Brandon Winkler
4/30/2021

Game Engine Cinematography

(Unreal Engine v4.26)

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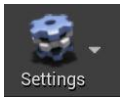
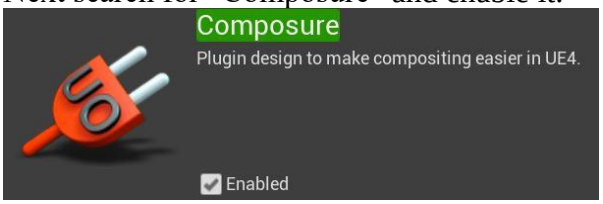
Unreal Engine Setup

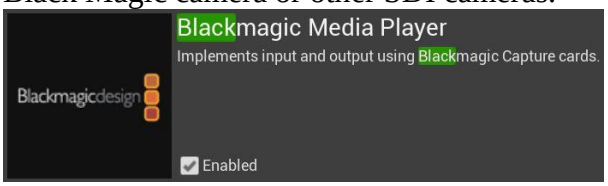
1. Create your Unreal Engine (UE) project.
    - While UE has a virtual production template, we did not have access to this at the start of our project, so this guide will be using the Third Person Game template as a starting point.
2. Once your project opens, click the “Settings” icon 

at the top of your screen.
3. Within the sub menu you then select “Plugins.” 

4. A new window should appear, then at the top right, search for “SteamVR” and ensure this plugin is enabled.
5. Next search for “Composure” and enable it.



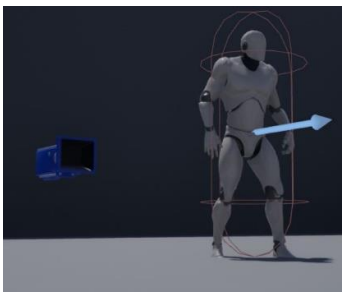
6. Finally, search and enable “Blackmagic Media Player”, if like us, you plan on using a Black Magic camera or other SDI cameras.



7. UE will now need to restart to enable your new plugins.

Creating a Virtual Camera Actor

1. Upon entering your 3rd person game scene, go ahead and delete the default Third Person Character.



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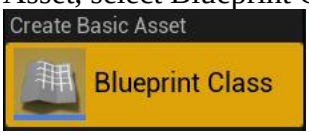
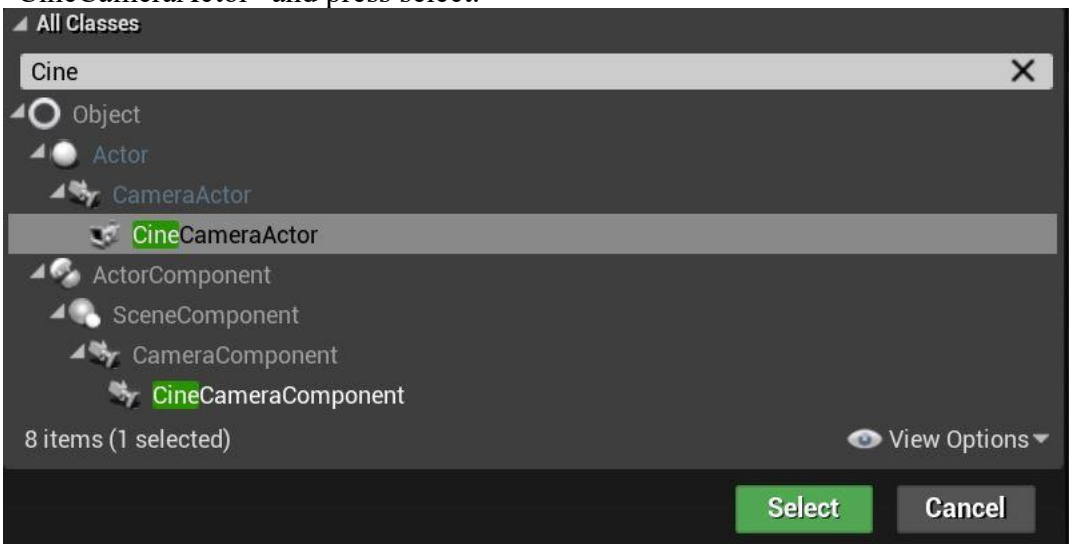
2. Right click within your Content Browser at the bottom of your screen, under Create Basic Asset, select Blueprint Class.



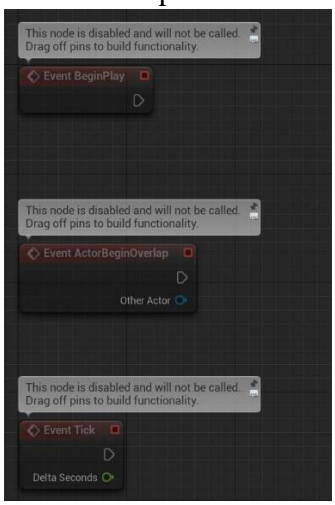
3. In this new window, open “All Classes” at the bottom and search “CineCamera.” Click “CineCameraActor” and press select.

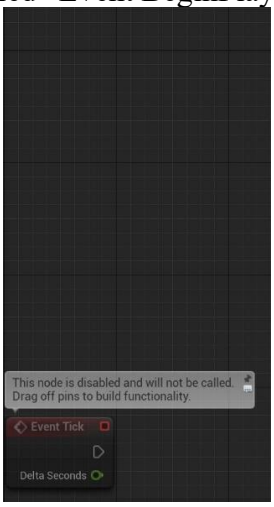


4. You may call this whatever you like, but we are calling ours “VirtualCameraActor.” (VCA)

5. Open your VCA blueprint, by double clicking on it, and switch to the Event Graph tab toward the top of your screen.

6. Delete the top two nodes labeled “Event BeginPlay” and “Event ActorBeginOverlap.”





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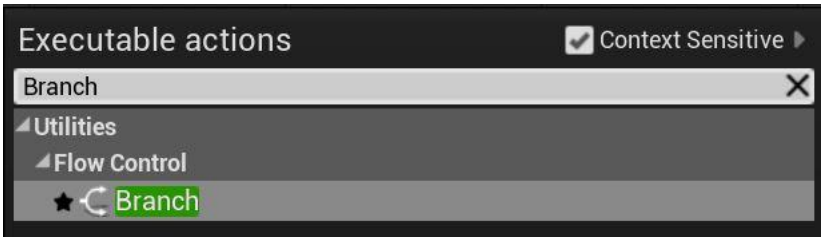
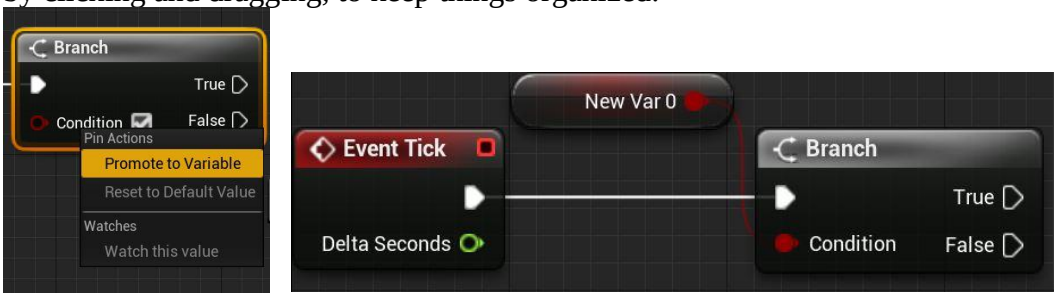
7. Drag a pin, from the Event Tick node, by clicking the white arrow  and dragging. Upon releasing your mouse, you will be prompted with a search. Type in “Branch” and select it.

