VR Wheel Removal Training

CS 485 Assignment 1

Demo video: https://youtu.be/oPTZlXH334Q

Design and Learning Goals

This is a virtual reality procedural training experience designed to teach users the process of removing a wheel from a car. The experience focuses on learning the correct sequence of actions through direct physical interaction with the vehicle and tools.

Main Steps

1. Position the jack correctly, keeping its base grounded.
2. Slightly loosen all five lug nuts while the wheel is on the ground.
3. Pump the jack to raise the vehicle.
4. Fully remove the nuts, pull off the wheel, and place it in the rack.

Audience and Prerequisites

Novices and automotive students. No maintenance experience is required, only basic familiarity with VR controls.

Learning Outcomes

By the end of the experience, the user should understand both how to perform each individual action and why the actions must be completed in the correct order. The goal is not to simulate every detail of changing a tire, but to teach a short and clearly structured real-world procedure.

Interaction Design

The interactions are designed to mirror the physical actions involved in wheel removal. The experience includes:

- **Grab and Move:** Picking up tools and handling the removed wheel.
- **Place:** Positioning the jack beneath the car and placing the wheel in the designated rack.
- **Snap:** Aligning the jack with its placement target and securing the wheel in the rack.
- **Tool Use:** Aligning the impact wrench with each lug nut and pressing the trigger to loosen or remove it.
- **Mechanical Interaction:** Pumping the jack handle to raise the vehicle.

Interaction Design continued

Alongside the wall-mounted instructions, environmental highlights guide users through the procedure. A highlighted floor area shows where to position the jack. During nut loosening and removal, the next suggested nut glows green, while the remaining nuts glow blue. The green highlight follows a star pattern, helping users identify their next action without numbered labels.

Snapping reduces the precision required for placement, allowing users to focus on the procedure. The wrench still requires socket alignment, reinforcing correct tool positioning.

Instructional Design

The four-step workflow provides clear structure, while the garage, car, and recognizable tools place learning in a realistic context. Users learn by positioning tools, pumping the jack, and removing the wheel. Simplified mechanics and automatic stand deployment keep attention on the procedure.

Instructions combine board text, object highlights, visible mechanical movement, and brief sound cues. These show users what to do and how their actions affect the task.

- **Correct action:** A confirmation message, tone, and visible change acknowledge progress.
- **Incorrect action:** An error tone and corrective message explain what to do next. Existing progress is preserved.
- **Step completion:** The board marks the step green with “DONE,” and the progress bar advances.
- **Next step:** Instructions and highlights shift to the next required action.

Training completes when the removed wheel is secured in the rack. Users can reset the session to practice again.

Learning-Related Error Handling

Step gates prevent lifting before loosening, removing nuts before support, and pulling the wheel before all nuts are removed.

Incorrect actions produce specific guidance, such as “Loosen the lug nuts before raising the vehicle.” Current instructions remain visible, and valid progress is preserved.

After 18 seconds without progress, required highlights become brighter and pulse faster. Dropped tools can return to their starting positions. Reset restores the training while preserving player position and tracking.