn't until the beginning of the Spring semester that they started choreographing because they wanted to avoid redoing any choreography that did not mesh well with the technology and the motion-sensing equipment. Because it took the dancers a long time to figure out what the project looked like with the chosen technology, they had a slower start to the artifact creation. The advisors warned them that the technology would take a while to perfect, and they would need ample time with the projection to successfully collaborate dance and visualization. The dancers were lucky to work with graduate student John Alberse who brought the ideas to life

with the motion sensing and projection software. He was able to adjust his software technology as the group continued with the project throughout the choreography aspect.

The dance students were constantly involved in more than just standard classes: they are all part of countless hours of extra rehearsals and performances, including many that they conducted themselves. This school year also provided fantastic opportunities that have taken them away for multiple weeks each semester; while they are incredibly grateful and have loved these experiences, this time away from campus proved challenging regarding their research timeline. With this, the dancers thought it was best for each of them to create a 30-second to 1-minute-long video of individually dancing a phrase they each created and presented. The videos provided ideas from their own perspectives on the performance theme. However, due to school opportunities taking away crucial time for them to come together and explore more choreographic ideas, it became challenging for the dancers to meet on a regular basis. When the time came for them to start melding everyone's ideas together, it became apparent that they had to work efficiently without sacrificing the basis of their theme. Collaborative choreography is already a challenging endeavor without time constraints. Still, in the end, the dancers were able to work together effectively in the limited timeframe to create something they were all proud of.

2. HISTORICAL CONTEXT, DISCIPLINARY PARADIGMS, AND AESTHETIC STANDARDS

2.1 Historical Context

Dance has always been an art form that is difficult to preserve. After photography was invented, capturing the stillness of dance in its organic state was uncommon and difficult to accomplish with the limited amount of technology and resources. Film was an innovative new advancement at the end of the 20th century, according to Sheehan (2014), who described it as an " emphasis within a general history and theory of representation". This idea reinforces that film, like other technologies, continues to exist in a perpetual state of change, just like dance and other creative forms of movement. Dance and technology have always been working in tandem in the context of production aspects like lighting and sound technology. However, other elements like augmented realities, motion sensing, and projections have since been introduced at the turn of the century. As this field of study becomes more interdisciplinary and innovative, so do the research and concepts paired with these fields of study. The research team's goal was to further investigate how technology and dance could work in tandem.

The idea of projection work has grasped the interest of the dance industry over the past few years. Instead of simply capturing the art form, technology can enhance it. Visual output on or behind a dancer's body has been experimented with in different ways before, but as technology continues to advance, the need for added research does too. In 2004, Marc Downie did a research study on why technology and dance are worth the integration. In specifics, Downie asked the question, "is there work to be done between dance and digital art that will bear artistic and technical fruit? And what is the worth of that fruit?" In his thesis, Downie continued

13

to say that "computer programming needs a form of representation to become more than an object on a screen" (2004). With the added element of dance, the research team aimed to bring that idea to life.

For this project, the students were fortunate enough to have a mentor who has a background in visualization work within the performing arts industry and has used projections before. Dr. Jinsil Hwaryoung Seo was willing to guide the dancers through different types of technological options and teach the group ways of implementing what kind of choreography would help portray the main idea within the artifact best. The dancers were also fortunate to have the assistance of a graduate student in the Texas A&M Visualization program, John Alberse, who was able to help their ideas come to life by developing software to fit their needs. The researchers explored virtual reality (VR) technologies, projecting onto different surfaces, and eventually landed on screen projection with motion-sensing devices. The dancers first researched and discussed the limitations of using technology for performing arts and chose to do this while looking at options for what was to be accomplished with this project to steer towards the technological atmosphere and aesthetic in mind. The research team initially had their first few meetings with virtual reality headsets to first grasp the idea of one type of technology that could be integrated into the project. While it was helpful for both sides of the research team to experience and observe how it would affect the dancing and presentation, it was ultimately not in the best interest for a dance performance to be limited by wiring and for the vision of the dancers to be obstructed through the headset. It took some in-depth discussion between the dancers and

the visualization department to develop the artifact's main idea and the intended aspect of how the two would be integrated seamlessly.

