

The Potential of Virtual Reality Training with Construction Robots

Erica De Guzman erica.deguzman2019@gmail.com
Maranatha High School, Class of 2019
USC Viterbi Department of Civil Engineering, SHINE 2018

Introduction

In recent years, fewer and fewer people have been entering the workforce as brick masons or other construction laborers, although the demand for these workers is rising. As these trends continue, it will become imperative for the construction industry to find new sources of labor, which may include robots. These robots will not replace human workers, but will instead complete the more menial tasks, allowing workers to focus on other aspects of the construction process and altering the responsibilities that laborers encounter on the job.



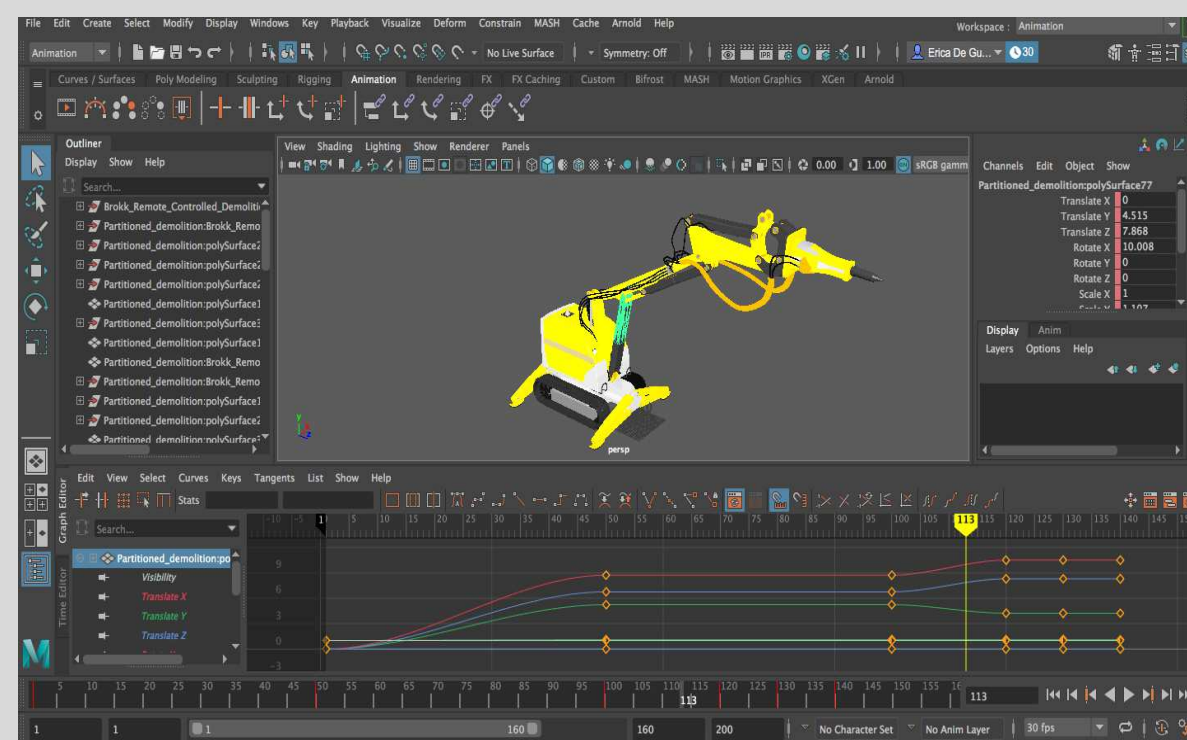
Final project in Unity. PC: Erica De Guzman

Objective & Impact of Professor's Research

Professor Becerik-Gerber is creating a virtual reality program to train laborers to work with construction robots. There are many benefits to using virtual reality, including that it is cheaper and more efficient than training workers with the robots themselves. However, the most important advantage is that this will allow workers to experience dangerous situations through virtual reality without being exposed to the physical risks they would face in that situation. This will improve safety conditions as robots are implemented into the construction industry since it will allow workers to better handle these situations and reduce potential injuries.

Advice for Future SHINE Students

- Learn the basics of each program before attempting to work with them
- Get to know other SHINE students and ask them about their research projects
- When you are working with computers, make extra copies of the project when it works in case future edits are unsuccessful
- Test the programs you make often



Maya animation of robot. PC: Erica De Guzman

Skills Learned

- Maya
- used for animating and editing model
- C# coding: allows controller to manipulate robot

```
void Start()
{
    movespeed = 0.4f;
    RotateSpeed = 0.1f;
    anim = GetComponent<Animator>();
}

// Update is called once per frame
void Update()
{
    MoveAngle = GameObject.Find("leg1").GetComponent<leg>().TotalAngle;
    legMoveAngle = GameObject.Find("leg1").GetComponent<leg>().LegAngle;

    if (MoveAngle <= 0 && MoveAngle > -15)
    {
        transform.Translate(0f, -legMoveAngle / 200, 0f);
        transform.Rotate(0, 0, 0);
    }
}
```

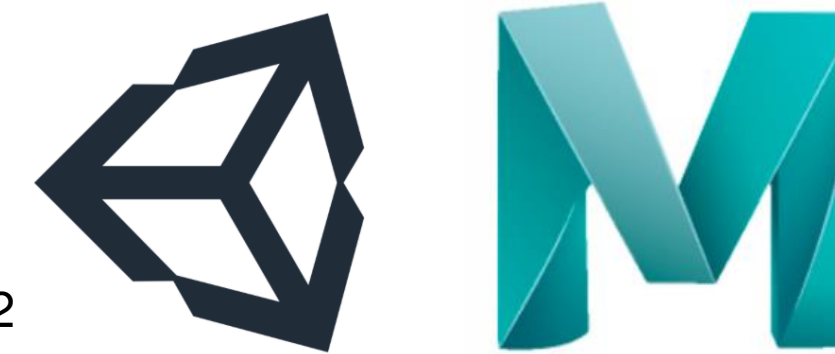
C# code used to control robot. PC: Erica De Guzman

- Unity
- combined construction site and robot
- made project compatible with virtual reality

Research Process

Week 1

- Learned Unity and Maya basics



Week 2

- Animated robot movement sequences in Maya
- Exported animations to Unity

Week 3

- Reviewed research proposal for project

Week 4

- Animated individual robot motions

Week 5

- Programmed robot controls
- Combined robot and construction site



Los Angeles Memorial Coliseum Construction Site
(Visited Week 5) PC: Soyoung Moon

Week 6

- Exported project to virtual reality
- Created survey and collected feedback

Feedback

- Object interaction (could walk/see through other objects)
- Robot controls were not intuitive
- Joystick controls did not follow head motion
- Some objects were blurry

How This Relates to my STEM Coursework

Computer Science

- I used what I learned in my computer science class to write code that controlled the robot



Next Steps

I would like to edit the Unity project and take my peers' feedback into account in order to create a more realistic experience. I would also like to be able to work with virtual reality and coding again in the future. One way I will do this is by taking my school's AP computer science class this coming year.



Brokk robot in Unity. PC: Erica De Guzman

Acknowledgements

Thank you to Dr. Mills and Dr. Herrold for organizing this amazing experience for us, my professor, Dr. Becerik-Gerber, for including us in her research, my mentor, Soyoung Moon, for teaching us about this project and guiding us along the way, and Maylin Martinez for working with me to build this program and being a great lab partner.