Vive Stereo Rendering Toolkit – Developer's Guide

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Introduction

Vive Stereo Rendering Toolkit provides drag-and-drop components for developers to create stereoscopic rendering effects in a few minutes.

With this toolkit, effects such as mirrors or portal doors can be easily achieved in your VR application.

System Requirement

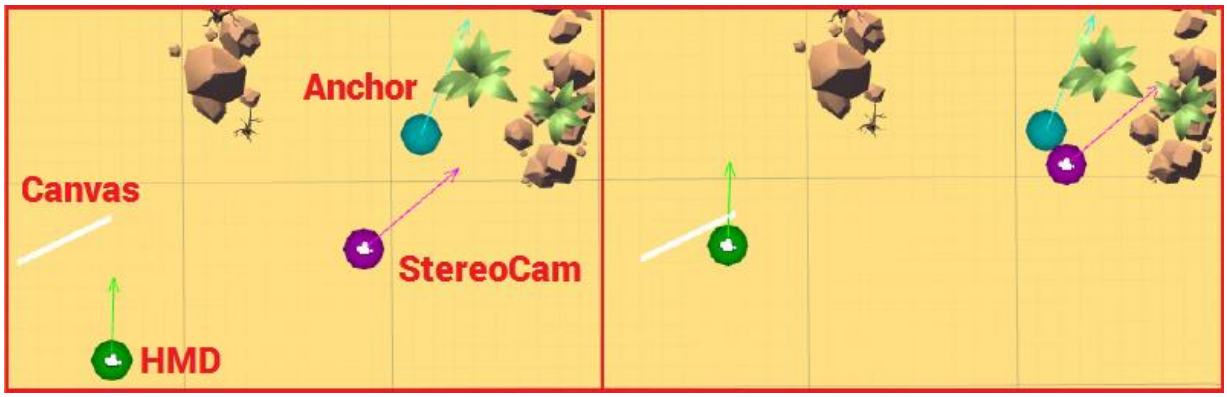
- Unity 5.5.0 or higher
- Appropriate SDK for target VR devices
  - Vive or other SteamVR-compatible HMDs: SteamVR Unity plugin, version 1.2.0 or higher
  - Vive Focus: WaveVR plugin, version 2.0.13 or higher
  - Oculus Rift: OVR plugin, version 1.20.0 or higher
- For some platforms, you **must use camera rig prefabs** from respective platform SDKs:
  - Vive Focus: add "**WaveVR"** from "WaveVR/Prefabs" to the scenes; remember to expand the camera rig.
  - Oculus Rift: add "**OVRCameraRig** from" "OVR/Prefabs" to your scene

Terminologies

A camera for performing stereo rendering is called a **stereo camera**. Its rendering result is applied to a **canvas**, which can be any planar GameObject with a Renderer.

Stereoscopic effect, such as parallax, is achieved by synchronizing the motion of HMD (both head and eyes) to the stereo camera object. This is done by assigning a **canvas-anchor** pair to a stereo camera.

The **anchor**'s pose defines the pose of associated stereo camera when the HMD overlaps with the canvas. Using this definition, our code retargets the relative motion between HMD and canvas to the motion between stereo camera and anchor (see the figures below).



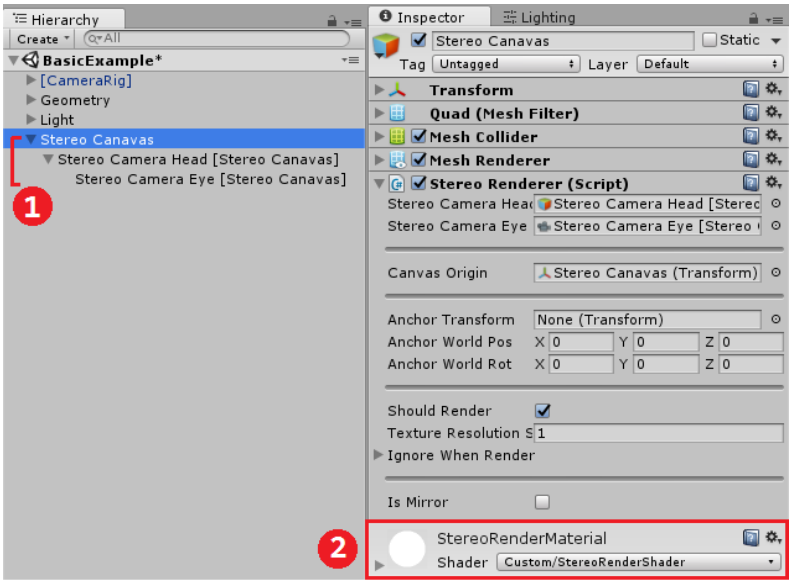
Quick Start Guide

Step 1

- Follow guide from you platform of choice to setup a basic VR application.