After heavily thought-out meetings and discussions between the dancers and the software designers, a final concept was determined. The group developed an idea that would help the audience connect with the performance while seamlessly integrating the technological aspect. They played with VR sets, discussed motion sensing, and even discussed using pre-recorded projection video that would play simultaneously with the performance. After much experimentation, they finally refined a technological plan that the dancers and visualization technicians could work with and execute in the limited time they had for this project. Other forms of technology, like pre-recorded projection, were off-putting to the research team as they felt it would not be able to fully capture the true essence and organic energy that is paired with live performance. The plan was to develop a software program that could encompass the aura of each dancer through live motion capture and projection and further develop the storyline by implementing color changes in the projection of each dancer.

What most of the public deems motion capture can be better explained by Sun[5] (2022) as computer recognition of a body or movement and turning that into a technological data record that can be depicted in various ways, one of which being projection. This projection can take the shape of mimicking the human body, which is what was utilized for this research specifically. Past research has demonstrated live motion capturing as a low cost and highly effective way of capturing people's actions while still being an accurate and reliable source of capturing movement. This was one of the main reasons the research team chose this specific piece of technology to integrate with dance, given the time constraints and lack of funding for the work.

Once a plan was decided, dancers began researching and experimenting with ways they could choreograph around the live motion capture and projections. They began discussing stage plans and how they could make the artifact more interactive for the audience to explore. The idea was to have the audience play with the technology and then see it in action in the performance. For this to happen, after the performance the audience could experience the ability of motion sensors on the projector and learn how the colors were created during the dance. The group also included a Q&A session after the performance to allow the audience to ask questions about the performance and the process through the development of the project as a whole. The group felt that this would bring the audience's perspective into learning about the technological processes behind the performance and why motion sensing was chosen to create the performance when there are plenty of other technical options.

3. EXPLANATION OF EXHIBIT

The researchers wanted to use something abstract and exciting for this research project. Technology is developing at such high speeds that things developed recently within the last year can be seen as outdated. As the dancers grew their project, they wanted the projections to be modern and match the choreography. The aesthetic goal for the projection was for it to look like an "aura" surrounding each dancer. This way, the technology enhanced the dancer's human emotions seen in the choreography and did not distract from the overall concept. The technology was integrated with the performing art to make it easy for the audience to observe simultaneously and understand the story behind the movement and projections.

3.1 Exhibit

The group had the incredible opportunity to utilize the Exxon Mobil Igloo Dome as a performance space for the project, located in the Langford Architecture Building. The dome consists of six projectors that are projected onto the dome's interior screens, allowing the dancers to have full 360-degree coverage of the performance space. The use of motion sensing and projection in dance performance is not an entirely novel concept, but the Igloo Dome added a new and exciting aspect. The overlap between the six projectors allows for a crisper image than with a single projector by itself. The 360° projection space allowed the audience to feel immersed in the performance, making it more of an all-encompassing experience than a typical show. The dome is enclosed by a door that serves as a projection screen to help keep the circular projections clear. Dance is a multi-faceted art form that can portray stories and emotions to an audience in a unique way, and the integration of interactive technology enables it to become even more powerful.

With the "stage" circular shape, some critical considerations were made for the setup as the performers were close to the audience members. With this in mind, the team positioned the audience's seating on one side of the dome, allowing the dancers to use a little over half of the floor space as a stage and the rest setting for an audience to observe. The dancers measured the dimensions of each motion-tracking device within the space to be sure no movement was out of place. With projections, the movement needs to be specific and done in the same place every time, and the dome being smaller in size caused a challenge choreographically.

With the challenges aside, it was clear that the positives outweighed these spatial limitations as the team could keep the technology set in one place. As a bonus, this negates extra set-up time during rehearsals and the need for additional personnel to set up equipment. The dome also offered a much wider variety of projection opportunities. This would accommodate the idea of having multiple small audiences' cycle through the space to allow for multiple showings of the piece.

Before entering the performance inside the Igloo, audience members were allowed to walk around and view more project features in the "entryway" space outside. A poster describing the meaning behind the colors shown, which allowed the audience to gather context on the show before it started. After each showing, the dancers held a question-and-answer session where the audience could voice their comments about the project. With this, they were allowed to be creative and test the performance space themselves. The audience could play with the connected devices and see themselves on the projection screen. The goal was to break down the barrier between the audience and performers and let them into the process. This also will give the audience not only the opportunity to see the creative artifact but gain a better understanding of what motion sensing is and why it is so complex to create.

