



SoCal Edison

Virtual Reality

Training Simulation

Liaison

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1. INTRODUCTION

1.1 Background

Southern California Edison (SCE) is the largest subsidiary of Edison International and the primary electricity utility for much of Southern California. With a service territory of approximately 50,000 square miles, SCE provides electricity to approximately 15 million people. Maintaining such a vast electric network demands frequent updates and maintenance. However, due to the shortage of SCE field workers, regular routine check-ups and updates have become a challenge. To overcome this issue, SCE hires outside contractors, but there are some challenges with their current contractor training program. The contractors do not receive the same level of training that a typical SCE field worker would need to receive in order to know how to install equipment safely and adequately, which can result in an increased risk of accidents and errors during equipment setup. Such incidents can cause power outages and require multiple visits to fix the equipment which costs SCE time and money. It is crucial for SCE to address this issue and enhance the training provided to their contractors.

To tackle this issue, our team has been tasked with developing a virtual reality training program that will not only prepare contractors for their work but also ensure that they are equipped to handle any unforeseen circumstances. The program will provide a safe environment for contractors to practice their skills and will simulate real-life installation scenarios. By using virtual reality, contractors will be able to learn through experience, without the risk of causing any accidents or mistakes.

Our virtual reality program will be developed using the Meta Quest 2 headset and controllers. The headset will provide contractors with an immersive experience, allowing them to interact with a three-dimensional model of a typical installation site. With the controllers, they will be able to manipulate the objects in the virtual world, simulating a real-world installation process. Additionally, the program will include a safety module that will teach important safety techniques and procedures that contractors need to follow to avoid accidents and ensure a safe working environment.

By investing in this virtual reality training program, SCE can ensure that its contractors are adequately trained and equipped to handle any installation tasks.

This will not only reduce the risk of accidents and mistakes but also improve the overall service provided to the 15 million people who rely on SCE for their electricity needs.

1.2 Design Principles

Our design process is centered around developing an immersive and captivating environment that simulates a scenario that a Southern California Edison contractor may face when installing equipment. We understand that virtual reality technology may not be familiar to some users, so we prioritized creating a simulation that is user-friendly so it can be easy to use. We achieved this through the incorporation of a simple, not too detailed, neighborhood scene. A simple scene will help mitigate the effects of VR sickness. Furthermore, we ensured that the code and overall design were easy to navigate and intuitive. By utilizing the XR Interaction Toolkit package with Unity, we were able to implement features in VR more efficiently. Our program is designed to be accessible and engaging for all users, regardless of their level of experience with VR.

1.3 Design Benefits

To ensure that the program is accessible to those who may not have much prior experience with virtual reality, we aimed to make the user interface as intuitive and straightforward as possible. This way, users can quickly get up to speed with the program's functionality without needing extensive VR knowledge.

Additionally, we recognized the importance of creating a sense of familiarity for users within the virtual environment. By incorporating familiar elements from the real world, such as objects and surroundings that users may encounter in their daily lives, we aimed to create a more comfortable and welcoming experience for the user.

In keeping with our goal of enabling others to build on our work, we made sure to design the code and user interface in a simple and organized manner. This not only made it easier for other developers to understand and modify the program but also provided a foundation for potential future expansion.

Ultimately, to create the program, we leveraged the XR Interaction Toolkit package to handle VR interactions. This package is widely used and has many resources available online, which allows us to efficiently develop the program while also ensuring its quality and usability.

1.4 Results and Achievements

Our team developed a virtual reality simulation Southern California Edison contractors can use to learn how to install equipment safely and adequately.

We used Unity, a game development engine, and Blender, a 3D modeling tool, to accurately create an immersive environment that replicated a real-world equipment installation scenario.

During the development process, we followed the safety protocols that were deemed most important by SCE, in order to guarantee the safety of all users who use our program. Additionally, we created models of all objects and their functionality with great attention to detail. Made interactivity a key priority for this app because it promotes muscle memory recall in the field.

We are proud to have successfully blended real-world field procedures with the benefits of VR capabilities to assist with user interactivity. Another priority that was satisfactorily implemented was the ease of use for first-time VR users to enable fast learning turnaround. We are pleased with the user feedback regarding the app's ability to engage most senses, including vibration for tactile feedback and voice directions and object sounds in training.

2. RELATED WORKS AND TECHNOLOGIES

Virtual reality (VR) technology has been increasingly used in education as it provides a more hands-on learning experience for students.

The current works in the market for VR training include outdated programs that may not provide an optimal experience, video tutorials that may not be suitable for all types of learners, and installation manuals that require a lot of reading, which can cause some individuals to avoid them. To overcome these limitations, the utilization of the latest VR technology combined with the most effective training practices can lead to the creation of a comprehensive training simulation.

Virtual Reality provides a safe and controlled environment that allows users to learn and experiment without jeopardizing their safety or making mistakes in setting up equipment. For instance, working with wires at significant heights is a potentially hazardous task, where even minor errors could result in severe injuries or fatalities. However, by utilizing VR simulations, users can simulate such scenarios, identify areas for improvement, and learn from their mistakes, thereby reducing the likelihood of accidents in real-world situations. As well, these visualizations can enhance users' preparation, alleviate anxiety, and boost their confidence when performing the task in the real world.

VR technology has the potential to revolutionize the way we learn and train. It provides a safe and controlled environment for learning, allows users to visualize real-world scenarios, and possesses unique features that cannot be replicated by reading from a piece of paper. As such, it is a valuable and powerful tool for education and training.

