

Excavator Simulator VR

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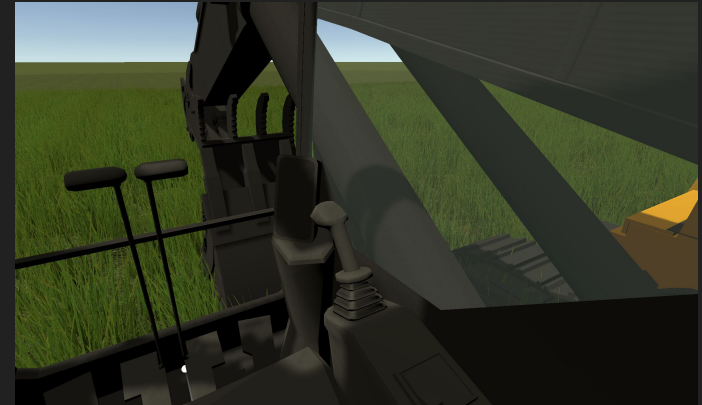
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Goals

- Learn more about the process of designing, implementing, testing, and potentially publishing a Steam game sometime after schooling.
- Create a fun-to-play simulator/game for VR users.
- VR application runs on mid to high tier PCs
- Using an excavator that mimics the real-world, allow users to interact with the environment in real-time.
- Learn how to manage a larger project with a 3 month deadline
- Adjust to any setbacks and avoid pitfalls/blockers

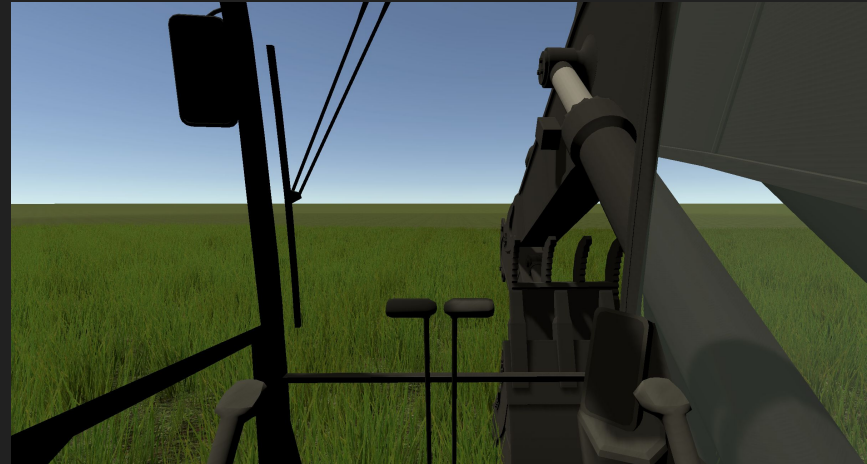
Intellectual Merits

- Discovered that controlling grip-joysticks in VR is not as intuitive as it may seem. Since all VR controllers are held in a different way a more universal calculation had to be performed.
- Optimization is very important for VR projects due to the heavy rendering and high target frames per second. Delaying optimization can easily lead to backtacking and reimplementation.
- While digging out voxel terrain adding physical objects and visual particles allows for greater digging estimation (increasing performance and visual simulation).