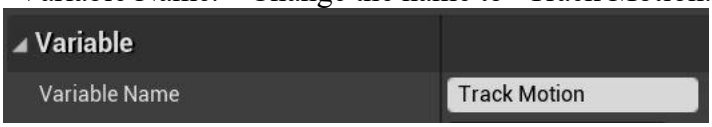


   - An Event Tick means that UE will activate this node once per frame. If your video or game runs at thirty frames a second, then UE will fire this pin thirty times in one second.
   - In UE’s visual scripting language, Blueprint, nodes will activate from left to right depending on certain conditions. In this case, we will be checking a boolean with a Branch, a true or false statement. Depending on if the incoming condition is true, it will fire the true pin, if it is false, it will fire the false pin.

8. Right click the word “Condition”, next to the red pin, and “Promote to Variable.” A new node should appear labeled “New Var 0”, feel free to move things around as we continue, by clicking and dragging, to keep things organized.



9. Make sure “New Var 0” is selected and examine the top right of your screen for “Variable Name.” Change the name to “Track Motion.”



10. Moving to the left-hand side of your screen, you will see your newly named variable listed under Variables. Click the option on the right, indicated by a closed eye, so that the eye opens.

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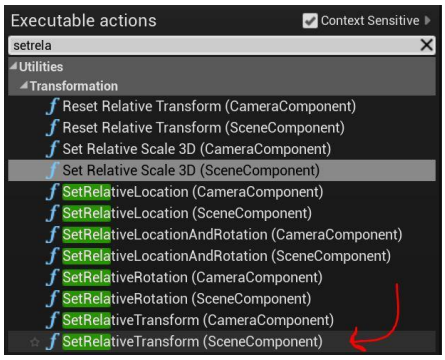
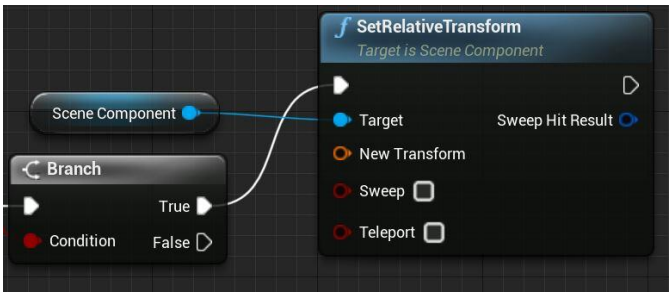
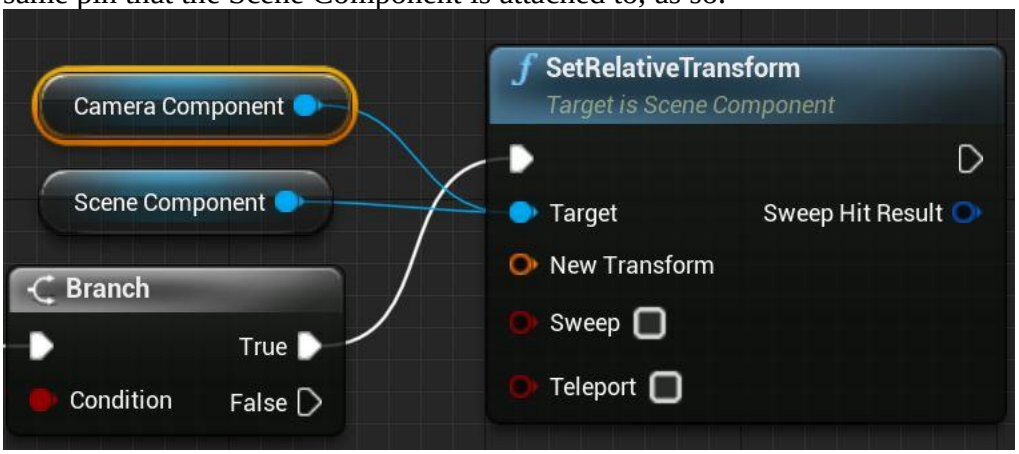
- In coding, there are private variables and public variables. The eye being closed makes the variable private, meaning other objects cannot access this variable. The eye being open turns it into a public variable, this makes other objects able to see this variable.

11. From the Branch node, click and drag from the True pin, and search "Set Relative Transform." This time it will not be the first option given to us, look through this list until you find "SetRelativeTransform(SceneComponent)."





12. We now must attach our camera's relative transform as well, to do this, drag it from the hierarchy, at the top left, onto your canvas. Then drag the blue pin and connect it to the same pin that the Scene Component is attached to, as so.



- The Camera Component will be keeping track of our camera's direction.
- The Scene Component will be keeping track of our virtual reality play area and our position in it.

13. Right click somewhere on the canvas, preferably below the "Event Tick" node for organization. In this search box, type in "Get Tracked Device Position and Orientation."

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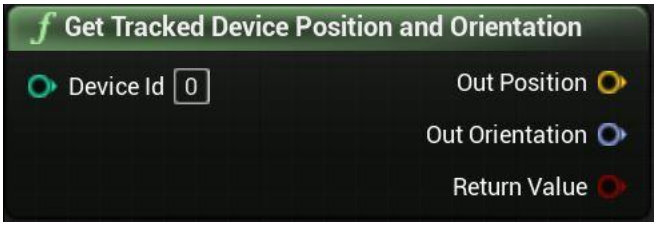


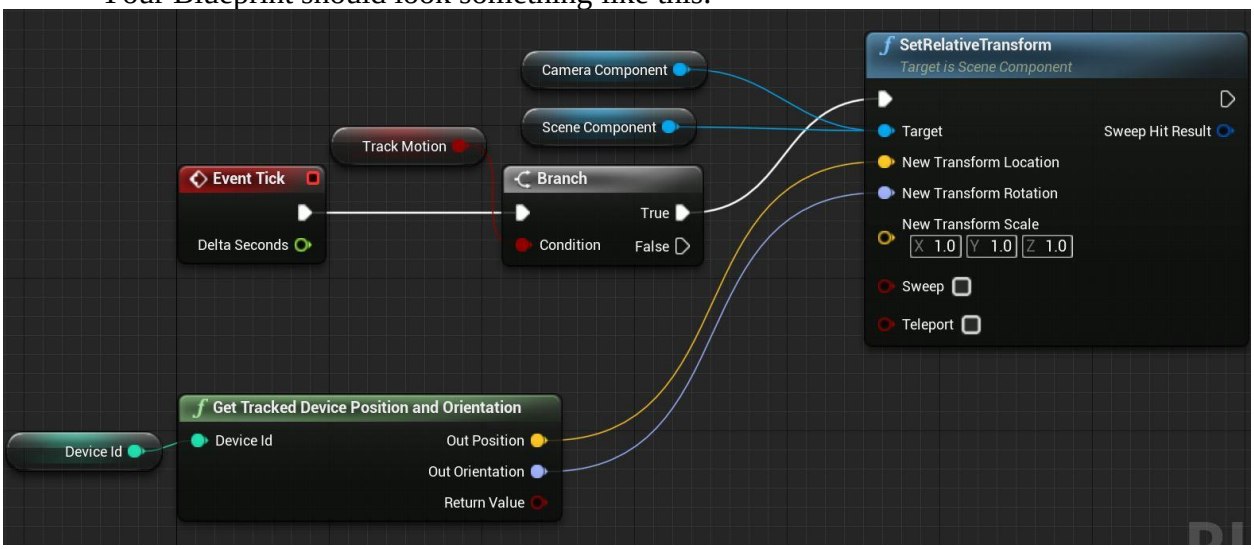
- This node will allow us to track one of our virtual reality device's position and orientation. This includes the headset, controllers, even the base stations.

