

# Virtual Reality-based Training for People with Disabilities in the Construction Industry

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## INTRODUCTION

Construction workers are at constant risk of getting physical injuries such as Musculoskeletal disorders due to their dangerous working conditions [1]. As a result of these injuries, most skilled workers end up retiring early. The industry experiences skilled worker shortages seeing that the rate in which workers retire is faster than the rate in which people enter the construction industry [2].

Advanced technology such as robotics have been recently introduced to the construction industry, and this provides new opportunities for people with disabilities to engage in this industry. However, utilizing these robots can be a difficult task because learning how to operate fairly recent technology along with working around a large variety of disabilities can be challenging.



Figure 1, construction robot called Brokk

## OBJECTIVE & IMPACT OF PROFESSOR'S RESEARCH

This research focuses on understanding the effectiveness of a personalized VR-based training for people with various kinds of physical disabilities. As there are limitations as to what tools could be utilized, finding a valuable learning mechanism that is personalized for people with a certain type of physical disability is crucial.

This is impactful to society because this provides a possible alternative ways for people with disabilities to work in the construction industry without being in a hazardous environment. This could also decrease the number of skilled construction workers who end up having to retire earlier.

## METHODOLOGY

The Unity 3D platform was used to create the VR simulation specialized for the different types of physical disabilities. However, this specific project focused on creating a VR-based simulation that is personalized for people with locomotor disabilities or those who usually mobilize in a wheelchair.

To create a navigation mechanism suitable for wheelchairs in a VR-based environment, my mentor and I used the HTC Vive Controllers instead of the VR treadmill, which requires a person to walk freely in any direction (fig 2).



Figure 2, HTC Vive controller, headset, and treadmill.

We wrote C# coding to allow the trackpad on the controller to move the person through the VR environment. We made it so that controller would move the character forward or backward based on the direction the person in training would be facing, and that they could change the direction in which they were facing. The speed in which the character could also be adjusted according to where the person presses the trackpad. The rigidbody component was attached to the character so it could move realistically, influenced by gravity, forces, and other objects in VR.

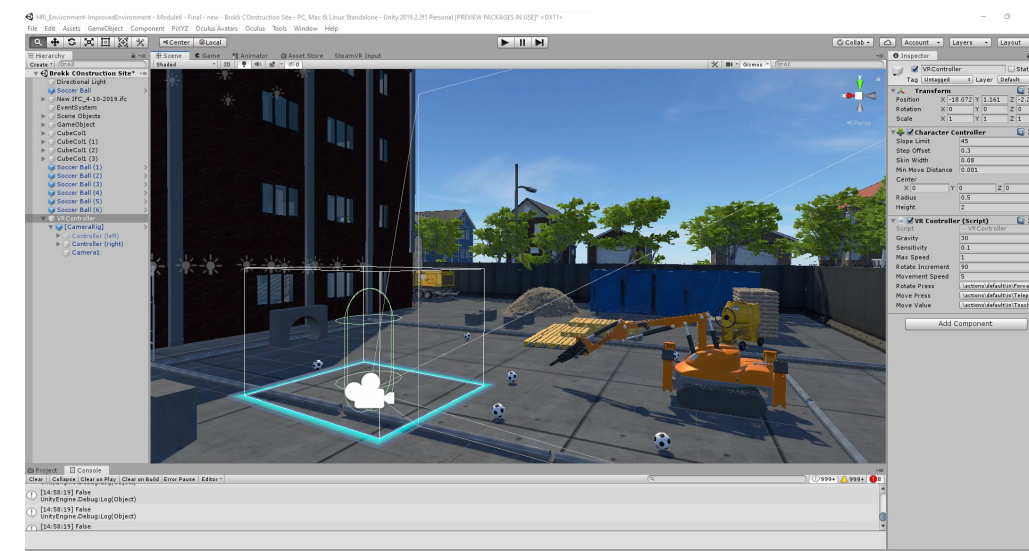


Figure 3, Camera icon indicates the direction where the person will be facing. PC: Joy Shin

## SKILLS LEARNED

I was able to learn new skills and experience many aspects of engineering research during my 7 weeks of SHINE.