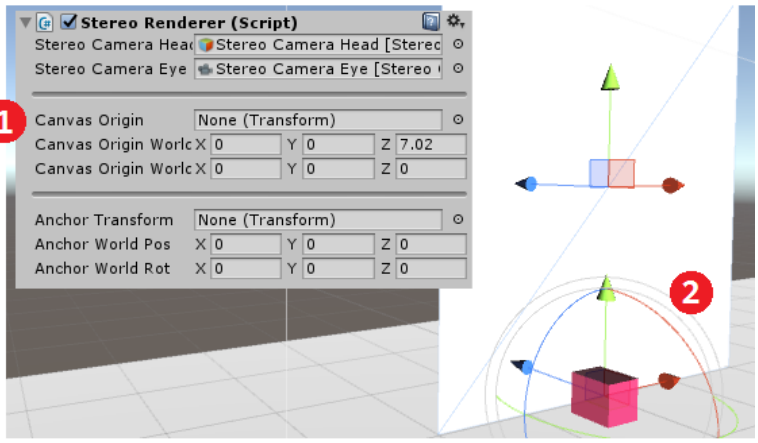
Step 2

- Add script **StereoRenderer** to your **Stereo Canvas**.
  The canvas should be a **planer object** with a Renderer.
- Once added, a Stereo Camera will be automatically added to your hierarchy. (1)
- If your renderer uses only 1 material, it will also be automatically replaced by our **StereoRenderMaterial**. (2)
- If your renderer uses multiple materials, manually change one of them to our **StereoRenderMaterial**.



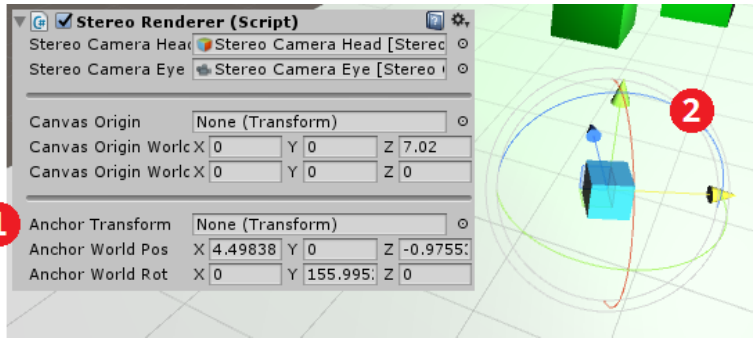
Step 3

- Set the **Canvas Origin** property if your canvas does not lie at the origin of local coordinate system.
- To change its pose, you can either assign a transform to it (1), or use the handles attached to the pink cube in scene (2).



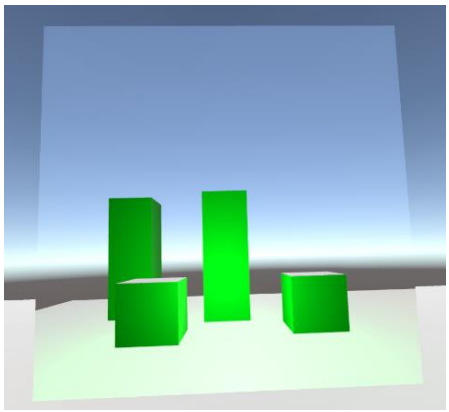
Step 4

- Set the pose of **Anchor**.
  See the "terminologies" section if you don't know its meaning.
- To change its pose, you can either assign a transform to it (1), or use the handles attached to the blue cube in scene (2).



Done!

- Click play, and you should see the result in HMD!
- You can find this tutorial scene in Assets/HTC.UnityPlugin/StereoRendering/Examples/1. BasicExample