14. Right click Device Id and promote it to a variable. This time, we will need to change its name to "Device Id", and we still need to make it public by opening the eye.

15. Back within the SetRelativeTransform node, right click "New Transform", next to the orange pin, and Split Struct Pin. Now we can attach our two new nodes.

16. Drag the Out Position pin into the New Transform Location.

17. Drag the Out Orientation pin into the New Transform Rotation.
    - Your Blueprint should look something like this.



- If it does look like this, press the Save button at the top of your screen and then press Compile. If you receive an error, you may have missed a step or have a pin placed in the wrong location!

Activating Our Camera

(These steps will need to be repeated per level.)

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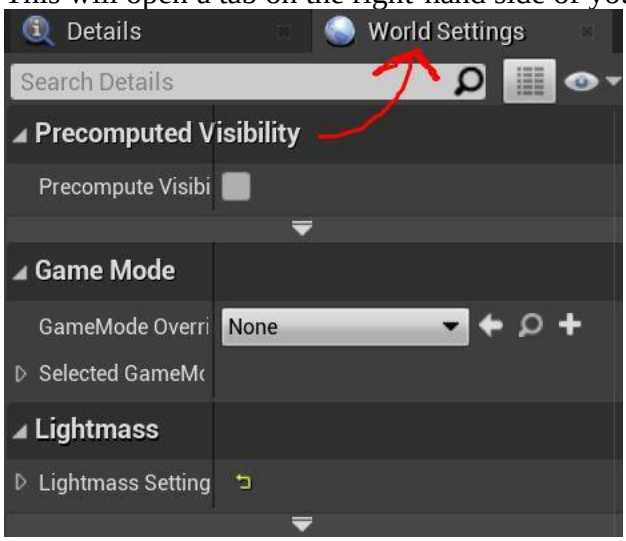
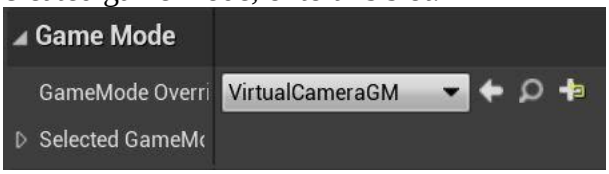
1. Back in UE, not the BluePrint from last chapter, we are going to create an Empty Game Mode. To do this, we need to right click in our Content Browser, select Blueprint Class, and choose Game Mode Base. You may name it what you like, but we will be going with "VirtualCameraGM."
    - This Blueprint will oversee telling our "game" what camera to use since we are changing from the default.

2. Click Window at the top of your screen and make sure World Settings is checked. By default, it is not!
    - This will open a tab on the right-hand side of your screen, that will look like this.



3. Once you have access to World Settings, scan down until you find "Game Mode Override." It will likely currently say "None" as its selection. Drag and drop your newly created game mode, onto this slot.



4. Just below Game Mode Override click the small arrow next to Selected GameMode. This will present you with new options. Change Default Pawn Class to None.

5. Within the Content Browser, drag and drop your camera into the scene. Its location does not have to be specific, but preferably above ground. Make sure your camera is selected, in the world, before moving to the next step! (Indicated by an orange outline.)

6. Now we are going to have a brief change of scenery, at the top of your screen click on Blueprints and Open Level Blueprint. (Make sure your camera was selected.)

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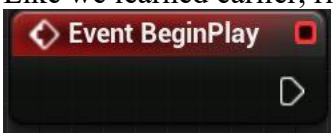
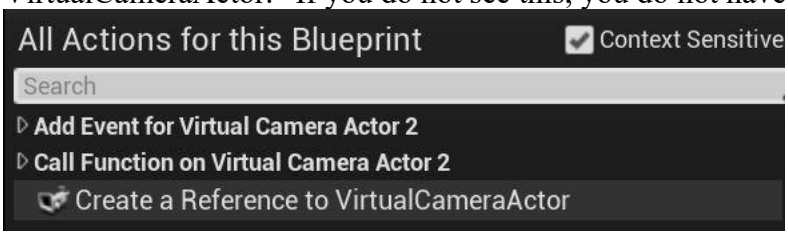
7. Like we learned earlier, right click within the canvas, search “Event Begin Play.”



8. The reason we needed our camera selected was because now we are going to right click in the canvas again and at the top we should see “Create a Reference to VirtualCameraActor.” If you do not see this, you do not have it selected in the world.

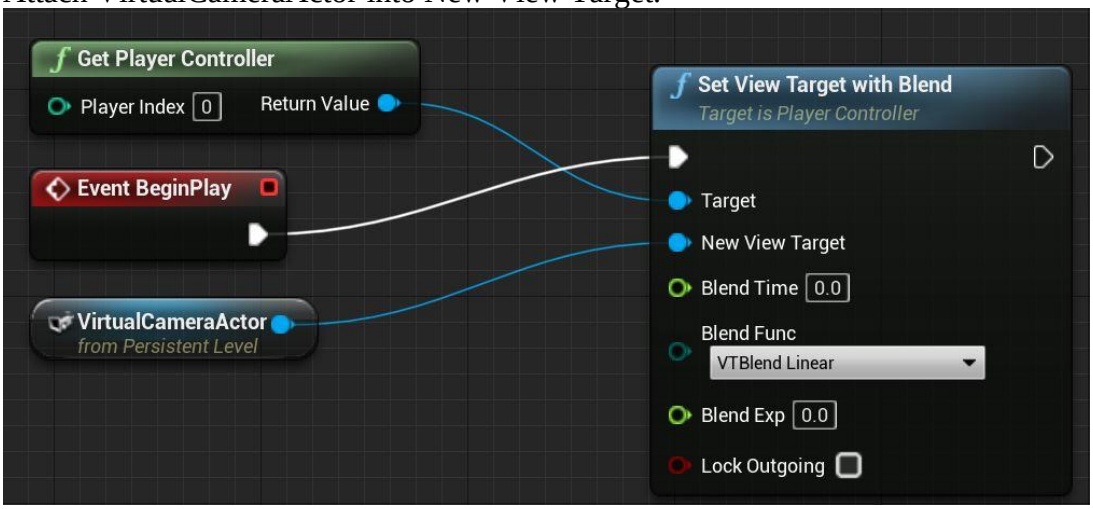


9. Now we will add one last node before we start connecting pins. Right click within the canvas again and this time search for “Get Player Controller.”

10. Drag your new blue pin from Get Player Controller and search “Set View Target with Blend.”

11. Attach Event Begin Play into Set View Target with Blend.

12. Attach VirtualCameraActor into New View Target.



13. Save and Compile.

Positioning our Camera

If you launched your game right now, the camera will automatically be placed at 0, 0, 0 or in other words, the world center. So, this was our way of fixing this issue.

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1. We are going to go back into our level blueprint, by clicking Blueprints at the top of the screen and selecting Open Level Blueprint.

