Creating Interactive Video Game Simulations of Engineering Labs

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Research Objective

The objective of this research project is to create a virtual reality engineering laboratory. Currently, the students do not have any laboratory experience in a number of courses. This greatly affects their understanding of the material studied. The interactive virtual laboratory will provide the students with a hands-on activity to enhance their learning experience. This project, that builds on our experience from a previous one started in September 2012, and this paper and presentation will concentration on showing our progress to date, including a brief demonstration of the virtual labs themselves.

Methods Used

To create the video game simulations, we are using Unity 3D game-design engine. Unity 3D is used to create professional video games for PC, iOS, Android, Xbox, and many more platforms and is the most commonly used one in the industry. To create the 3D models of the lab equipment, we use the programs Adobe Photoshop and 3ds Max. This allows us to create realistic parts. After completing the modeling, the models are then exported from those programs and imported into Unity 3D.

Unity 3D allows us to use either C# or JavaScript to program the simulation. We use JavaScript because we are more familiar with it thus making it easier to program. These JavaScript scripts are then attached to their relative objects in the game scene. For example, the scripts that make a drill press move up and down would be attached to the model of the moving drill press part. By animating this single part, it makes it look like the actual drill press in the real lab.

The perspective that the students see in the game is a first person view. There is no character present in the simulation. This allows them to feel immersed in this virtual lab and get as close to the real experience as possible. An example of this is that the student navigates through the room using the arrow keys to move and the mouse to look around with a hand at the center of the screen. They can then click on a cup full of liquid to pick it up. This makes the cup stay at the center of the screen as if they were carrying it around. Once the cup is above the cement mixer, the student then lets go of the mouse and an animation of the pouring liquid begins. This process is very similar for the rest of the tasks that the students do for their lab assignment. For reference, see Figures 1 and 2 below which demonstrate the first person view of the lab equipment.

Progress to Date

       We have worked on simulating three labs so far. These are the electron microscope, concrete compression, and the asphalt binding labs. Figures 1 and 2 below are from the asphalt mixing and concrete compression labs, respectively. The models of the lab equipment are not completely finished yet but these figures demonstrate how the students can take their experience from the simulation and translate it to the hands-on work in the lab room.

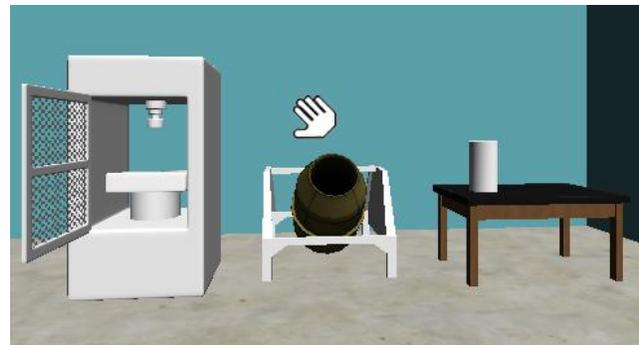**Figure 1:** Simulation of asphalt mixing   **Figure 2:** Simulation of concrete compression

       For the asphalt mixing lab, the student can click on each of the buttons and control the mixing machine. The directional buttons raise and lower the mixer and the student can also turn the mixing on. This actually animates the mixer to provide an experience similar to the real machine.

       The concrete compression lab development is not as far along as the asphalt mixing one. In this lab, the student can start the pouring animation by clicking on the cylinder sitting on the desk. When this starts, the cylinder slides over to the mixing drum and shows it pouring into the drum. Then, the student can hold the mouse over the drum to cause it to rotate. Lastly, the door to the compression box closes with a simple click. For every simulation, the student has the ability to move around the room with the hand staying at the center of the screen.

Results

       The implementation of the lab in a teaching environment is expected to begin soon. Assessment data will be collected and analyzed to gauge the success of the virtual laboratory experiments and its contributions to student success.

Conclusion

Our objective for this research project is to allow students to perform a hands-on simulation of engineering laboratories. This allows the students to gain experience that helps them understand the lecture material better. To do this, we are using the Unity 3D software and are currently in the process of developing three laboratories: electron microscopy, asphalt mixing, and concrete compression. Once these are complete, they will be implemented in the relevant courses. After they are used in the courses, feedback will be used to improve them, and as appropriate used for demonstrations to younger audience.

Acknowledgment