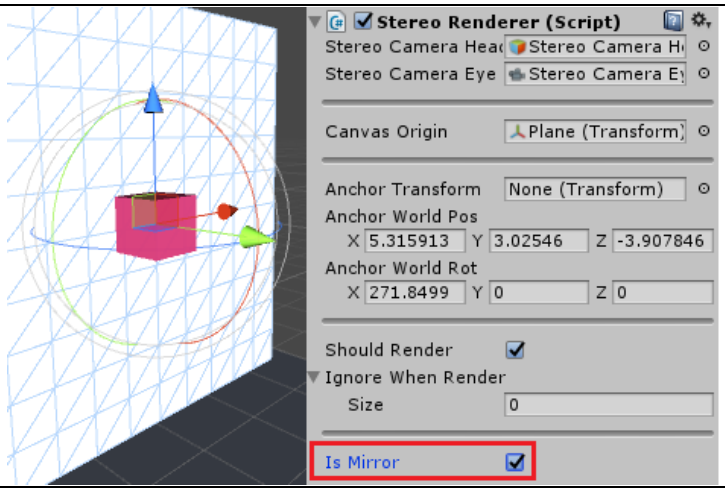
Tutorial - Mirror

Step 1-3

- Follow Steps 1-3 of previous quick start guide.

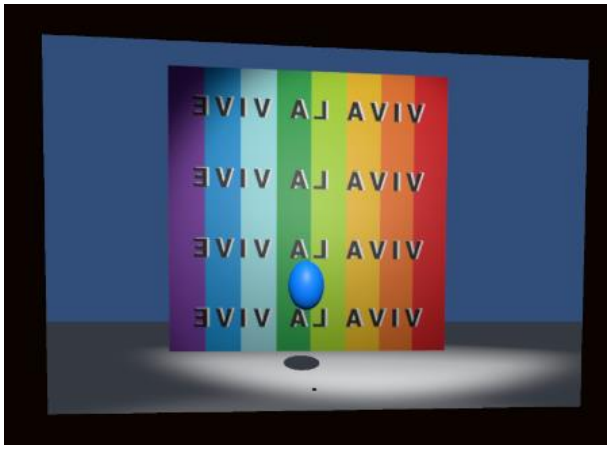
Step 4

- Check the **IsMirror** option of StereoRenderer.
- Rotate the **Canvas Origin** so that its **Y axis** (green arrow) **aligned with the mirror's normal vector** (the vector that is perpendicular to mirror plane).



Done!

- Click play, and you should see the result in HMD!
- You can find this tutorial scene in Assets/HTC.UnityPlugin/StereoRendering/Examples/2. Mirror



Tutorial – Double-Sided StereoRenderer

By default, meshes in Unity are rendered with back-face culling enabled. This means, the polygons face away from viewer are not rendered. However, sometimes we may also want to render back faces (for example, some kind of portal doors).

To render both sides of StereoRenderers, **uncomment** line 20 of StereoRenderShader.shader (or line 19 of StereoRenderShader-SingleTexture.shader). The image below shows the effect of this modification.

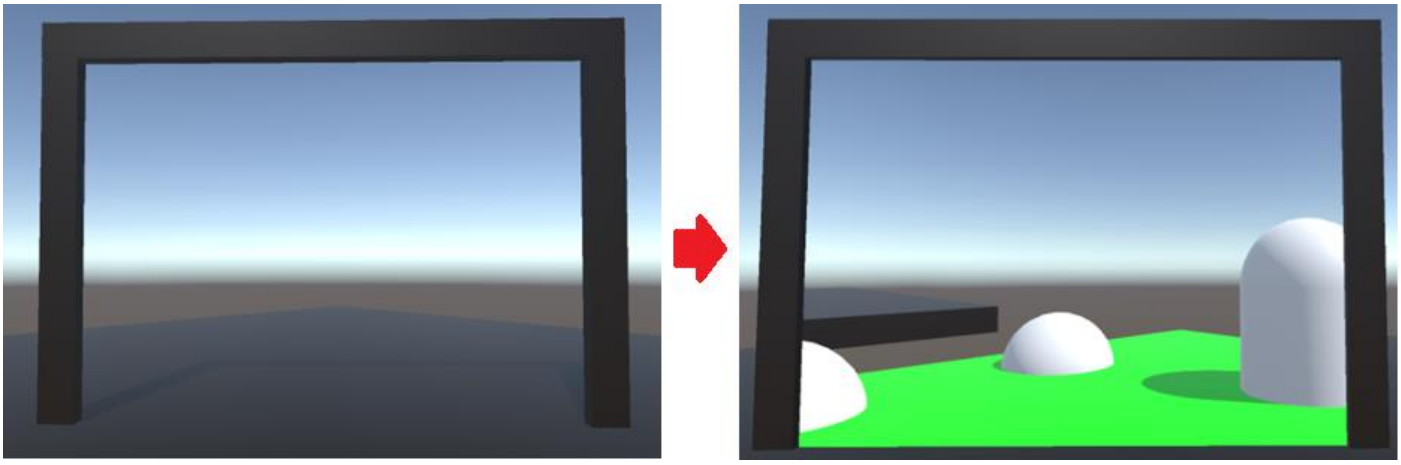
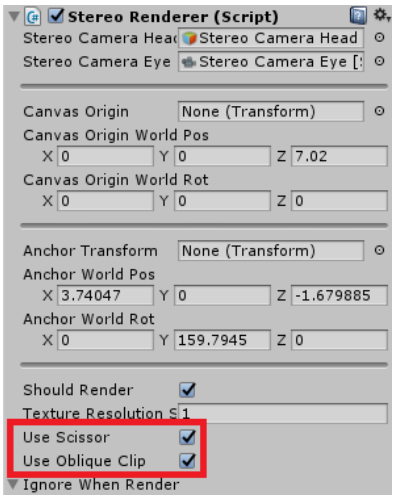