3.2 Equipment and Resources

The equipment used for the project is available through collaborations with PVFA faculty and students. The initial idea was to bring projection screens into the space in the Physical Education building. The group would have the audience sit in raised seats and watch the performance straight on. The problem was that straight-on sitting did not give the full effect of being immersed in technology and dance; thus, other options had to be explored. The Exxon Igloo apparatus is a state-of-the-art piece of equipment recently purchased by the visualization department that allows creation to have a more immersive experience than if the project showing was done in a traditional performance space. The software used for the motion sensing aspect was developed by the graduate student working on this project, John Alberse. Alberse used Kinect software in tandem with his work on movement tracking. This motion sensing software integrates a technological aspect to work, elevating the creativity and level of connection with the audience.

3.3 Planning Process

The planning process remained relatively the same from the beginning of the project to the end. From the beginning, the team wanted an interactive dance performance for the dancers, technology, and audience to all intertwine. There were several ideas for the dance theme, and the group wanted the concept to be relatively straightforward. Combining dance and technology is a lot for audience members to take in, so they didn't want the storyline to be too complex. The target audience was not exactly dancers; the goal was to invite people who were not as familiar with this world to give them a new experience with dance and technology. The dancers started by brainstorming ideas to figure out what they could do with the space and technology they were given. The choreography came later because it was the most adjustable aspect of the project,

especially with group members being the sole choreographers and performers. At the beginning

of the spring semester, the Visualization faculty recommended the Igloo as the performance

space to ensure the performance would have the highest quality projections while utilizing

motion sensing software.

Once the location was finalized, the group had to determine the spatial parameters they

would be working in while using the Kinect motion sensing software. The Kinect sensor only

functioned in a limited space, so the dancers tested its limits while in the Igloo and placed tape

on the floor so the dancers could see the boundaries they needed to stay in. While

choreographing with the Kinect sensors, it was crucial to use angles and certain positions in the

choreography that allowed the movement to be projected clearly in the silhouette to show

different shapes.

For Kinects to create the best image from action, Kitsikidis, et. al. (2014) found that the

dancer had to be facing toward the sensor and always facing in the same direction when dancing

in front of them to capture a clear image of the entire body, including upper & lower extremities.

For this to work, movements to the side or sharply angled would erase the body imaging of the

silhouette and not show precise shapes of the body. This became an added challenge for the

choreographers as the dancers were not used to dancing in small areas. From here, modifying the

choreography would need to provide clear body images within the limited range of sensory that

the Kinect could capture. Next, the group had to figure out how to let themselves go on and off

stage without having traditional stage wings. They had dancers emerge from the audience and

take the stage from there; this created an element of surprise because the audience most likely

thought the dancer was another audience member. The goal was to make the audience think

about the ways humans connect. Putting dancers on the same level as the audience likely helped them connect more with the story.

The piece's concept is centered around colors and their different meanings. Each color can have two different contrasting meanings. For example, red can be perceived as love or hate. See the Appendix to view the poster put up in the performance space to give the audience a better understanding of the color meanings that were envisioned when creating the piece. In addition to the colors, they wanted interactions between the dancers without touching them. They accomplished this using interactions between the dancers' silhouettes on the screen so that one dancer would influence the other's. The group also incorporated partnering between the dancers, so they physically interacted with each other while on stage. This helped the dancers impart their message to the audience as they demonstrated human connection through dance. They combined the dancers' colors when sharing the same space to represent how people can affect each other's lives.

Once the dancers had established the plan for the performance, it was determined to include the audience and allow them to experience the interactive technology themselves. The Q&A session allowed the researchers to explain how the process worked and answer any questions they had after watching. They also invited the audience to try out the motion sensing and projection software to let them see firsthand how it worked during the performance. This brought a new level of depth to the experience as they understood that the technological and dance aspects worked together in real-time.