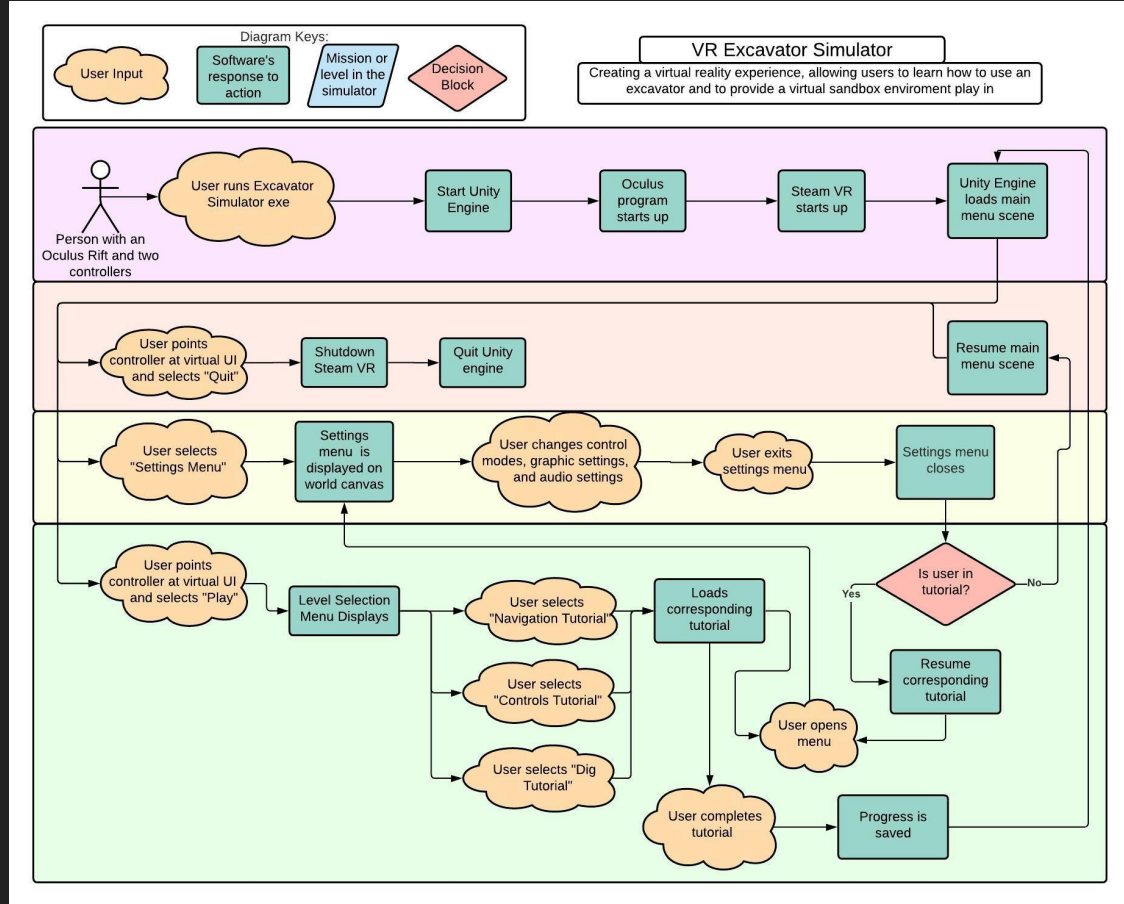
Broader Impacts

- Since running this excavator simulator only requires a PC and one of the many popular VR devices, almost anyone can download and play. All other excavator simulators are either not for personal download, use proprietary hardware, or are not VR capable.
- Provide educational entertainment via virtual reality
- Allow people who do not have access to expensive heavy equipment of what it could feel like.



Design Specifications

The application runs in the game engine Unity with a plugin called SteamVR (used for VR input). Once a user loads the app they are loaded into a main menu scene with a UI menu. Clicking different options determines where the user is taken. Eventually the user ends back up in the main menu scene.