Fig. Viewing a portal door from its back. In the left image, the mesh is culled so nothing is rendered. After back-face culling is disabled, the portal door is rendered (right image).

Note that, disabling back-face culling may have an impact on the performance of your application, depends on the complexity of your target mesh.

Performance Optimizations

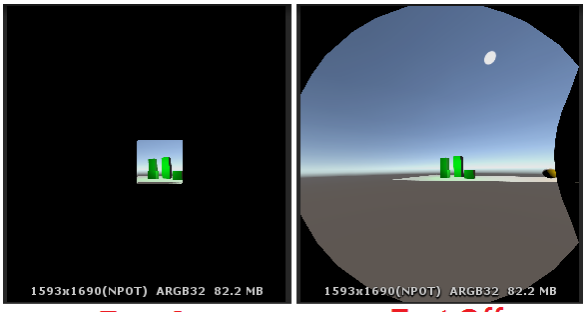
There are 2 build-in performance optimizations. Both are default turned on, but they can be turned off from editor inspector (the options in the red box in the left figure) or via script.



Scissor Test

This is useful for stereo renderers that occupies only a tiny fraction of user's FOV.

In this test, we modify the projection matrix of stereo camera, so the objects which sit outside of the box defined by visible stereo canvas will not be rendered. The effect can be seen in the figure below.

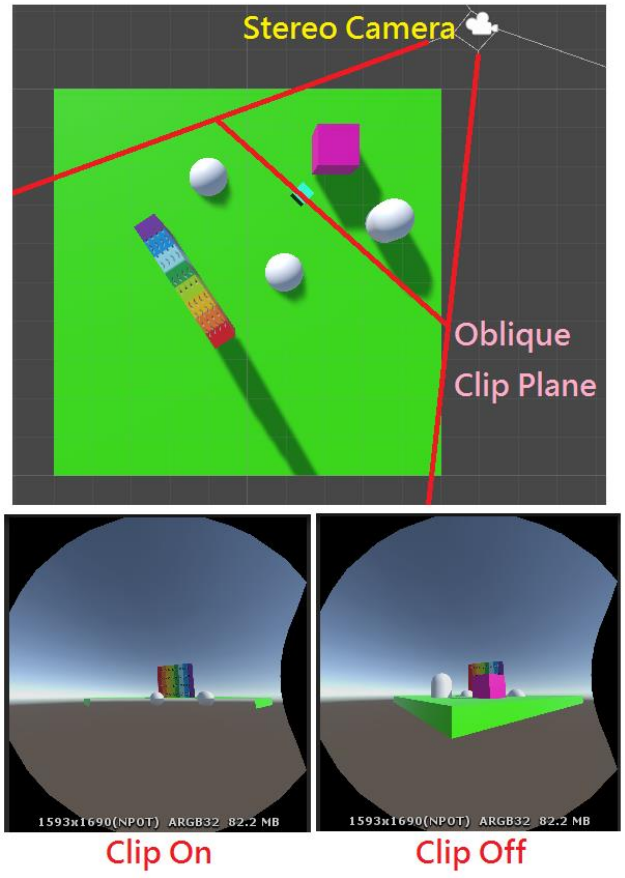


Note that, to make the rendering more robust, we turned off the test when numerical instability is detected. This usually happens when the user view a very large stereo renderer from a short distance (typically < 1m for a 5m x 5m renderer), and from a skewed viewpoint.

(For advanced readers: this is not traditional scissor test, i.e. GL_SCISSOR_TEST, because Unity does not support such test. We can only simulate the test by modifying the projection matrix so the unwanted vertices would be clipped.)