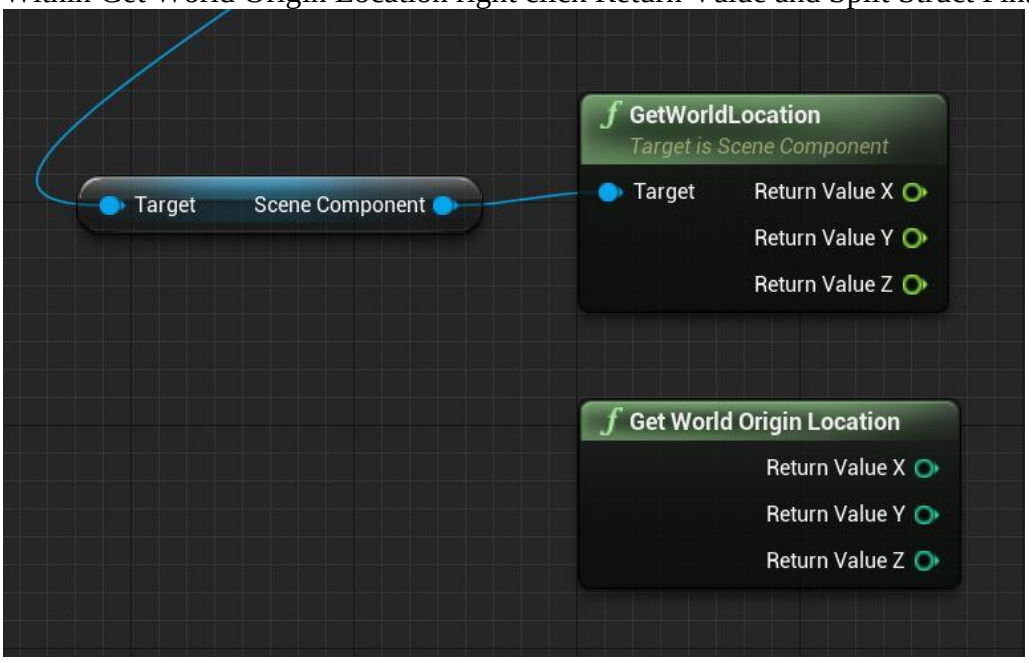
2. Our nodes from last chapter should still be present, click and drag off the blue pin in VirtualCameraActor, and search “GetScene.” Then select Get Scene Component.

3. Dragging from our new node we will search “GetWorldLocation.”

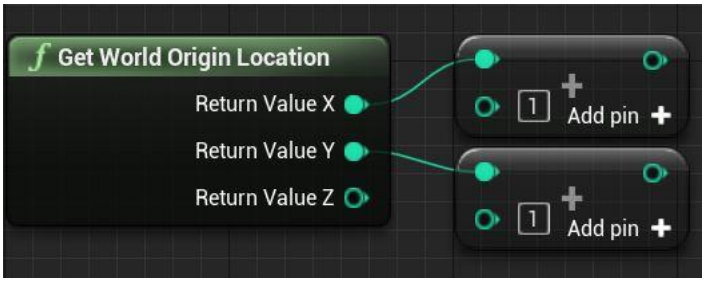
4. Within GetWorldLocation right click Return Value and Split Struct Pin.

5. Right click the canvas and search “Get World Origin Location.”

6. Within Get World Origin Location right click Return Value and Split Struct Pin.

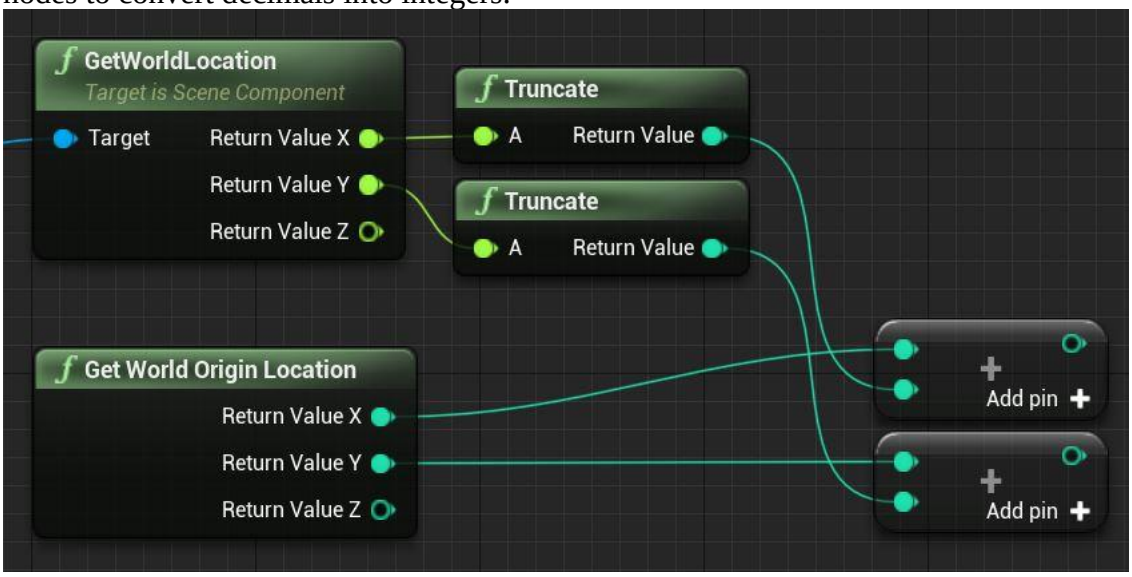


7. From both Return X and Return Y within the Get World Origin Location pull the pins and search “Integer + Integer.”



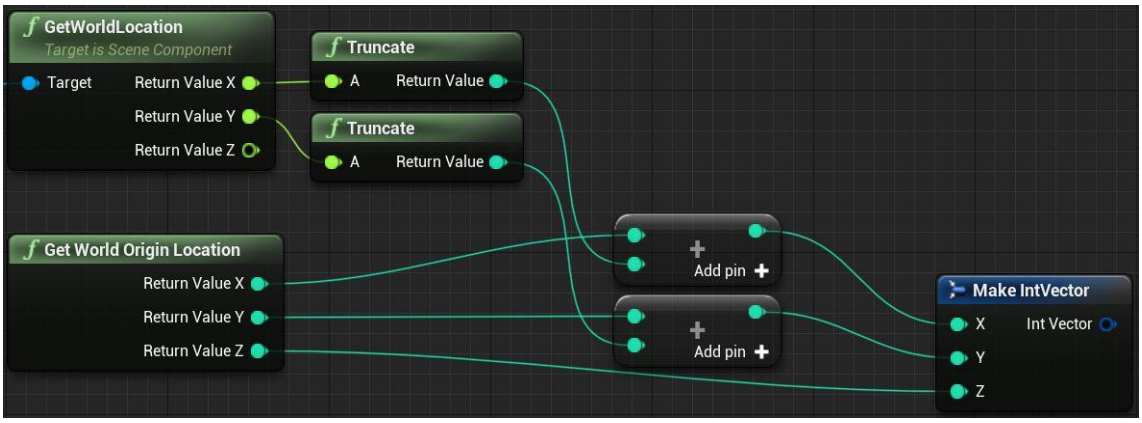
8. Now, within GetWorldLocation, pull the Return Value X pin and plug it into the bottom X integer + integer. Then do the same for the respective Ys. It will create two Truncate

nodes to convert decimals into integers.



9. Right click within the canvas and search “Make IntVector.”

10. By truncating and adding integers we took the two locations and made them integers even though they started as vectors. So now we will return them to vectors after our math. Plug the X Integer pin into the X within Make IntVector, do the same for Y. For Z simply use the original Get World Original Location Z.