3. SYSTEM ARCHITECTURE

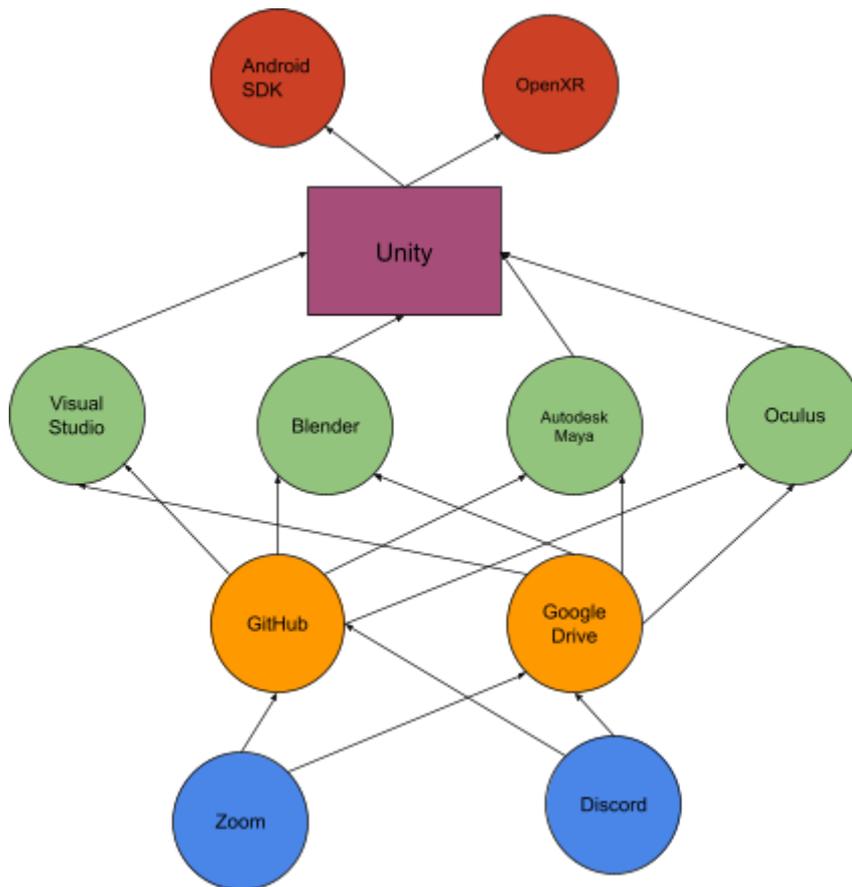
The VR training simulation for Southern California Edison was created using Unity, a game engine, Oculus headset, as well as the Oculus application, Blender, and Autodesk Maya for 3D model development. Lastly, Visual Studio Code was utilized for custom script creation.

The programs involved were used to design and develop software components that work together to create an engaging and interactive training simulation experience. For instance, text-to-speech (TTS) is used to give our users a voice prompt for the installation steps. TTS is a technology that converts written text into spoken words. Furthermore, we incorporated XR interactable using OpenXR to facilitate the implementation of pre-built features such as object interaction for setting and placing objects, X-ray interaction, hand gestures, canvas manipulation, and teleportation.

The data flow between these components is illustrated in the DFD graph below. The software development process involved designing and developing the software components, testing and debugging the code, integrating the components into a working system, and porting into a lightweight Android SDK.

To ensure efficient and effective collaboration, prior to development, platforms such as Zoom and Discord were used as communication channels. Other programs, such as GitHub and Google Drive were used for project development collaboration and version control.

Data Flow Diagram



4. CONCLUSIONS

One of the biggest findings is how efficient Virtual reality is for education since it provides an immersive and interactive experience that can engage learners and improve retention of information. This can be done by enabling the users to interact with virtual objects, environments while receiving instantaneous feedback through different features.

The research on the tools and training information has provided valuable insights into the specialized Southern California Edison equipment, gear, and the work it takes to create a VR app.

Although the sponsor provided detailed documentation, visiting the Southern California Edison training facility proved valuable research experience in making

the simulation as interactive and accurate as possible. Our guide on the facility, Mr. Tran, is very knowledgeable of the details such as the calculations and procedures which helped us understand why the operations are the way they are.

Various youtube tutorial videos helped us visually understand the software such as Unity and Blender. For further detailed sources, the Unity documentation allowed us to see what methods could be used in creating our custom scripts.

Unfortunately, due to project collaboration consistency, we kept the project's software/plugins on certain versions which created a challenge to find content to help us with our exact needs for the VR app. This created a conflict with the tutorials and documentation search where the source was either outdated or had an improved layout/code compared to our project versions. Nonetheless, they did serve as a good base point and contributed to our grasp of how the programs work, ultimately testing, and debugging is how we ended up moving forward.

A future step to overcome this would be for monthly group software syncs. For the future team to add sound effects to the project, there are voice lines implemented. Overall we are happy with what we were able to accomplish in the time frame given. As it stands, we believe the app demonstrates what is possible for Edison Training to incorporate other training procedures and save money while improving training safety. With future improvements, it can further enhance graphics and immersion.

ACKNOWLEDGMENTS

We would like to express our appreciation to our advisor and liaison for their valuable guidance and support throughout the duration of this project. The generous sponsorship and valuable input enabled us to successfully complete our project and achieve our goals. Their expertise and commitment have been instrumental in enabling us to overcome challenges.

We especially appreciate the opportunity to visit the Edison Training Facility to learn and further research the concepts that we needed to know. The tour was very informative and inspiring for us. We are happy with the final product, and we hope that it meets your expectations and standards. We would love to hear your feedback and further suggestions for improvement.

Furthermore, we extend our gratitude to the department for entrusting us with this project, which has been an excellent opportunity for us to acquire new knowledge and skills. We have learned many valuable lessons that will undoubtedly benefit us in our future endeavors.

Finally, we are grateful to have had the privilege of collaborating with one of our local businesses to help make an impact with new technology. We are truly grateful for your mentorship and generosity.

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