Oblique near plane clipping

By enabling this test, we modify the near clip plane of the stereo camera, so objects that sit between stereo camera and stereo anchor will not be rendered. The effect can be seen in the figure below.



Scripting Reference

- **StereoRenderManager**

  This script should be attached to the object that tracks the pose of HMD.
  If not attached manually, we will attempt to attach the script at run time.

  The manager keeps reference to all StereoRenderers in current scene, and evokes rendering functions of these renderers each frame (just before the rendering of HMD camera starts).

  - `static StereoRenderManager StereoRenderManager.Instance`
    Get instance of this singleton.
  - `void StereoRenderManager.AddToManager(StereoRenderer stereoRenderer)`
    Register the stereoRenderer to manager so it will be evoked.
  - `void StereoRenderManager.RemoveFromManager(StereoRenderer stereoRenderer)`
    Unregister the stereoRenderer from manager.
  - `void StereoRenderManager.AddPreRenderListener(System.Action Listener)`
    Add a callback function that will be evoked just before the first SteroRenderer starts rendering.
  - `void StereoRenderManager.AddPostRenderListener(System.Action Listener)`
    Add a callback function that will be evoked after the last SteroRenderer finished rendering.
  - `void StereoRenderManager.RemovePreRenderListener(System.Action Listener)`
    Remove specified callback.
  - `void StereoRenderManager.RemovePostRenderListener(System.Action Listener)`
    Remove specified callback.

- **StereoRenderer**

  This script should be attached to the canvas, which is the object that displays stereo rendering result. The canvas should be a planar object with a single Renderer. The stereo camera and anchor associated with the canvas are also accessible via this class.

  Since the canvas mesh is not necessarily at the origin of its local coordinates system, you should access the Canvas' pose via CanvasOrigin instead of Canvas.transform.

  - `bool shouldRender`

    If set to false, StereoRenderManager will not invoke rendering of this object.
  - `Vector3 canvasOriginPos`

    The position of CanvaOrigin in world coordinate system.
  - `Vector3 canvasOriginEuler`

    The orientation of CanvaOrigin in world coordinate system, in the form of Euler angles.
  - `Quaternion canvasOriginRot`

    The orientation of CanvaOrigin in world coordinate system, in the form of quaternion.
  - `Vector3 canvasOriginForward`

    The forward vector from the orientation of CanvasOrigin in world coordinate system. (Read Only)
  - `Vector3 canvasOriginUp`

    The up vector from the orientation of CanvasOrigin in world coordinate system. (Read Only)
  - `Vector3 canvasOriginRight`

    The right vector from the orientation of CanvasOrigin in world coordinate system. (Read Only)
  - `Vector3 localCanvasOriginPos`

    The position of CanvaOrigin in Canvas' local coordinate system.
  - `Vector3 localCanvasOriginEuler`

    The orientation of CanvaOrigin in Canvas' local coordinate system, in the form of Euler angles.
  - `Quaternion localCanvasOriginRot`

    The orientation of CanvaOrigin in Canvas' local coordinate system, in the form of quaternion.
  - `Vector3 anchorPos`

    The position of Anchor in world coordinate system.
  - `Vector3 anchorEuler`

    The orientation of Anchor in world coordinate system, in the form of Euler angles.
  - `Quaternion anchorRot`

    The orientation of Anchor in world coordinate system, in the form of quaternion.
  - `Quaternion anchorForward`

    The forward vector from the orientation of CanvasOrigin in world coordinate system. (Read Only)
  - `Quaternion anchorUp`

    The up vector from the orientation of CanvasOrigin in world coordinate system. (Read Only)

- `GameObject stereoCameraHead`

  The camera rig object used to move StereoCamera.

- `Camera stereoCameraEye`

  The camera used to perform stereo rendering.

- `bool shuoldRender`

  If the flag is set to false, the stereo renderer will not be rendered. Default value is true.

- `bool useObliqueClip`

  If the flag is set to true, oblique near plane clipping will be applied Default value is true.

- `bool useScissor`

  If the flag is set to true, scissor test will be applied. Default value is true.

- `void StereoRenderer.AddPreRenderListener(System.Action Listener)`

  Add a callback function that will be evoked just before the this SteroRenderer starts rendering.

- `void StereoRenderer.AddPostRenderListener(System.Action Listener)`

  Add a callback function that will be evoked after this SteroRenderer finished rendering.

- `void StereoRenderer.RemovePreRenderListener(System.Action Listener)`

  Remove specified callback.

- `void StereoRenderer.RemovePostRenderListener(System.Action Listener)`

  Remove specified callback.