11. Dragging from Make IntVector we will search for “Set World Origin Location.”

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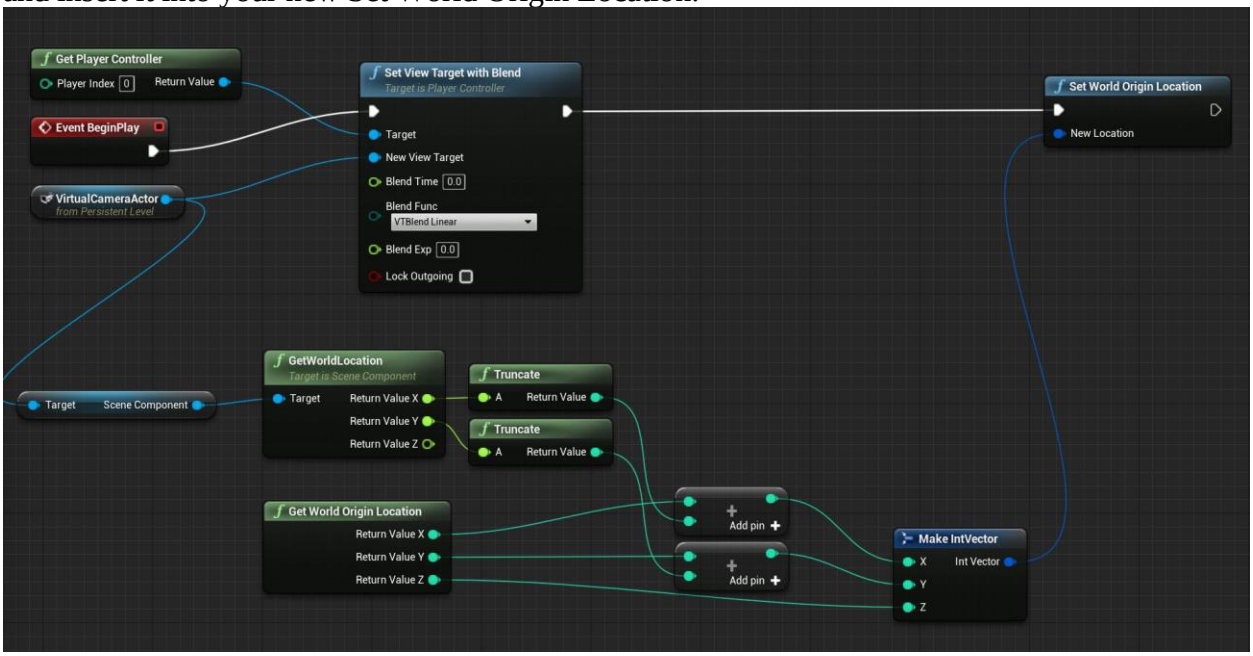
12. From our previous node in last chapter, Set View Target with Blend, drag the arrow pin and insert it into your new Set World Origin Location.

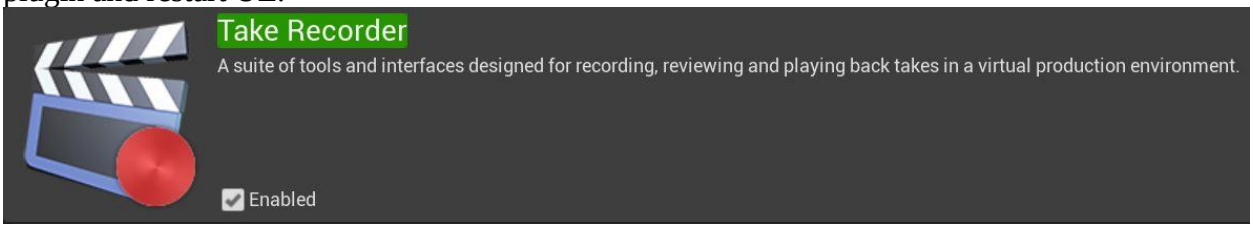


- So, what exactly did we just do? The world origin is default set to 0,0,0. So by adding our camera's X and Y location to the world's origin, we move the world origin to our camera's position. Therefore, no matter where we place the camera, that becomes the world origin, thus solving the issue of the camera always being placed at the origin.
- You do not need to set the Z or height of the camera if you are using a full virtual reality setup and play area. If you are only using a headset then you will want to play with the Z until it feels about the right height.

13. Save and Compile.

Your First Shot

1. To begin recording you will need to activate another plugin, this one is called Take Recorder. At the top of UE click Settings, Plugins, search "Take Recorder." Enable this plugin and restart UE.



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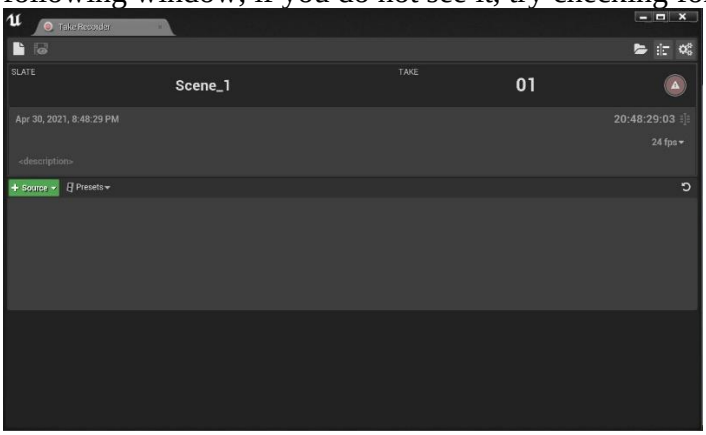
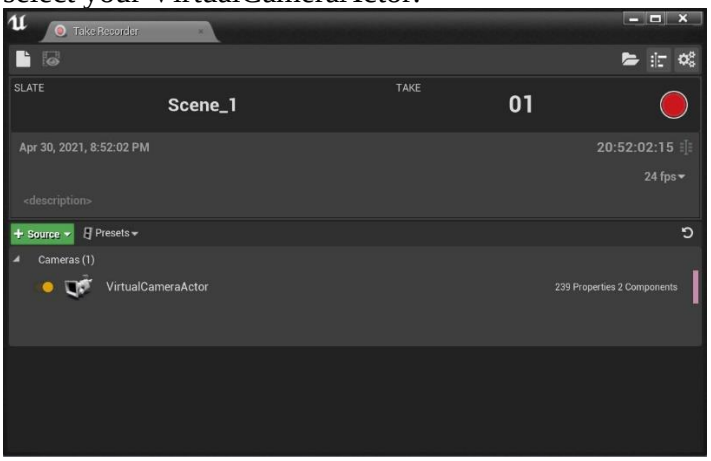
2. Once Take Recorder has been enabled and UE restarted, we can click on Window at the top of the screen, hover over cinematics, and click Take Recorder. This will open the following window, if you do not see it, try checking for tabs in other locations.



3. In the Take Recorder window, click the green Source button, hover From Actor, and select your VirtualCameraActor.



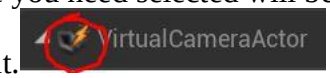
4. Now if you press play in UE, and then press the big red circle in the Take Recorder window, you will get a countdown and begin recording your first shot! Congratulations!

5. After your first shot, a new folder structure will appear in your Content Browser, Cinematics > Takes > *Current Date*. This is where your newly shot footage is stored.

