



Virtual Zoo – A VR Experience

(CS344 - Introduction to Metaverse)

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PROJECT OVERVIEW

The Virtual Zoo is a groundbreaking Virtual Reality (VR) experience developed as a core project under the CS344 - Introduction to Metaverse course. This innovative endeavor reimagines the traditional zoo concept by transporting it into a fully immersive and interactive digital environment.

The project seeks to replicate the atmosphere and functionality of a real-world zoo while offering an enriched and ethical alternative to conventional zoos. With detailed 3D modeling, realistic animal behaviors, and educational components, users can explore a vibrant digital space populated with lifelike animals, rich landscapes, and interactive learning modules.

The Virtual Zoo serves as both an educational tool and a source of entertainment, making it suitable for a wide audience including school students, wildlife enthusiasts, educators, and the general public. Its virtual nature eliminates geographical barriers and logistical constraints, enabling global access while promoting animal welfare and wildlife conservation.

PROJECT OBJECTIVES

The main goals of the Virtual Zoo are:

- **Realistic Environment:** Create a visually and functionally accurate zoo environment featuring natural habitats, enclosures, and a diverse range of animals.
- **User-Friendly Interface:** Design a smooth and accessible interface that caters to both experienced and new VR users.
- **Educational Platform:** Provide informative content to enhance user knowledge about wildlife, including animal behavior, diets, habitats, and conservation issues.
- **Performance Optimization:** Ensure the VR environment runs smoothly on consumer-grade VR hardware, specifically the Oculus Quest 2.
- **Global Accessibility:** Leverage VR technology to reach a worldwide audience, transcending physical and economic limitations.

TECHNICAL SPECIFICATIONS

- **Game Engine:** Unreal Engine – selected for its powerful rendering capabilities and comprehensive support for VR development.
- **3D Modeling Tools:** Unreal Engine's asset libraries were used to create high-fidelity animal models and environment assets.
- **VR Hardware:** Oculus Quest 2 – chosen for its standalone functionality, affordability, and user-friendly design.

DEVELOPMENT PHASES

The development of the Virtual Zoo was structured into five distinct phases. Each phase contributed significantly to building a comprehensive, engaging, and educational VR experience. Below is a detailed breakdown of each phase.

A. Phase 1: Environment Creation

This initial phase focused on laying the groundwork for the Virtual Zoo. It involved creating a realistic and immersive digital environment replicating the layout and ambiance of a physical zoo.

- **Structural Planning:**
 - Designed the overall layout of the zoo, including pathways, animal enclosures, and thematic zones.
 - Mapped out user flow to ensure a logical and engaging exploration experience.
- **Environmental Design:**
 - Used Unreal Engine's asset libraries to create trees, shrubs, rocks and terrain.
 - Added architectural elements such as fences, viewing platforms, and signboards.
- **Performance Optimization:**
 - Reduced polygon counts of 3D models.
 - Used efficient texture mapping to maintain high frame rates on Oculus Quest 2.

B. Phase 2: VR Integration

This phase aimed at making the environment VR-compatible, ensuring a high level of immersion for users.

- VR Framework Implementation:
 - Integrated Unreal Engine’s native VR support for Oculus Quest 2.
 - Enabled full 360-degree head-tracking and motion input.
- Rendering Optimization:
 - Implemented real-time lighting, ambient occlusion, and dynamic shadows.
 - Balanced visual fidelity with performance for a smooth experience.
- Immersion Enhancements:
 - Calibrated field of view and depth perception.
 - Tuned VR scaling to reduce motion sickness and enhance realism.

C. Phase 3: Navigation and Scaling

To make the zoo environment navigable and expansive, this phase concentrated on movement mechanics and layout expansion.

- Navigation Mechanics:
 - Developed a dual system using teleportation and smooth locomotion.
 - Provided intuitive controls for users of different experience levels.
- Environment Expansion:
 - Increased the number of enclosures and zones.
 - Introduced varied animal habitats to diversify content.
- Spatial Refinement:
 - Adjusted paths and placements for natural flow and better user engagement.
 - Minimized visual clutter while maximizing interaction points.

D. Phase 4: Animal and Behavioral Implementation

This phase brought the zoo to life by adding animals and making their behavior feel realistic.

- Animal Integration:
 - Added a total 9 species of animals namely antelope, deer, fox, wolf, zebra, giraffe, elephant, cheetah and lion into their designated habitats.
 - Each animal was placed in an accurately designed enclosure.
- Behavioral Trees:
 - Used Unreal Engine’s behavior trees.
 - Enabled animals to graze, sleep, roam, or react to the environment.
- Habitat Accuracy:
 - Designed environments that reflect animals’ natural habitats.
 - Incorporated environmental stimuli for enhanced realism.

E. Phase 5: Educational Enhancements

To fulfill the educational mission, the final phase focused on enriching user learning through interactive content.

- Information Panels:
 - Installed panels at enclosures detailing species information.
 - Included facts about diet, habitat, behavior, and conservation.
- Interactive Widgets:
 - Added clickable elements and pop-ups.
 - Enabled users to engage deeply with educational content.
- Teleportation Refinement:
 - Polished the teleportation system to complement learning paths.
 - Made navigation between learning points seamless and user-friendly.

ACHIEVEMENTS

The Virtual Zoo project achieved the following milestones:

- Developed a visually realistic and behaviorally rich virtual zoo environment.
- Delivered a user-centric VR experience with intuitive navigation and interaction.
- Created a versatile educational platform suitable for classrooms and personal learning.
- Maintained high performance on Oculus Quest 2 with seamless interactions.
- Made wildlife education accessible within fingertips.

CONCLUSION

The Virtual Zoo VR Experience exemplifies how technology can be harnessed to educate and inspire. Through strategic planning, technical excellence, and creative design, the project has transformed traditional concepts of zoological education and entertainment. The integration of VR, behavioral movements, and interactive learning makes this a pioneering project in the realm of virtual education. The Virtual Zoo not only offers a compelling alternative to real zoos but also redefines how people engage with the natural world through immersive technology.