4.   REFLECTION

4.1   Limitations

One of the most time-consuming parts of this project was the initial research exploration process. If the dancers could start the whole project over, they'd feel this part of the research was necessary but could have been shortened. Because they all dove into this entirely new field with no prior knowledge or experience, they found it challenging to find common ground between their ideas and the tangible options they presented. The group was also unaware of what was available to them regularly, so they mainly had vague ideas that proved difficult to explain to those assisting them with the software side of the project. The dancers or team did not receive funding for this project, so they had to use the technology available to the dance and visualization team. John Alberse was very diligent at creating a motion-sensing device for the dancers from what they had on hand. One difficulty was that the students would have a specific idea but couldn't get the technology. Lack of funding challenged them to take the technology they were given and explore new ways to use it. The Kinect devices are from old Xboxes. The complexity of it comes from connecting them to the computer software and making them work together. Until the night before the show, John found issues that would arise out of nowhere. Complications would come up that were never an issue before. Working together and problem-solving with limited time and resources was crucial to the group's process.

Had ideas been consolidated, the exploration portion of the research could have spent a lot more time investigating how to implement choreography cohesively with the technology. The study felt a little rushed in the choreographic process since it took a while to officially figure out what technological features would be included in the piece. To add on, it was the dancers' first

time choreographing with an added technical effect that created spatial and visual limitations that had never been encountered before. Even the dancers with more choreographic experience had to think outside of what they were used to meet the specific demands of this project. Trying to mesh the ideas of so many creative minds was also a hurdle for the six dancers initially; luckily, all were adaptable during this process and could incorporate everyone's suggestions.

In January, the performance space was switched to the Igloo dome after the choreography process had begun, forcing the dancers to make many adjustments. The choreography was initially created in the black box theater in the Physical Education Activity Programs building. This studio was a space the dancers were familiar with and had used for many dance classes and other performances prior. A considerable downfall with this space was that the dancers had to draw a blueprint for the performance space based on what was easiest for the technology team. Unlike the dome, no projectors or technology were already in place. This made it particularly challenging in that the space the performance was in was circular, while the space that was most accessible was square. Even mapping the area out to the correct parameters, it was discovered by the team while rehearsing in the space that it would be the most beneficial way of rehearsing leading up to the performance. Even though switching performance spaces mid-choreographic process was a considerable challenge, it worked out for the best as no technology set up or take down was necessary. After rehearsing and planning, the faculty advisors suggested hosting the performance in the Exxon Mobil Igloo Dome, as this was the best visual and technological option. The process would also become much easier because the Dome was already constructed and maintained as a permanent residence in Langford. In contrast, the technical aspects would have to be set up and taken down for each rehearsal in the dance studio. After obtaining measurements of the new Kinect parameters inside the dome, re-choreographing began.

Not only did the dancers have to modify their movements to fit the space, but also to work within the range & sensitivity of the motion sensors in order to project a clear silhouette on the screen. It became clear that the sensors only measured movement that was somewhat slow and mostly upright. Often, stepping outside these restrictions resulted in the silhouettes disappearing from the projection screen. This heavily influenced how the dancers choreographed movements on the floor and the speed at which the movements were performed. Dancers and researchers also decided to wear white costumes for the motion-tracking sensor to capture their bodies more effectively. The screens in the Igloo were solid black when no motion sensing was being projected, so any dark clothing would have easily blended in with the background.

4.2   Final Thoughts

The experience of being able to perform with technology greatly influenced the dancers' perceptions of dance performance. It opened their minds to the variety of ways that technology can be manipulated. Experimenting with ideas and implementing them into what was provided was an exciting process, especially as a group of dancers with no prior experience in visualization performance work. The most valuable part of this project was collaborating with people with a software and projection technology background. Without them, this project would not have been as successful as it was. It is imperative to note that the software designers entirely created their own program for the purpose of this research and worked diligently with the researchers to provide the best opportunity to create movement. Although there was little time to finalize the technological choices for the project, they helped every step of the way.

