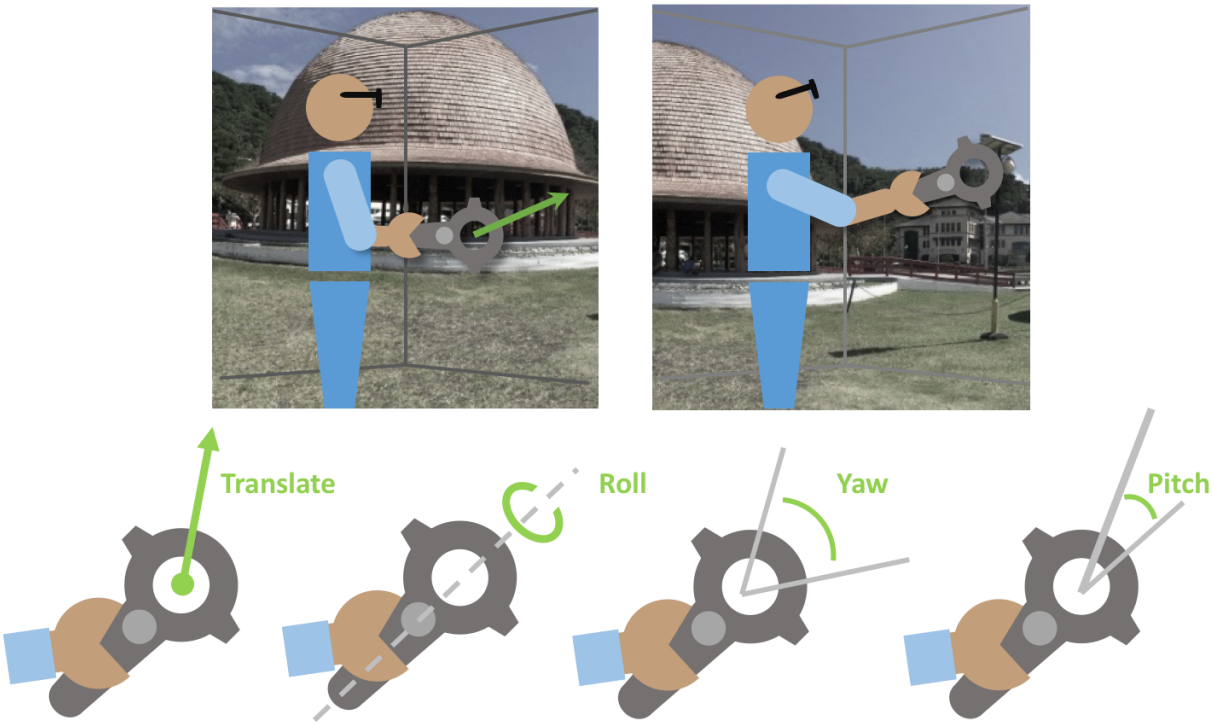
The Omni-Navigator

Version 2024/10/14

In the Omni-navigator VR travel scheme[1] the user imagines that he/she is holding a paper airplane or bird in one's hand, and how he/she positions and orients the bird determines how the user will travel through the space. To use this travel scheme, the user begins by holding the VR interaction controller (wand) at an initial origin/starting position and orientation. Then by pressing a designated button and moving the wand from that origin, the distance, direction and orientation from the initial origin determines the direction, rate of translation (movement in location) and rotation about all 3 axes (see picture below). For example, to move forward, the user presses a button and moves the wand forward. The distance from the starting position of the wand determines the speed of movement. To move upward, the user presses the button and moves upward. The distance from the starting position again determines the speed of movement. To pitch, yaw, or roll, the user presses the button and tilts the wand in one or more of the 3 axes. The greater the angle of tilt the more rapid the rotation.



The Omni-navigator control scheme.

This travel scheme has the advantage that with only the use of one button and the position and orientation of the wand, the user can achieve full 6-degree of freedom movement in addition to rate of movement. Once mastered users typically find the degree of control unparalleled by any

[1] Excerpted from Chapter 13 of the Book: Virtual Reality Development Gems

other VR travel scheme. Of course, if desired, some degrees of movement can also be constrained. For example, if one wanted to adapt this scheme to a first-person-shoot-style of movement along a horizontal plane, one simply has to exclude vertical (Y axis) movement, pitching and rolling.

