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Project Export Download: Midterm_Project_Demo.unitypackage

Project Demo Video: https://youtu.be/ZP1ib8MmKZs

Midterm Prototype Report

VR Protoype Design Rationale

For our project, we are developing a VR and AR training simulator for gearbox assembly. The current VR prototype establishes the core framework for the experience and sets up a strong foundation for future development. Starting with VR allowed us to focus on developing precise interaction mechanics and spatial understanding before extending the simulator to AR. Our design decisions were guided by the goal of creating an intuitive, realistic, and modular training experience while keeping unnecessary aspects simplified to focus the user. We implemented a home screen with start, settings, and exit options to establish a familiar user interface pattern and to support easy navigation for future modules. The decision to focus only on the “Start” button for the midterm prototype ensured that our development time was concentrated on building core functionality rather than peripheral UI elements.

The inclusion of a virtual instruction screen was intended to simulate guided learning scenarios, where users can reference step-by-step instructions while performing the task. This approach supports both self-paced learning and potential instructor-led training in future iterations.

To make the training experience feel natural, we integrated VR grab and manipulation mechanics for interacting with the gearbox components and UI. Rigidbodies and Colliders were added to each object to enhance realism through accurate physics and collision detection, allowing components to be assembled in a believable way. These foundational features will also make it easier to expand the simulator’s interactivity and incorporate feedback mechanisms such as error detection or progress tracking in later stages.

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AR Sketch and Design Rationale

On the shop floor, augmented reality will overlay step-by-step instructions, and 3D ghosting of parts anchored to the physical fixture/workbench. Interactive UI overlays will include assembly checklists and a photo capture widget for easy quality control and documentation. The key components used from the course in our AR design will be tracking & anchoring to place the overlays, multimodal input to interact with the displays, and C# for custom behavior.

Sketch included on last page

Applied and Future Design Principals

Our current prototype applies several key interaction and usability principles to support an intuitive and comfortable training experience. The workbench environment leverages real-world affordances, as the tools and gearbox components on the table resemble their physical counterparts, allowing users to infer their functionality naturally. The display screen above the workstation acts as a clear signifier, drawing attention to where users can view and follow training instructions. Logical mappings are also maintained. When users rotate against the VR controller, the held object rotates correspondingly, reinforcing a direct connection between user input and system response. Additionally, the scale and proportions of the scene have been designed to reflect real-world dimensions, keeping all interactive objects within reachable proximity. The focused workspace minimizes distractions and limits unnecessary movement, maintaining cognitive ease and ensuring that the user remains both immersed and comfortable, whether seated or standing.

In future iterations, we plan to extend these principles with additional layers of feedback and accessibility. Tooltips or highlights will be introduced to indicate which objects can be interacted with, guiding new users through complex tasks. Haptic vibrations will provide tactile confirmation when an object is grabbed, while auditory clicks will signal when components successfully snap into place, enhancing sensory feedback and engagement. The home screen buttons will include hover lighting effects to visually reinforce interactivity. Finally, the settings menu will incorporate accessibility options such as adjustable text size, color contrast, and interaction sensitivity, ensuring the simulator is inclusive and comfortable for a wide range of users.

Functional Test Overview and Planned Iterations

After Carter designed the basic layout of the main menu and the VR simulation scene, Nick tested the user's workflow of going from the main menu to the VR scene. Nick was asked to navigate to the training scene and provide feedback along the way, and he brought up a couple of problems/observations. First off, the hitboxes for the buttons were incorrect and seemed to be offset upwards. Secondly, the user notices that the main menu was not a 3D environment, but instead it was just a 2D overlay in the headset. To address the first point, we had to make edits to the main menu scene, as the hitboxes were indeed too large and overlapping. This occurred because the background image of the button had large margins, so it along with the hitbox was accidentally enlarged. To address the second point, we had a conversation about whether we actually wanted a 3D environment for the main menu. We concluded that a 2D environment would be best to keep things simple and understandable for the user.

Technical Architecture Overview

The VR training simulator is built in Unity using the XR Interaction Toolkit, enabling cross-platform support for Oculus and desktop VR devices. The architecture follows a modular design to separate core components such as scene management, user interaction, and scene composition. The main menu screen and the VR training simulator are separated into different scenes, and a script manages the navigation between the two. User interaction and VR implementation is organized into scripts as well. Assets within the VR training scene are organized into empty parent objects to categorize and group similar objects.

A maintenance or service use case sketch for AR

Bad shaft highlighted for worker