# Intro (10 s)

Hello everyone, thank you for coming!

My name is Codey Winslow, and during Summer 2020, I worked on Optimized Learning with Virtual Reality thanks to the Oregon NASA Space Grant Consortium.

# The goal (10 s)

The purpose of this project was the investigate the viability of VR technology as an educational device for industry skills. More specifically, to teach skills that require some kind of environmental interaction that would be expensive to mock. I would do this by setting up an experiment where subjects would learn using a VR application I develop.

# The initial idea / final (40 s)

Originally, I wanted to model a tactile skill like playing cornhole and a procedural task in VR. In the experiment, one group would learn using this model while another would learn by watching a video. Both would then be tested on the real thing to measure how well they learned each.

As it turns out, my mentor had some issues with this, particularly the accuracy with which I would be able to model throwing a bean bag for the cornhole model. Instead, we settled on a much more approachable project: 3 levels of procedures for a touchscreen UI. This would allow me to develop one application usable for the test and the VR learning environment.

# The Procedures

[The procedures]

The three levels of procedures are separated by difficulty, where the easiest is level 1 and the most difficult is level 3.

For level 1, users are asked use controls on the interface in a specific order.

The level 2 procedure was very similar to the level 1, but a unique set of actions is require for each of the 3 different lights. If a light comes one, the user is supposed to perform the correct sequence for that light.

For the level 3 procedure, the goal was to move away from rote memorization, and more toward higher level skills, like problem solving. The interface is instead used to manage a set of systems. The user has to turn on one system from each of the 3 groups, but without using more power than is available, and without overloading the current limit.

# Creating UI / Code arch. (2 min)

[How I wrap functionality in custom classes]

Now that the procedures are defined, let’s dive into how these applications were made. Each UI control triggers some behavior when it is clicked, so I wrapped each type of control in my custom classes so that all controls notify my procedures when the user uses them.

[How procedures work]

With this system in place, building a procedure is somewhat trivial. At a high level, I just need to define my expectations for the procedure, and whenever a control is used, I inspect the behavior to see if it matches my expectation.

For the level 1 procedure, I created a list of functions known as “Steps.” Each of these functions captures click events from controls and decides if they match expectations. If not, the procedure is marked as failed and is ended.

The level 2 procedure was very similar to the level 1, except I created a set of expected steps for each light.

Creating the level 3 procedure was quite different. In some ways, it was easier. I only had to define success and failure conditions, and if either was met, the procedure was ended. I also needed some backend system to keep track of values and allow the user to turn systems on and off. The most challenging part was ensuring that out of the randomly generated options, there was a guaranteed way to succeed.

[Tutorials]

This wraps up most of what the procedure part consists of, but the virtual reality part needs tutorials to teach the procedures to the user. Conceptually, it didn’t seem too difficult: make a version of each procedure where messages are shown explaining what to do. As it turns out, this was one of the most difficult and pivotal parts of the project, but we’ll get to that in a minute.

# VR in Unity (1 min)

[SteamVR plugin]

So how did I implement VR into this application? Luckily, the popular platform for VR applications and games SteamVR has a plugin for Unity that makes developing for their platform trivial. After wrestling with version discrepancies between the plugin and Unity, I was able to insert a prebuilt object representing the player into the scene and BOOM, I have VR capabilities.

[Touchscreen in UI]

To get VR interaction with the UI to work nicely, I used a component from the plugin to capture collisions between a user’s hand and UI control, but this didn’t work well with sliders. Instead, I used another component that allows the user to “grab” the slider and move it along its axis.

# Testing / adjustments (2 min)

[Family testing performance]

Now that I had a functional application, the next step was to test it to make sure it not only worked as expected, but also that it was clear in its teaching procedures.

I had family members who vary in tech skills test my application using just the touchscreen, but they all failed miserably at first. After this, I realized I needed to adjust my wording quite a bit to be clearer on what actions needed to be done.

[Adjustments made]

Originally, I made hints concise to keep the screen clean and prevent overload for the user. It turns out that being too concise confuses users and causes them to overanalyze. I changed some of the wording and added extra hints in the tutorials to “hold their hand” if you will. The next round I made using my family members went much better, but what seemed to challenge them was the difficulty of the procedures. Being the person that created the procedures, I knew them like the back of my hand. In an effort to keep the procedures from being too easy, I used myself as a reference as I designed them to be challenging, but I was probably the worst person to represent the user. I revised each procedure to require less steps and, for the final procedure, display what each control represented for added clarity. My final round of testing went much smoother and with hardly any time left, I was prepared to polish my experiment design and perform it.

# Getting approval / didn't test (1 min)

[Why approval was pursued]

My mentor, Dr. Phil Howard, brought up the question of getting approval for using human subjects, which hadn’t even crossed my mind. I was advised to contact the Institutional Research Board to pursue approval for my experiment.

[Process delayed testing]

This process required a lot of documents to be written and verbose information. I had to fill out and revise an application a few times, as well as write an Informed Consent Form for participants to sign. I recorded my training video and continued to polish my application while awaiting the verdict, but my 9-week internship window came to an end before receiving an answer.

[Verdict]

Even though I didn’t receive a response from the IRB in the internship window, I did eventually get approval sometime this term, so I intend to perform this experiment on my own time.

# My experience (1 min)

[What I gained from the experience]

I want to take a minute to highlight some of the valuable experience I gained from this project. Being a remote internship, I didn’t have the luxury of working in a typical work environment or next to a team of experienced professionals, but the experience I had just working with my mentor to solve problems and come to agreements on design decisions was a great learning experience.

Designing and developing a project like this helped me build the skills necessary to work on large code bases. It’s so important to be descriptive in your code, comment sufficiently, and design with the intention of modification and extensibility in the future.

Perhaps the most valuable experience I gained from this internship was being able to work alone, at home, and stay focused. When you’re at home with people and things that can distract you easily, those skills are challenged, and you are forced to hone them if you wish to succeed. And who knows, maybe this kind of experience will be a new normal for development positions, so it doesn’t hurt to strengthen these skills.

# Where to go from here (1 min)

[what else should be done to answer the question]

I think the question this experiment will answer follows more closely with “can learning be done effectively in VR?” If the answer turns out to be yes, I think the next step would be to test whether or not physical skills can be learned better in VR. This was what I intended to ask in the beginning, but more time and perhaps more engineers would be better suited for that project.

[My thoughts on the matter]

I think the world of VR is important to explore and use as an educational tool. VR is already being used on a large scale as an experiential tool, but such a groundbreaking facet of technology has a world of potential, we just have to discover and bring that potential to reality.