6. The main file  is your master sequence, the folder contains all the subscenes.

7. By double clicking your master sequence, you will be shown UE's Sequencer. In here are all the keyframes that got created while you were moving things around, like the camera!

8. However, we have a small problem to fix, with your VirtualCameraActor selected in your sequence, under the details panel on the right, make sure Track Motion, is unchecked.

    - UE runs the simulation every time you hit play! This means, if you start rendering out your movie, it will begin tracking again and the camera will not move and override your keyframe data!
    - It is important to make sure you have the right camera selected when you turn of tracking. This can be easy to mix up, the one you need selected will be in your sequencer and identified with a lightning bolt. 

If you do not see this when your sequence is open, try pressing the play in Sequencer to make it run through the sequence. Pause when you see the camera you're looking for appear in the scene, and tick "Track Motion" off.

9. Once you have your desired shot, feel free to click save within the sequencer, and render movie. 
    - If you do not set a Filename Format it will default to the level's name.
    - The render preview only shows a small section of the video, do not worry, the whole thing is being rendered.

Composure
(For Greenscreen Use)

1. To access composure, click Window at the top of your screen, and select Composure Compositing.

2. Once open, right click within the window and Create New Comp, then Empty Comp Shot.

3. Right click your newly created comp, Add Media Layer, Media Plate. If you do not see your media plate, click the arrow by your comp to open it up.

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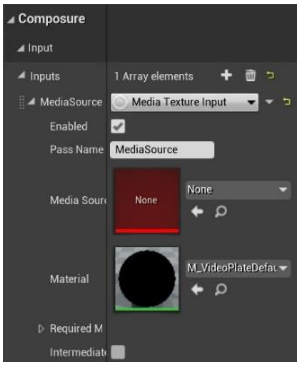
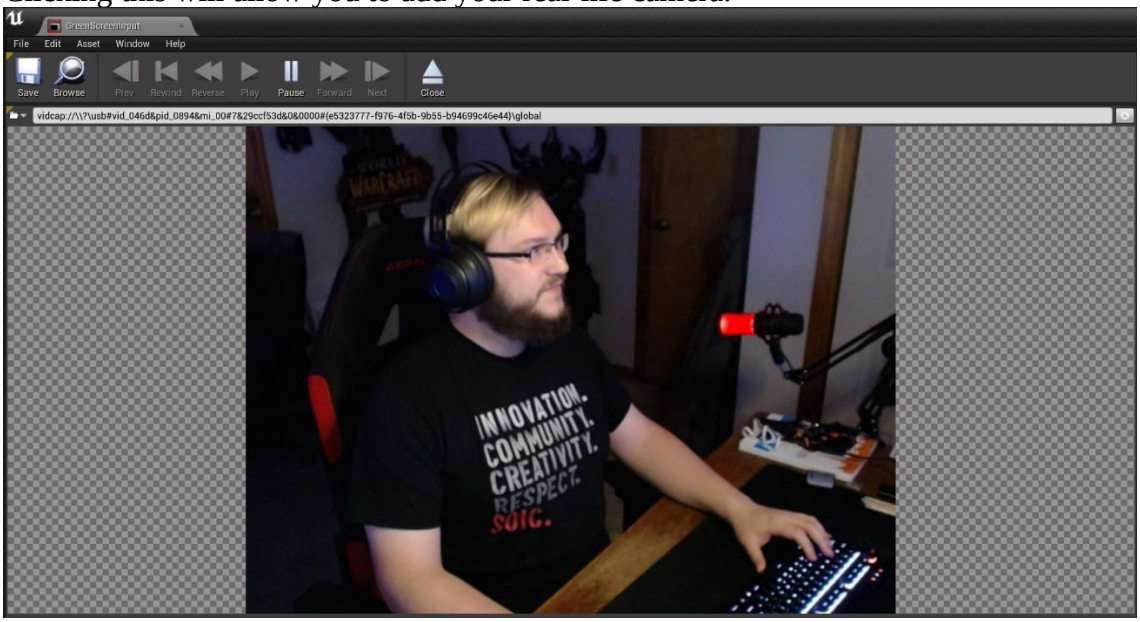
4. Click on your media plate within the World Outliner. Within the details, open Composure, Input, Inputs, Media Source so it looks like this.



5. In your Cinematics folder, within the Content Browser, create a new folder and name it "MediaPlayer."

6. Open that folder and right click within the Content Browser, hover Media, and select Media Player. Name this new file "GreenScreenInput."

7. Open GreenScreenInput, at the top left you will see a small icon of a folder.  Clicking this will allow you to add your real-life camera.



8. Once you have your camera selected, be sure to save before closing GreenScreenInput!

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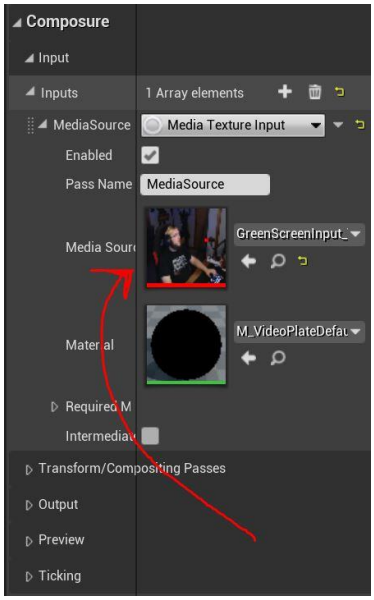
9. This step can get a little different for everyone. In your Content Browser, next to your GreenScreenInput, there should be a file named “GreenScreenInput_Video.” If so, then great move on to step 10. If not, follow these instructions.

    - Right click in the Content Browser, hover Media, and select Media Texture, name it “GreenScreenInput_Video.”
    - Open this file and in this new window, on the right, change the Media Player to GreenScreenInput.
    - Save the file and move on to step 10

10. Drag GreenScreenInput_Video into the media plate Media Source.



11. Right click in your Content Browser, hover Media, and this time we are going to create a Stream Media Source. You can name this what you like but naming it after your camera will help you remember what it is.

12. Re-open GreenScreenInput, select your camera again, but this time copy the address above your camera’s preview.

13. Once copied, open your stream file, named after your camera, and paste this line into the Stream URL.

Starting the Greenscreen Camera

1. Open your level blueprint, by clicking Blueprints, Open Level Blueprint.
    - If you have followed the guide up to the point, the previous nodes will still be here, this is fine!

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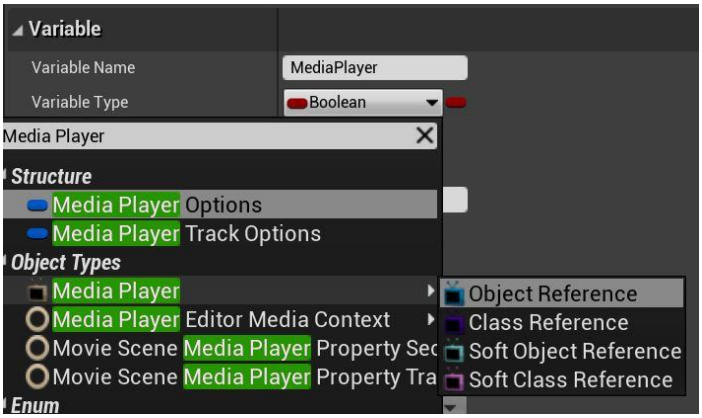
2. Start by making a new variable, by clicking the + next to Variables on the left-hand side of your screen.