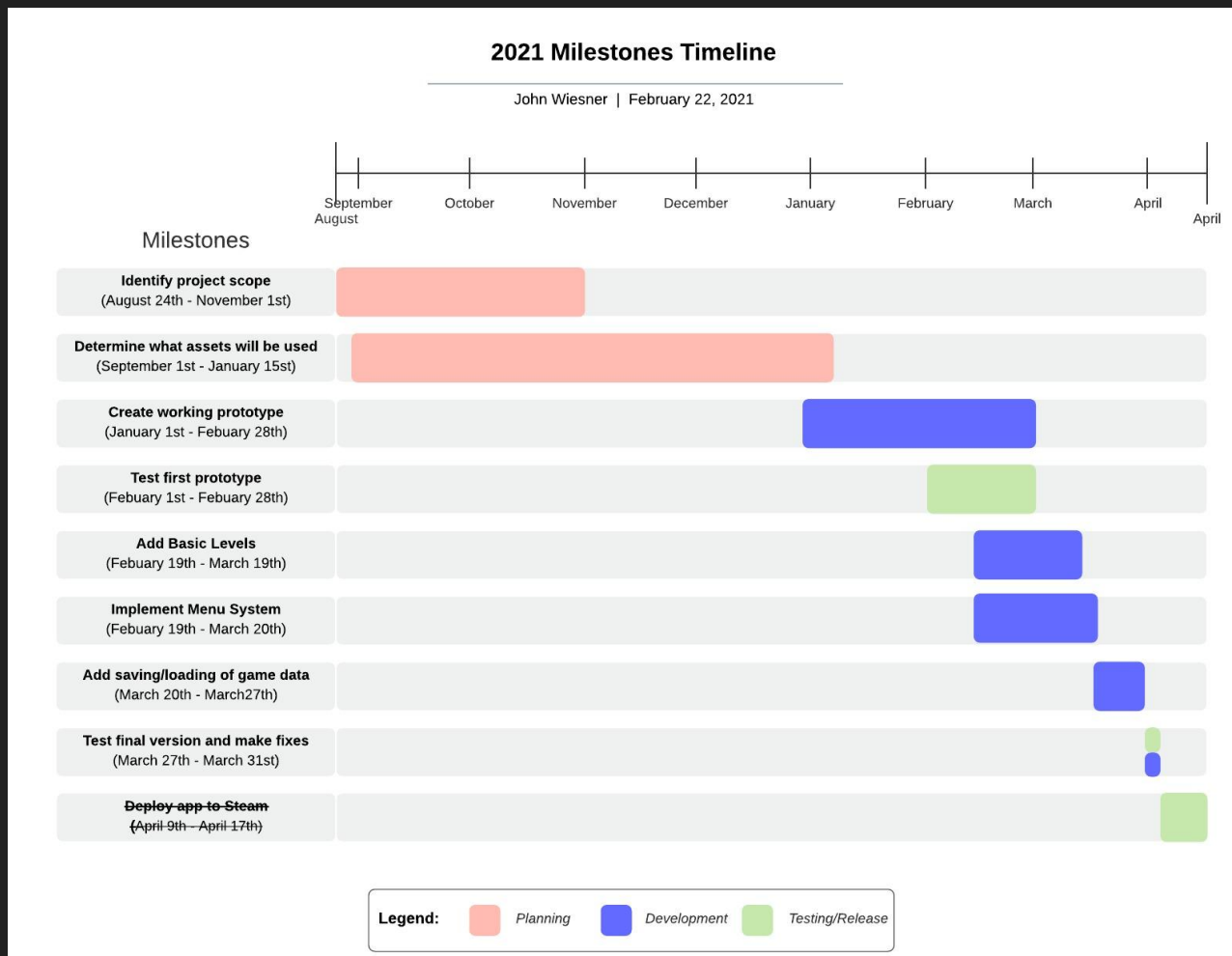
Technologies

- Unity 3D - Game engine
- Blender - 3D modeling software
- Ultimate Terrains - Voxel engine for real-time terrain modification
- Steam VR - Interface API for Open VR
- Physical Tank Treads - Realistic track movement
- Real-time physics - Environment objects are dynamic and impact excavator's performance



Milestones

Milestones had to be tweaked and cut due to the narrowed scope, setbacks, and shortened deadlines encountered throughout development



Results

- Virtual joysticks and levers that feel “real” or natural
- Excavator physics that do not throw user around too much (avoid creating motion sickness)
- Interactive digging of dirt with particles and terrain re-absorption
- Have basics of the core functionality working

What Is Left?

- Menu system hud
- Navigation tutorial level
- Controls tutorial level
- Digging tutorial level
- Test build and polish current features if time allows

Challenges and How They Were Overcome

- Planned deadline was moved up by an entire month
 - Idea of publishing a game to steam was removed
- Allocated project time was reduced by 60% (due to other school work and real-world responsibilities)
 - Had to narrow the initial scope of work but worked on the project every chance I got
- Default Unity joint simulation physics were too unstable for use case
 - Invested time into learning a newer articulation body system but ended up just using character controllers and a tank simulation plugin
- Spent longer in prototype stage than predicted
 - Project scope had to be narrowed to create a working deliverable with some polish
- Performance issues throughout development
 - Modified and optimized geometry and shaders
 - Real-time terrain deformation technology had to be changed midway through development