

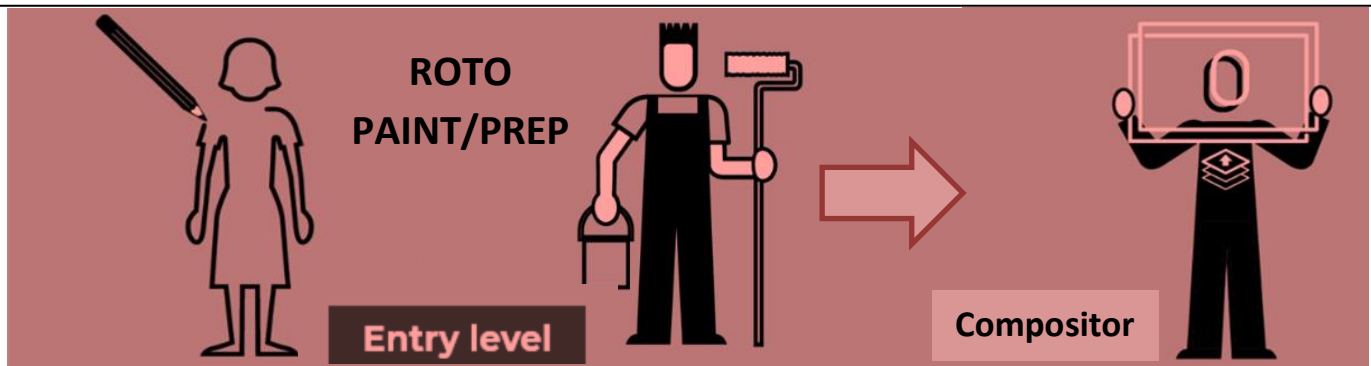
# **ZERO GRAVITY**

A final Major project by JOHN OVUSON

# AIMS/OBJECTIVE

My primary objective of this piece is to create a photorealistic piece; highlighting acquired skillset across the course.

- To create shots worthy of upgrading my showreel. According to renowned compositor – Josh Parks, an aspiring compositor should demonstrate Projection, CG integration, Keying, and Color Grading (Parks in Foundry, 2020). At the point of documentation, my 2020 showreel didn't have a decent CG integration and I wanted to use this project to feature CG in my 2021 showreel.
- To showcase entry level skill for a compositor in the industry – Roto, Paint/Prep (ScreenSkills, no date).
- To showcase a good level of compositing using Nuke in a bid to acquire a job upon graduating.



My secondary objectives include:

- To acquire and demonstrate more skill in FX using Houdini
- To create a creative artistic piece from pre-production till post production.
- To extend my collaboration with other departments – Animation, sound, etc.



# SCIENCE OF GRAVITY

Newton's law of universal gravitation

$$F = G \frac{m_1 m_2}{r^2}$$

$F$  = force

$G$  = gravitational constant

$m_1$  = mass of object 1

$m_2$  = mass of object 2

$r$  = distance between centers of the masses

- Gravitational impact is subject to the object's mass and relative to the distance of the object away from the center of the earth.
- Upon gravitational impact, speed of object towards the ground increases at  $9.81\text{m/s}^2$  (every second).
- Gravity is responsible for our experiencing impact of weight.



## WHEN GRAVITY = 0

- There is no force ( $F$ ) impact on object/matter.
- Movement/direction is dependent of micro forces like wind, and external push; with object's mass playing NO ROLE.
- We feel NO impact of weight.

# RESEARCH: ZERO GRAVITY

I began by researching into recorded footage of real-life zero gravity; with keen interest of observing the physical attributes of the objects experiencing zero gravity. I looked into footage from NASA, as well as other filmed experience of zero gravity. I found the music video – Upside Down and Inside Out (by OK Go) very interesting as the entire video was shot in actual zero gravity.



I also looked into VFX shots that recreated the zero gravity experience, at this point, I was trying to observe the similarity/difference between live-recorded zero gravity and VFX recreation/simulation.



