CSE493V VR SYSTEMS FINAL

3D physics interactions with hand tracking in VR

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The problem

While VR/AR has advanced immersion, most experiences still rely on controllers, limiting realism. Hand tracking exists but is mainly used for navigation. We aim to change that by enabling natural interactions like grabbing and pushing. However, tracking inaccuracies and physics engine issues, like clipping and unstable collisions, present challenges. Solving these problems could greatly improve VR experiences.

Related Work

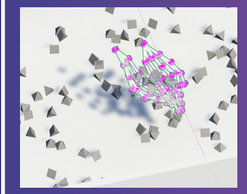
While working on our project, we discovered Hand Physics Lab on the Meta Library. It uses hand tracking to interact with objects and solve puzzles—similar to our idea. It was discouraging to find a similar project but we noticed many issues mentioned in the reviews. This motivated us to continue exploring our approach and improve on those problems.

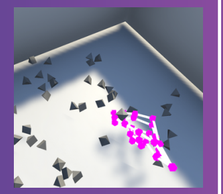
Our solution

Our project uses the Meta Quest 2's hand tracking with Unity's physics engine to enable realistic, physics-based hand-object interactions in VR. Unlike previous systems that rely on artificial constraints or animations, our approach directly addresses issues like tracking inaccuracies and unstable collisions. By refining collision models, friction settings, and constraint-based grabbing, we aim to improve realism and stability. This approach enhances existing work, such as Hand Physics Lab, by focusing on solving common problems like object clipping and inconsistent physics behavior.

Method/progress

We integrate Meta Quest 2's hand tracking data with Unity's physics system to simulate natural interactions. To improve accuracy, we experiment with multiple collision models (e.g., mesh-based and simplified primitives) to balance precision and performance. We fine-tune friction settings for better object handling and use constraint-based grabbing to prevent objects from slipping or phasing through hands. Our system dynamically adjusts collision boundaries based on hand motion, reducing clipping issues and improving object stability during interactions like grabbing, pushing, and stacking.





Results

Our method enables stable and responsive hand-object interactions, reducing object clipping and improving accuracy. Users can naturally grab, push, and manipulate virtual objects without controllers, offering a more immersive and accessible VR experience. Our system improves on similar projects by providing smoother, more reliable interactions.