Using the Omni-Navigator

In most VR environments there is the notion of a “container” or “vesse” in which the user’s head and interaction controllers reside. So, when travel is performed it is this container that is moved through the larger virtual space, and then from within the container the user may walk around the limited physical space constrained by the VR hardware. This container is sometimes called a “Camera Rig”, “VR Rig”, “VR Hub” etc. In Unity this container is instantiated as a game object, and within this game object there are usually game objects that refer to the user’s head, as well as hands.

The general steps for using the Omni-navigator are below. If you wish to apply these steps to Meta Building Blocks go to Building Blocks Instructions in the next section.

1. Create an empty game object and add the Omni-navigator script (component) to the game object.
2. In the Omni-navigator script component:
    a. assign the Camera Rig to the Main Hub parameter.
    b. assign the game object in the Camera Rig that refers to the user’s head, to the Head parameter.
    c. assign the game object in the Camera Rig that refers to the user’s hand (either left or right hand), to the Wand parameter.
    d. adjust other parameters as necessary (see section below on “other Omni-Navigator Settings”.
    e. If you wish to enable your movement to be blocked by stationary walls, or if you wish to be able to walk up ramps, set Enable Collision to true, and add a Rigid body and a Capsule Collider to the Camera Rig. Then for the rigid body set Freeze Rotation x y and z to all true. For the capsule collider set Center to (0, 0.89, 0;) set radius to 0.05; set Height to 1.75; set Direction to y-axis. These set the collider to represent your body trying to physically move through space. 1.75 is roughly 5'10".

To trigger the navigation, you will need to write code to call the script’s NavGo function when your travel button is pressed. Then when your button is released, call NavStop.

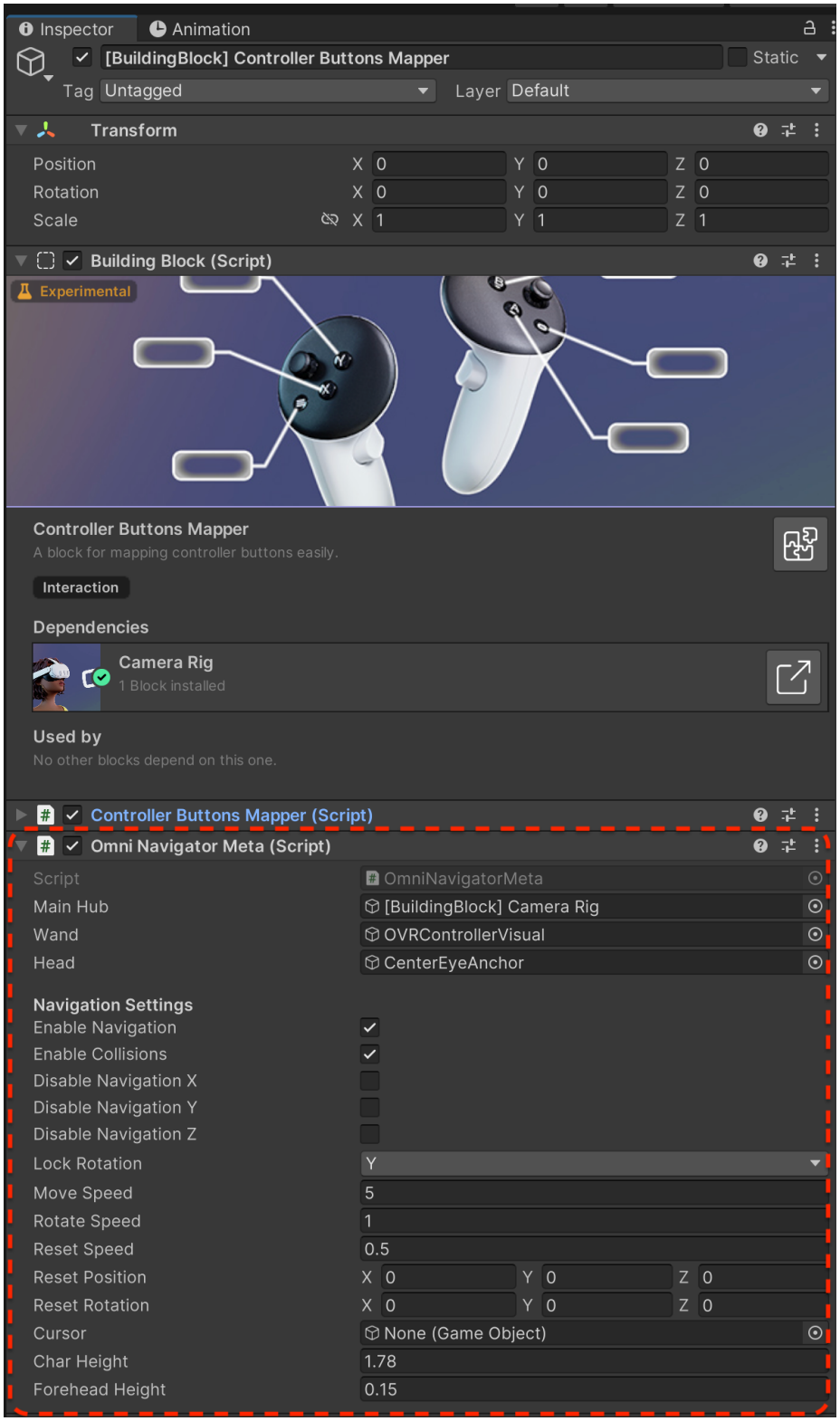
There are also two other useful functions- ResetGo and ResetStop to consider. These let you return to a customizable navigation home position and orientation. The best way to use this is to allocate a button (like the grip button on your controller) that, when you press and hold it, will call ResetGo to take the user on the path back to the home location. Then when the user releases the button, call ResetStop to stop the movement.