3. Name this MediaPlayer, then under the details panel, change the Variable Type. You will search for Media Player, then under Object Types hover Media Player, and select Object Refence.



4. Save and compile this file, but do not close it just yet. With your MediaPlayer variable selected, you should now be able to select the Media Player you created named GreenScreenInput from the details panel.

5. Drag and drop your MediaPlayer variable into the canvas, select Get Media Player.

    - I would suggest placing it above the last node we created named Set World Origin Location.

6. Drag out from the blue pin and search “Open Source.”

7. Now drag the white pin from our Set World Origin Location into Open Source.

8. Within the Open Source node, open the Media Source drop down menu and you should see the Stream Camera you made earlier, select it.

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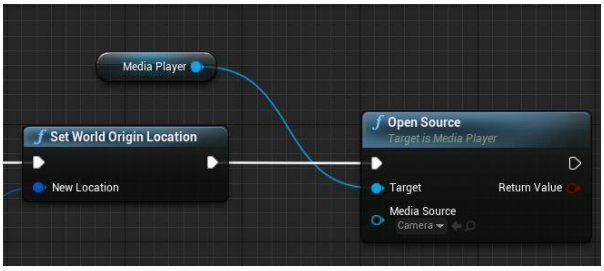


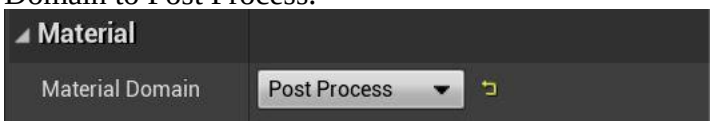
9. Save and compile!

Applying the Greenscreen Transparency

1. Select your comp from the World Outliner. Within its details open Composure > Transform/Compositing Passes > TransformPasses, click the + to add an array element, and name it MediaPlate.

2. Within your Content Browser, right click and create a material. Name it VideoOverlay and open it up.

3. In this new material window, on the left-hand side under details, change the Material Domain to Post Process.



4. We need access to the Blend Mode, so just have the Material Domain search for "Output Alpha" and enable it.

5. Under Material Domain change the Blend Mode to Masked.

6. Right click within the Canvas and search "TextureSampleParameter2D."

7. Then attach the RGBA pin (Not RGB) to Emissive Color.

8. At the top of this window click Apply and Save.

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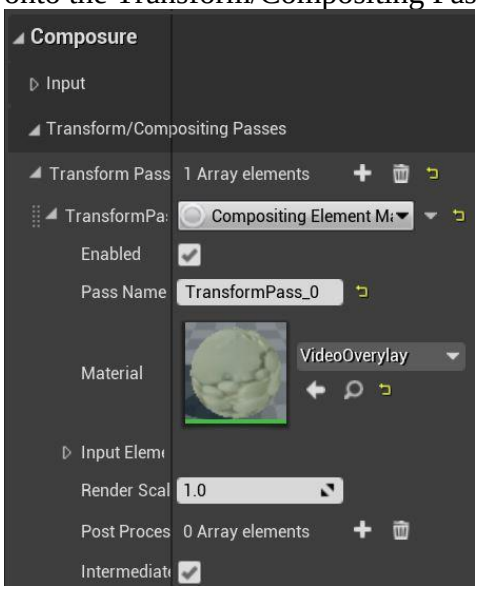
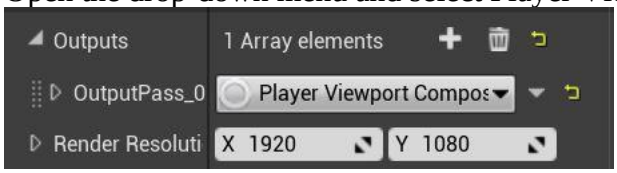
9. Now, with the comp selected in the World Outliner, drag your VideoOverlay material onto the Transform/Compositing Passes Material.



10. Just under your newly added material, open Input Elements. Open the drop-down menu labeled MediaPlate and select your media plate.

11. Still within comp, open Composure > Output and click the + to add an array element.

12. Open the drop-down menu and select Player Viewport Compositing.



13. Back within Composure > Transform/Compositing Passes, add a second Array Element by pressing the +. Expand this new transform pass and name it ChromaKeying.

14. Head into your Content Browser and on the bottom right you will see “View Options.” Open this menu and enable Show Plugin Content.

    - Show Engine Content should be enabled by default, but if not, make sure you turn it on as well!

15. Back over in your Composure > Transform/Compositing > Transform Passes > TransformPass that you just created, click the drop-down menu and search SinglePassDiffColorKeyer.

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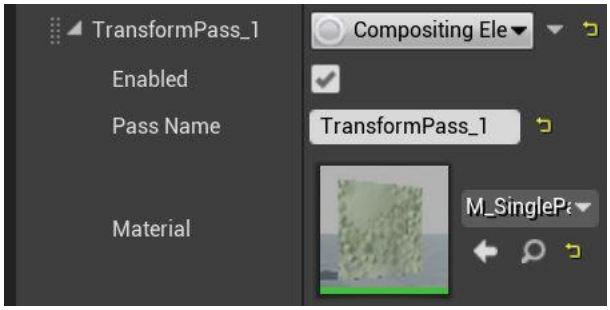
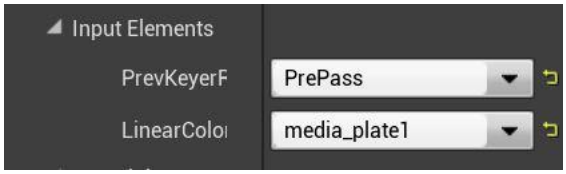


16. Now under Input Elements change PrevKeyerResult to PrePass.

17. Set LinearColorPlate to your media plate.



18. Just under your Input Elements, open the Material Parameter tab. Toward the bottom of this subsection you will see KeyColor, by clicking the + you can now select the color you wish to key.

- If you are just seeing a black screen when trying to select your color, head back to your GreenScreenInput and reselect your camera!
- If you drag the eye dropper tool, it can increase the effect of the chroma key by grabbing a range of greens.
- Feel free to click the Maximize button, at the top right of the preview, to help you adjust the Material Parameter settings.
- Within the Maximized preview, you can open the menu at the top left and turn on and off the alpha to help you adjust.

Placing the World Behind You

1. First, we need to create a new widget, do this by right clicking in you Content Browser, hovering User Interface, and selecting Widget Blueprint. You can name this “Footage Display.”