For the performance, the dancers provided a poster for the audience to write down words on colored paper on what they thought each color used in the performance meant to them. There was also a survey provided that had the audience rate how the experience was for them and what

it meant to them. The team got a lot of great feedback, with dancers answering questions on the experimentation process to people asking the visualization team members how the technological aspect worked. The dancers provided three interval times to provide multiple performances for people to come at the best time for them. There were even some people who stayed and watched again due to their fascination with the project. This gave the team the opportunity to answer more questions and explain more of the specifics of the process. Due to the timing of announcing the performance to the general public, the team believed that there would not be a full house in every performance, but luckily, all of the seats were taken at every performance. Even though the performance was a success, each performance differed in how the Kinects portrayed the colors. The dancers were still learning how to perform with the Kinect for them to be seen by the motion sensors. This called for modifying the choreography by implementing pauses, suspense, and performing certain movements slower during the performance. They wanted to have the colors projected as much as possible to convey the meaning to the audience.

For the team's future goals, there is still more to explore in the world of dance technology. The group barely scratched the surface of all the possible opportunities; with more time, funding, and higher level technology, there are a variety of ways this research could be continued. Funding would be helpful in the future so it would be possible to try out higher-level technology with even better motion sensors. Motion tracking is something the team did not get to try but is very interested in as well. This project could also expand with more members dancing in a bigger space. It was done with the resources available on hand, but by reaching out to other universities and collaborating with them to use the technology they can provide, something more extensive and complex could be created. Many of the group's dancers hope to choreograph professionally and this project allowed them to expand on their perceived thoughts of

choreography. They hope to get even more feedback by sharing the final video with colleagues

and peers, and gain more perspective on the realm of dance and technology.

WORKS CITED

[1]   Downie, Marc. 2004. "Choreographing the Extended Agent: *performance graphics for dance theatre*" Doctoral dissertation, Massachusetts Institute of Technology.

[2]   Kitsikidis, A., Dimitropoulos, K., Douka, S., & Grammalidis, N. (2014, January). Dance analysis using multiple kinect sensors. In *2014 international conference on computer vision theory and applications (VISAPP)* (Vol. 2, pp. 789-795). IEEE.

[3]   Misemer, Sarah M. 2005. "Bridging the Gaps in Cultural Memory: Carlos Gorostiza's El Puente, and Gabriel Peveroni's Sarajevo Esquina Montevideo (El Puente)." *Latin American Theatre Review*. https://doi.org/10.1353/ltr.2005.0015.

[4]   Russell, Susan H., Mary P. Hancock, and James McCullough. 2007. "Benefits of Undergraduate Research Experiences." *Science*. https://doi.org/10.1126/science.1140384.

[5]   Sheehan, T. (Ed.). (2014). Photography, history, difference. University Press of New England.

[6]   Sun, K. (2022). Research on Dance Motion Capture Technology for Visualization Requirements. *Scientific Programming*, 1–8. https://doi.org/10.1155/2022/2062791

[7]   Yu, H. C. (2014). A cross-cultural analysis of symbolic meanings of color. *Chang Gung Journal of Humanities and Social Sciences*, *7*(1), 49-74.

APPENDIX: CREATIVE ARTIFACT

Figure 1: Poster that was placed in the room outside the performance space.
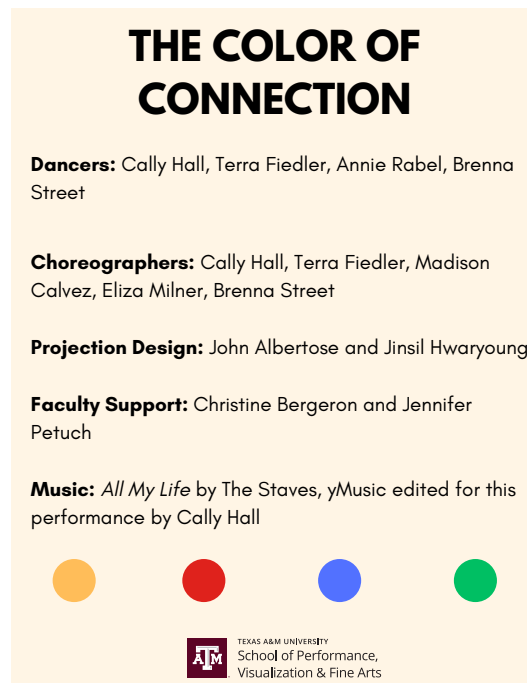
Figure 2: Poster created as advertisement.

Figure 3: Program provided to audience members at final performance.