Meta Building Blocks Instructions

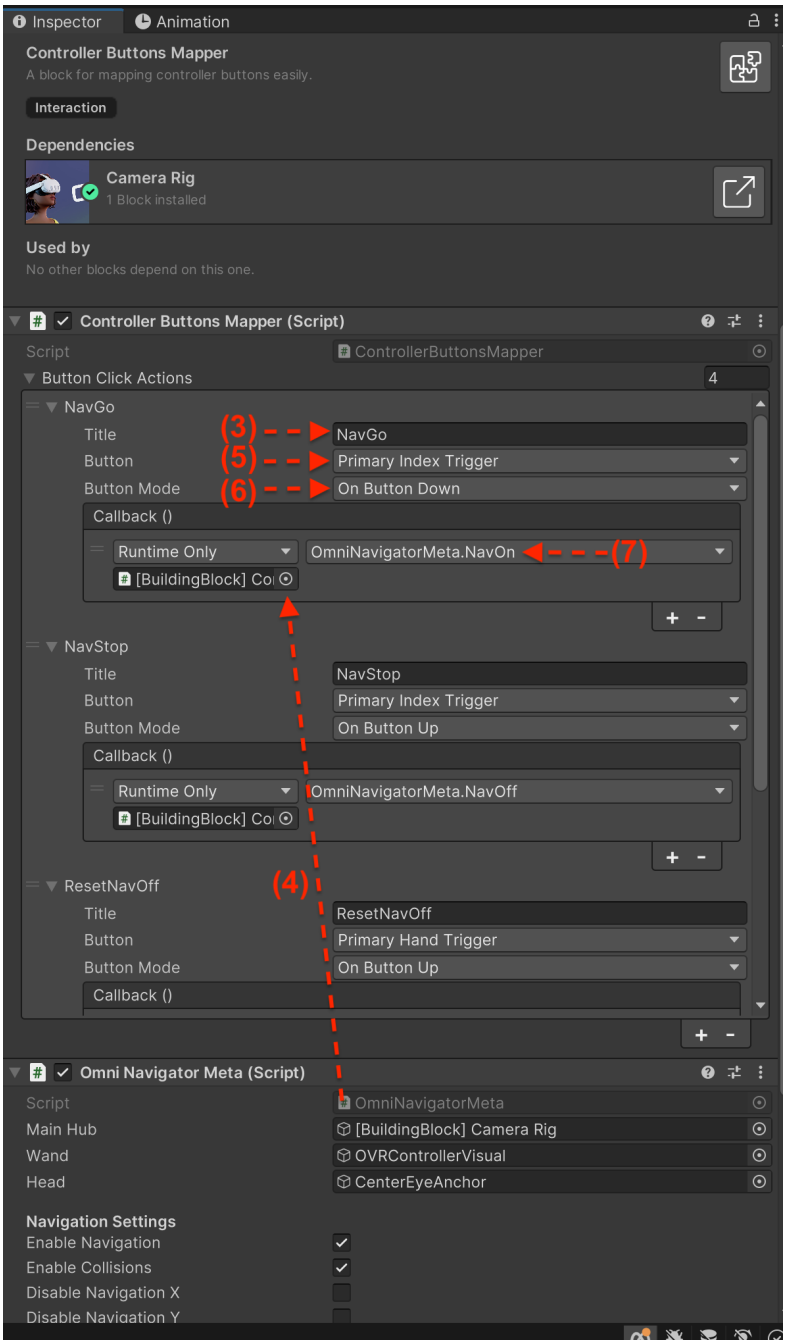
Before taking the following steps, set up a basic VR environment using Meta Building Blocks.