2. Open this new file, then under Palette, toward the top left, drag an image onto the Canvas.

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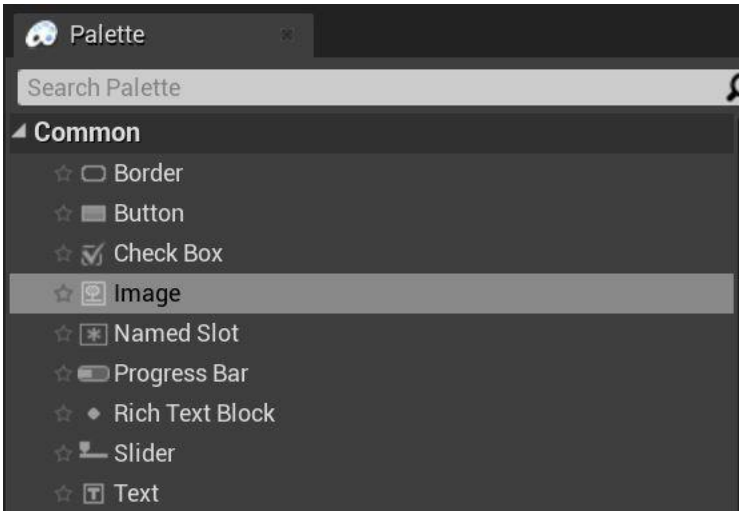
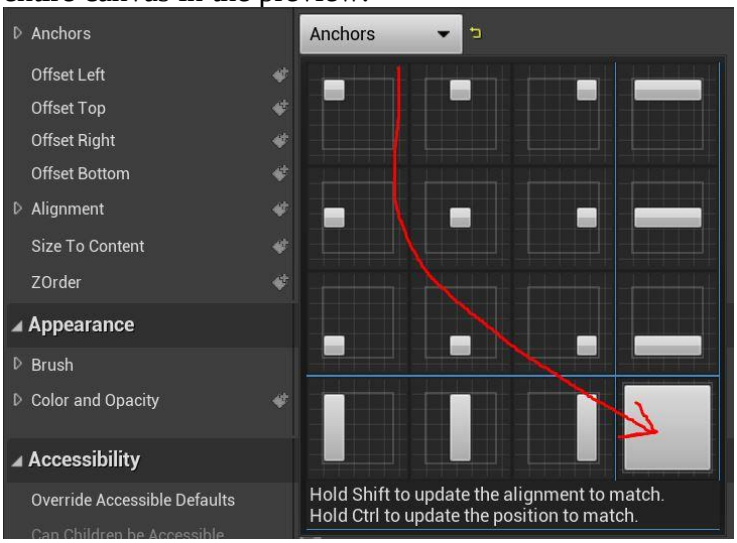
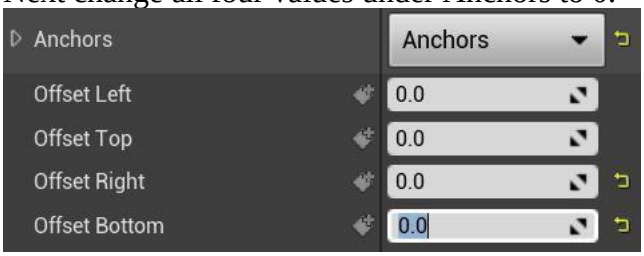


3. Toward the top right of your screen, under Slot (Canvas Panel Slot), click the drop-down menu labeled Anchors and choose the bottom right option. It should be a box that fills the entire canvas in the preview.



4. Next change all four values under Anchors to 0.



5. Save and Compile!

6. Return to your MediaPlayer folder within you Content Browser. Right click within the Content Browser, hover Materials & Textures, and Select Render Target. You can name this “CompositeRenderTarget.”

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7. Return to your FootageDisplay widget, navigate your details panel to, Appearance > Brush, and change the image target to your new CompositeRenderTarget.

8. Save and Compile!

9. Open your level blueprint by clicking Blueprints > Open Level Blueprint. Pull the white arrow pin from your newest node Open Source, and search “Create Widget.”

10. In this node change the class to “Footage Display.”

11. Draw out from the Return Value pin and search “Add to Viewport.”

12. Save and Compile!

13. Head back to your default UE screen and select your Comp from the World Outliner. Navigate to Composure > Output > Outputs and change your OutputPass to Render Target Compositing Output.

Render the Shot

1. Click on Cinematics at the top of the UE screen, select Add Master Sequence.

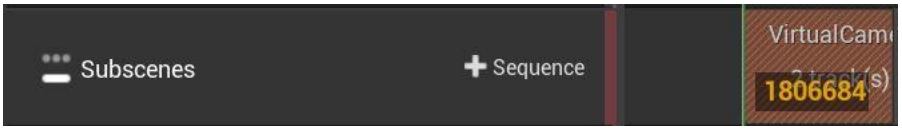
2. Feel free to name it and change the Base Path to what ever you prefer within your project.

    - It should automatically open but if it does not, there should be a “Sequences” folder.

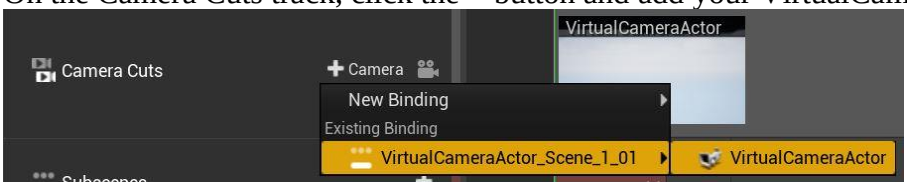
3. Within this new window click the green +Track button and add a Camera Cuts track.

4. Press the +Track button again and this time add a Subscenes track.

5. Navigate to the take you are wanting to render and open the Subscenes folder. Add this VirtualCameraActor file to the sequencer, more specifically to the subscene track you added.

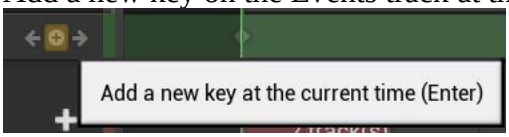


6. On the Camera Cuts track, click the + button and add your VirtualCameraActor.



7. Once again open the +Track menu, hover Events, and select Trigger.

8. Add a new key on the Events track at the starting frame.



9. Right click the newly created keyframe, hover Properties, open the drop-down menu labeled event, Create new Endpoint.

10. Open your level blueprint, by clicking Blueprints, Open Level Blueprint. Copy the last two nodes we added, creating the widget and adding to viewport. Go back to the newly opened window, Sequence Director, and paste these nodes.

11. Attatch the SequenceEvent_0 to the Create Footage Display Widget.

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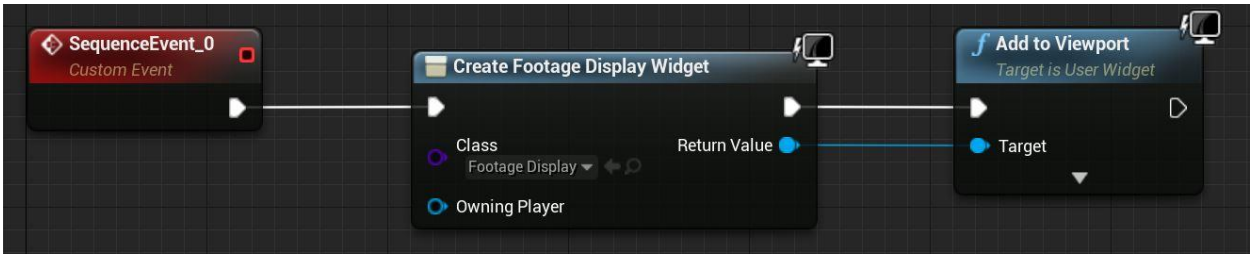
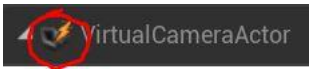


12. Heading back to the Sequencer window, double click your subscene track, and check for a lightning bolt on the VirtualCameraActor, click on it. In the details panel navigate to Default > Track Motions and turn it off if it is on.



13. You can now go back to the main Sequence Master page and click the  icon to select your prefered settings and render your movie.
    - If the video is going extremely fast, this is a downside to using UE sequencer for some users. If this happens, go to your level blueprint, search for the Open Source node, and change the media source to image sequence.
    - Right click in your Content Browser, hover media, and create a Image Media Source. You can open this file and select your first image in the sequence and it will automaticaly identify it as a sequence.
    - Re-open the master sequence and render your project.