eXtended Reality (XR) – Engineering Education

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Summary

In higher education engineering, one vital learning technique is through hands-on experience and experimentation. Teaching courses that require mandatory laboratory components make the remote education experience challenging. Through the vision of extended reality (XR), a mixture of virtual and augmented reality, we can integrate XR, as a key component, into our laboratory-oriented classes for experiential learning. To do this, we will develop and pilot a VR/AR learning platform for a few fundamental classes within the ECE curriculum.

1. Introduction

VR/AR immersive learning technology is already employed in other industries including the medical field. Nurses and Paramedics can train in an isolated and safe environment to practice within.

With XR we can provide the same concept, an environment to safely tinker with instruments that intro-level students wouldn't normally have access to.

The initial design will be developed for iOS/android, as there are applications and tools that are readily available to us, which we can use to develop, test and visualize early our early concepts.

As we get closer to our midterm, (end of semester goal) we plan to move into wearable technology to make an environment which allows for more interactivity and the implementation of intuitive controls.

2. Design Constraints

The two main potential constraints for the project are as follows:

- Time Costs: Time spent researching, learning, and developing XR environment.
- Monetary Costs: Money spent on a VR headset to test in XR environment.

3. Proposed Solution

Engineering Diagram:

A visual example of our first prototype is included in Figure 1 below.

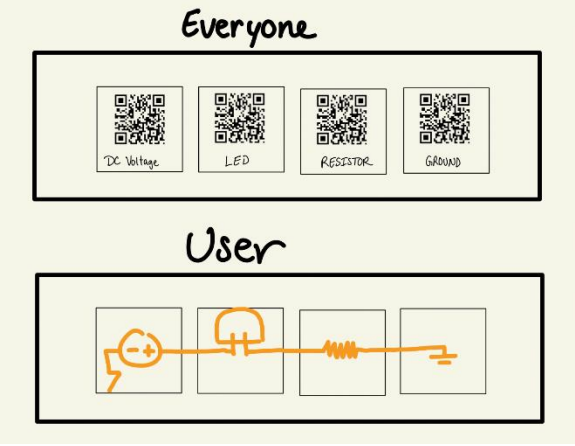

Figure 1. Example of what everyone would see vs. what the user would see.

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remotely, without the need for any other physical equipment other than the device that they need to operate the software.

This also gives instructors more versatility with the given laboratory hardware as labs can be directed with no concern with unavailable components (back orders, etc.) and safety as the environment is isolated from expensive/dangerous laboratory equipment.

The first action the user would be able to perform would be designing a simple circuit i.e., powering on a light bulb.

Functional Requirements:

- Working XR Environment: Functional developer environment to test experimental code.
- Intuitive controls: The manner in which the user manipulates the software should be easy to understand and master.

Non-Functional Requirements:

- Smooth Gameplay: The user should be able to experience this learning experience without major hiccups or stutters.
- Configurable Design: The software should be easily expandable, as to allow easier development for new applications/add-ons
- Accessibility: The software should be easily attainable, as well as simple to run.

Justification:

This design choice was chosen to other alternatives due in part to the fact that we can test our environment through our phones, which requires a minimal amount of setup, is a convenient platform for our users, and has a relatively large support in comparison to other hardware.

4. Initial Prototype

Semester Goal:

Our semester goal is to have a functioning alpha version of the project where we can get user experience and input. We can also measure how well users respond to the project and see where we can take the final product.

The iOS/android build will use mobile smart phone cameras and (phone) screens as lenses to view the XR environment.

To interact with the environment, the user will have to move around the QR cards to create various preprogrammed circuits.

This milestone should give the users enough to interact with to generate valuable feedback to which direction the vision of education XR could go.

Main Goal:

Our main and final objective is to be able to develop and pilot the first AR/VR lab instruction for ECE students at the University at Albany.

By shifting from an iOS/android mobile supported to a wearable XR interactive environment we open more opportunities to improve on the XR education technology.

The real time interactive aspect to the environment allows us to develop and experiment with more controls (multimeter prongs, signal generation, internal laboratory components).