1. Add a Controller Buttons Mapper to your Unity scene from the Meta Building Blocks panel.

2. Add the Omni-Navigator script to the Controller Buttons Mapper.



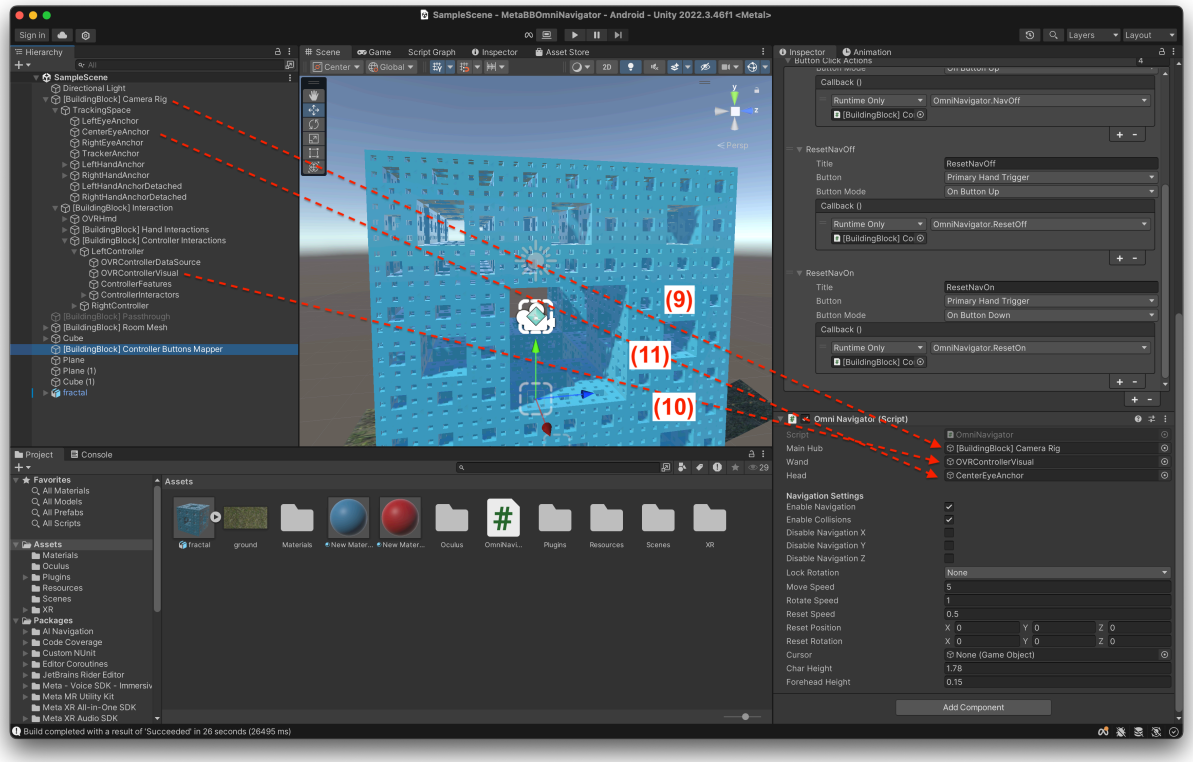
3. In the Controller Buttons Mapper component, add 4 Button Click Actions to the controller buttons mapper, named something like: navGo, navStop, resetGo, resetStop.



