Developing User Operations for 3D Brain Model Observation in Virtual Reality

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Abstract

Metaverse platforms have opened up exciting possibilities for virtual exploration, but they restrict users to view-only operations, preventing more interactive actions like grabbing or rotating 3D objects. Developers face challenges in customizing operations in existing metaverse platforms to meet this specialized need because they need to learn the constraints and limitations of a particular metaverse platform. In this project, we leverage the Unity game engine to address these limitations rather than writing codes in existing metaverse platforms. By developing a robust grabbing mechanism, we enable precise interactions with 3D objects. Specifically, we apply this mechanism to brain observation, empowering students and scientists to explore brain structures within a virtual space. Our main contribution through this approach is that we enhance the metaverse experiences for all users for precise user operations for 3D objects.

Motivation

Existing metaverse platforms have limitations of how to manipulate the 3D objects in a Virtual Reality (VR) environment without additional coding. When we tried to bring the metaverse platform to a classroom or research activities. Having no grabbing mechanism in the default metaverse's features introduces many constraints for designing an activity or exploring a 3D object.

As an example, human brains are complex objects with curved folds not represented well on 2D computer screens or statically on 3D screens, and they need to be viewed from several angles for their complex shapes to be understood. Being able to grasp and rotate them in any direction is essential for studying them in the classroom and allow students to contrast and compare specimens between sugjects.

Development

- **Platform**
  - Oculus 2
  - Unity and C# programming language.

- **Design**
  Our VR space will be on the Oculus device. Oculus has two controllers that can control the movement of the virtual hands without clicking any buttons. The buttons can be used for grabbing and rotating. Fig. 1 show what buttons are used for grabbing a 3D object.

  Our Oculus client will also communicates with the server on the Internet in order to download the 3D models that were uploaded by the user. The system architecture is shown on Fig. 2.

- **Testing and Deployment**
  Unity 3D application can be tested on PC. But, PC can only offer a emulator for a VR application. The actually user operations still require validations on VR device. This bring many challenges, such as platform compatibility or deployment process, when we test on Oculus and deploy the application.

- **3D Model**
  The brain models are scanned to be a PLY format file. In order to cooperate with the Unity application. We need to convert the file to be FBX format. However, we also need to adjust the center of rotation of the 3D model because the scanned model often does not have the correct coordinations for the rotation center.

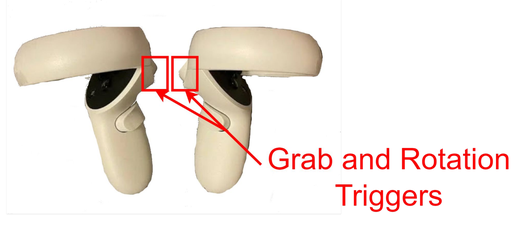

Fig. 1. Grabbing Triggers in the Oculus Controller

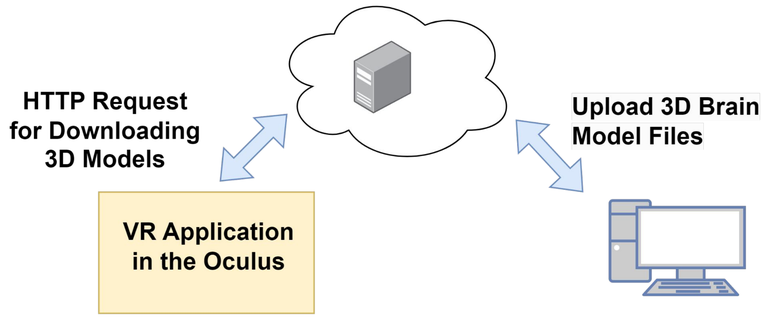

Fig. 2. System Architecture

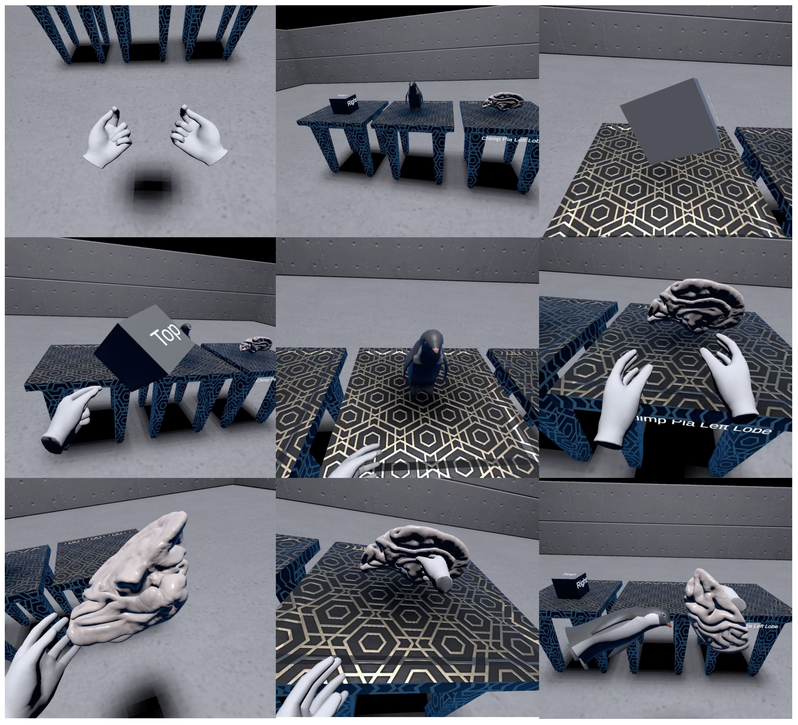

Fig. 3. A Series of 3D Movements Made by Oculus Controllers

Conclusion and Future Work

We successfully implemented the 3D object grabbing mechanism that can help users to explore the details of the 3D brain model to aid the brain research. We expect to make this function more generic so that it can be used in creating class or research activities.