Packet 39 Crane Simulator

Experience Design Document

This describes a prototype VR simulator in which the user embodies the operator of a crane required to perform tasks using various controls while in the cab of the crane.

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Overview

Cranes are heavy, dangerous and expensive equipment. Crane accidents are often the direct result of negligence of the crane-related professional or the lack of adequate operator training or experience.

- 90% of crane accidents occur due to human error
- 50% of U.S. crane accidents that had injuries in 2009 resulted in fatalities

Adequate training is a must. A crane simulator is a cost-efficient solution for offering training and refresh training to crane operators in a safe and sound environment with no risk of damage or injuries.

Goals

The crane simulator that we are proposing will offer the following experience:

1. The trainee will be able to turn an ignition key in two positions, and lift and lower a parking brake lever
2. The trainee will be able to move 4 hand levers corresponding to rotating the crane platform, lifting and lowering the boom, extending and retracting the sub boom, and raising and lowering the hook
3. Two performance measures will be calculated and tabulated by the crane simulator at the end of each training session: One will measure the success of loading and dropping a charge on target; and two, the time taken to perform the tasks, beginning and ending with turning on and off the ignition switch

Specifications

The application will be created in Unity with the XR Interaction Toolkit.

The deployment platform is the Oculus Quest.

Features

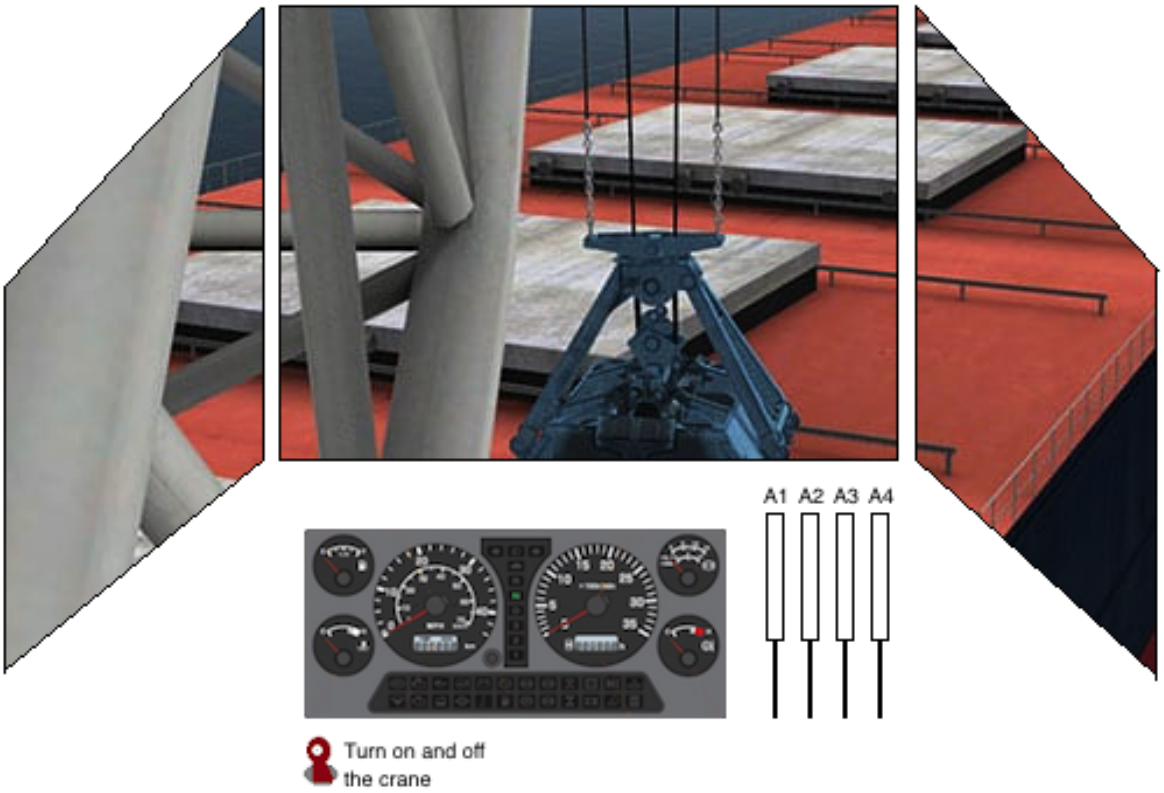
The crane simulator will try to reproduce a real crane experience with lever control and crane reaction and movement simulations.

The pick up and drop of objects will be a magnet-like “touch-and-connect” mechanism

In the simulated cabin, pop-up windows will indicate button and lever functionalities with direction for step-by-step operations.

Sound effects will accompany movements and operations of the crane.

Diagram



A1 → rotating the crane platform (right/left)
A2 → lifting and lowering the boom
A3 → extending and retracting the sub boom
A4 → raising and lowering the hook

Process Flow / Checklist

[Begin]
- Step 1: Turn on ignition key
- Step 2: Lift a load and place it on an elevated platform or truck (using the levers)
- Step 3: Raise the hook
- Step 4: Retract the boom
- Step 5: Rotate the cabin in alignment with the moving base
- Step 6: Turn off ignition key

[End]

Milestones

Create Essential Visual Assets

Create the base, the cab, the boom, the sub boom, the hook, an item to pickup and a destination indicating where the item is to be relocated

Create Essential Joints of the Crane

Join the cab with the base so that the cab rotates. Join the boom with a hinge joint with the cab so that the boom may be raised and lowered. Create code to simulate a prismatic joint between the boom and the sub boom

Create Cab Controls With Levers

Create the four hand levers, the ignition key, and parking brake lever. Create the joints necessary to have them move naturally, and within limits.

Test Crane Tasks With Buttons

Have buttons like a HUD for testing the functionality

Oculus-Specific Tasks

Recognize hand postures and positions so detection of grasping of controls is done naturally for the user.

Test with Oculus Quest

Using the Oculus with livestream of the view to test the operator tasks.

Implement Tracking of Performance Measures and Present to User

Determine the accuracy of the load placement and the time to complete all the tasks to move the load and then shut off the vehicle

Timeline

4/7: Experience Design Document delivered

4/11: Present Alpha to Packet 39 and receive feedback

4/14: Make final presentation to Packet 39

Wishlist

Provide steps up front that the user must undertake to complete the simulator

Provide incremental steps so the user understands which task is to be done next