4. For navGo click and drag the OmniNavigator component to the navGo callback.
5. Select the input button to trigger the navigation (e.g. Primary Index Trigger).
6. Set button mode to On Button Down.
7. Select the function to call, in this case: OmniNavigator.NavOn.
8. Do the following for all the other actions (navStop, resetGo, resetStop):

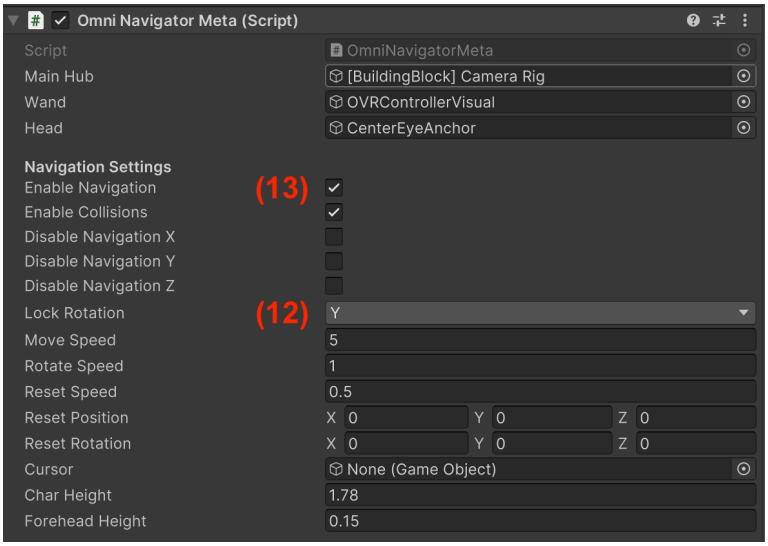
- for resetGo: set input button to Primary Hand Trigger, set button mode to On Button Down, set function to resetGo (this makes it so that if you hold the grip button, the navigator will smoothly return you to your home starting position and orientation.
- for navStop: set input button toPrimary Index Trigger, set button mode to On Button Up, set function to navStop (signals navigation to stop when you release the trigger button)
- for resetStop: set input button to Primary Hand Trigger, set button mode to On Button Up, set function to resetStop (signals return-home behavior to stop when you release the grip button).