I learned how to use a game engine called Unity to understand the basics of creating a virtual environment (fig 3). I also learned how to operate the VR controllers and headset and apply it through writing C# code.

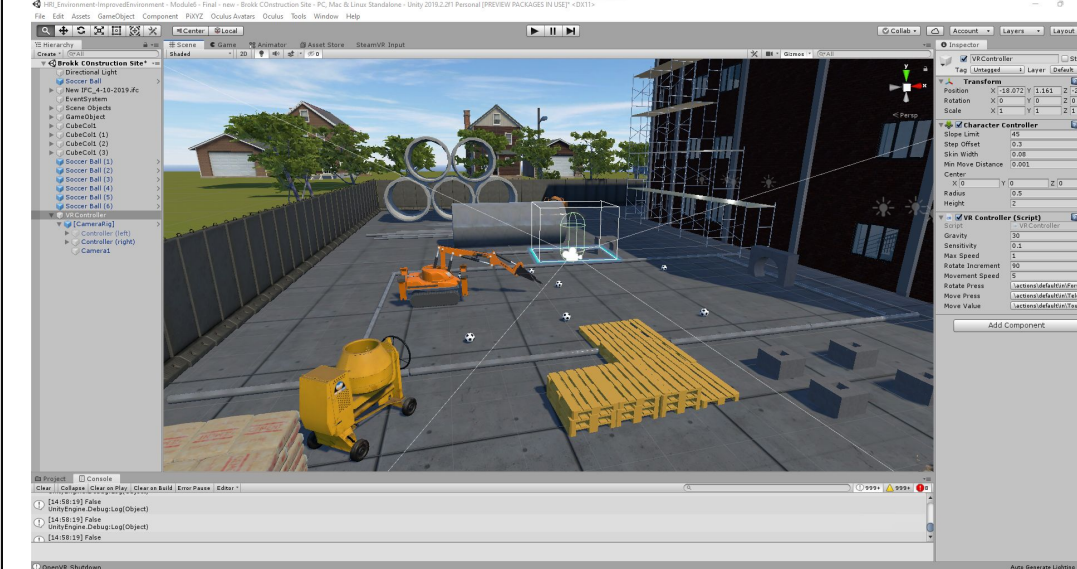


Figure 4. Unity platform PC: Joy Shin

Moreover, I realized the importance of troubleshooting when obstacles were present by communicating and discussing what could be done to solve the problem.

I also gained understanding on how to effectively read a research paper. I learned to prioritize what information to take in and where to look for that kind of reliable information.

Ultimately, I discovered more about the field of civil engineering and how important it is to the structural parts of society. I've grown to appreciate the long and tedious process in STEM research through working on this project.



## NEXT STEPS

The next steps for this project would be to research and investigate whether VR based training could be effective for other types of disabilities such as hearing or vision impairment. We need to know whether or not the specific training could be suited for certain disabilities.

## HOW THIS RELATES TO YOUR STEM COURSEWORK

My experience in SHINE will definitely impact what I do in the future steps of my STEM journey. I can apply the skills I learned in Unity and C# coding in my future STEM classes. I can also use my knowledge on reading research papers and looking up reliable and accurate information in future research projects I will be partaking in.

## ACKNOWLEDGEMENTS

I would like to thank Dr. Burcin Becerik-Gerber for providing me this opportunity to experience what it's like to be in research. I also show my appreciation to my SHINE mentor Pooya Adami for introducing me to the world of virtual reality. Lastly, I express my gratitude to Dr. Katie Mills and the rest of the SHINE team for organizing such an amazing program.

## REFERENCES

- [1] The Center for Construction Research and Training. Nonfatal Injury Trends in the Construction Industry. Last accessed July 2022; <https://www.cpwrt.com/wp-content/uploads/DataBulletin-December2020.pdf>
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