9. Click and drag the Camera Rig game object to MainHub in the Omni-Navigator component.

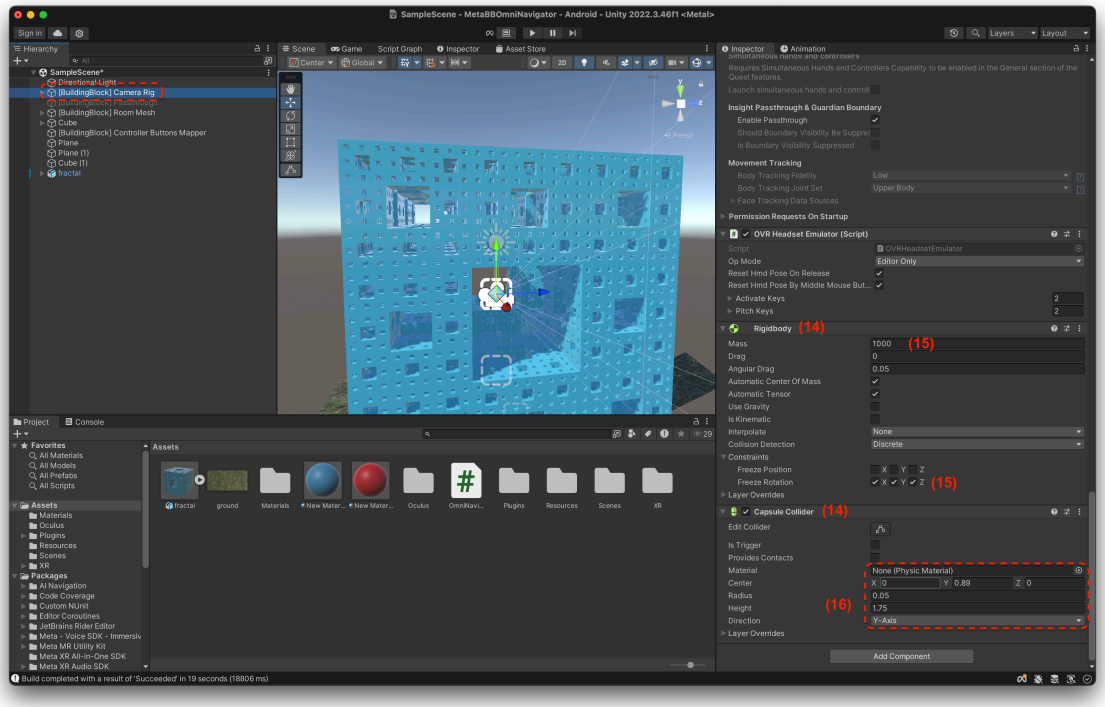


10. Click and drag Camera Rig> Interaction>ControllerInteractions>LeftController> OVRControllerVisual to Wand in the Omni-Navigator. (this assigns your left controller as the navigation wand)
11. Click and drag CameraRig>TrackingSpace>CenterEyeAnchor to Head in Omni-Navigator (this lets the navigator detect your head position, so that you can duck under objects).
12. Lock rotation in Omni-Navigator to None for fully unconstrained rotation – recommend you leave it as None (later you can try the classical 1st person shooter type of constrained rotation, by setting this to Y)

13. If you wish to enable your movement to be blocked by stationary walls, or if you wish to be able to walk up ramps, set Enable Collision to true.



14. In the Camera Rig, add a Rigid body and a Capsule collider.
15. For the rigid body set Mass to 1000; set Freeze Rotation x y and z to all true; and set Use Gravity to false (later when you try the classic 1st-person-shooter set Use Gravity to true.)
16. For the capsule collider set Center to (0, 0.89, 0); set radius to 0.05; set Height to 1.75; set Direction to y-axis. These set the collider to represent your body trying to physically move through space. 1.75 is roughly 5'10".



17. Build and run your application.

After you've gotten the above to work, you may wish to try the classic 1st-person shooter style navigation where you are walking along the ground and climbing up ramps. To do this, make the following adjustments:

- In the Camera Rig's Rigid Body component, set Use Gravity to true.
- In the Omni-Navigator component, Set Lock Rotation to Y.

Explanation of the other Omni-Navigator Settings

- **Disable Navigation** (in X, Y, Z): Disable movement along the selected axes.
- **Lock Rotation**: Lock rotation around an axis (either X, Y, Z or none). Lock rotation so that it only occurs along one of the axes.
- **Move Speed**: Movement speed in (grid-units/s).
- **Rotate Speed**: Rotation speed in (degrees/s).
- **Reset Position** (Vector3): Position considered the home position for the environment.
- **Reset Rotation** (Vector3): Specify the home rotation angle.
- **Cursor** (GameObject): Specify a 3D model asset to make visible when in navigation mode (in this example the bird is assigned as the cursor).
- **Char Height**: Anticipated height of the user (set to 1.78m by default).
- **Forehead Height**: Height of the user's forehead (set to 0.15m by default).