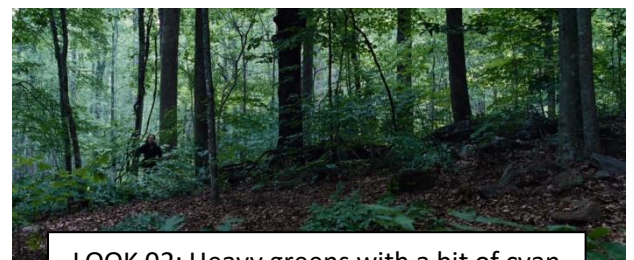
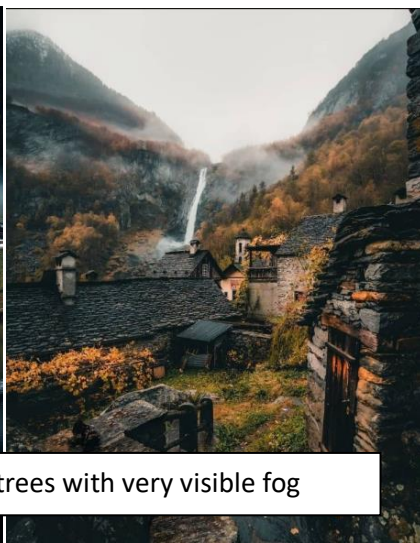


# PRE-PRODUCTION

I have learnt from experience to never 'fix it in post'. So I was considering the final look of the piece as early as the preproduction stage – Color, viz-a-viz costume as well as framing. Due to the Covid limitations, I wanted to go for an outdoor scene (to reduce my lighting considerations and extra hands involved); a place with limited people moving around, and I decided to film in the woods at the Three Bears Cave and looked into reference photos of how the woods have been nortraved and colored.



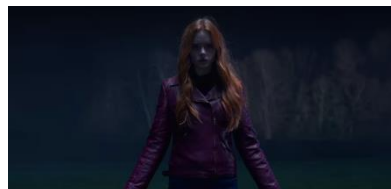
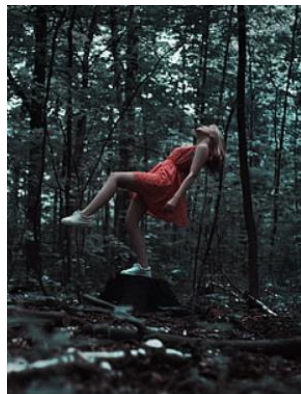
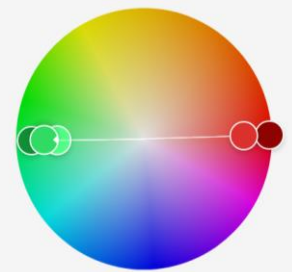
LOOK 01: Brownish trees with very visible fog



LOOK 02: Heavy greens with a bit of cyan



I decided to go with a red costume for the character and this is based off of the principle of simultaneous contrast as described by Brinkmann (2008:17) – “a color will appear more vibrant and saturated when surrounded by complimentary colors – red surrounded by cyan or green”. Looking at the examples below, the red outfit tends to stand out when surrounded by green/brown.



# CINEMATOGRAPHY



Based off the predetermined look, I decided to film with a camera that had a high dynamic range – so as to be able to explore and push different aspects of the color palette. I settled with a Black Magic 4k Cinema camera.

To further expand the color contrast captured on camera, I decided to use Roto-lights to serve as a secondary illumination for the scene. The plan is to use the gels to compliment the environmental light of the scene.



I expect most of the scene to be tracked, and with that in mind, I opted to use a DJI ronin MX gimbal for smooth camera movements. Worst case scenario, I'd add a camera shake within Nuke (If the scene absolutely needs it).

I was sure to get help with filming from my housemates, who have become quite knowledgeable with the filming equipment (by virtue of assisting me with filming since the initial lockdown back in March, 2020).



# STORYBOARD

With the primary aim being to showcase skillset; I decided to go for a straight-forward storyline – A scientist who discovers a location in the woods that has a zero-gravity field. I was very much interested in the cinematography so I planned all the way into the framing and costume. Finally, in line with the Government regulation, I was sure to complete the Covid-19 training test, as well as risk assessment procedure and I handed in a filming application to the Cardiff Film Council as well as the Natural Resources Wales.



SHOT 1: Medium shot of scientist, as she reports disappointing observations in research.



SHOT 2: Close up of scientist in awe as she sees something remarkable..



SHOT 3: Wide shot of scientist as she walks towards the setup barricade in the location



SHOT 4: Close up (over shoulder) shot of scientist in close proximity with a view of the floating rocks.



SHOT 5: Medium (side view) shot of scientist in making a closer observation.



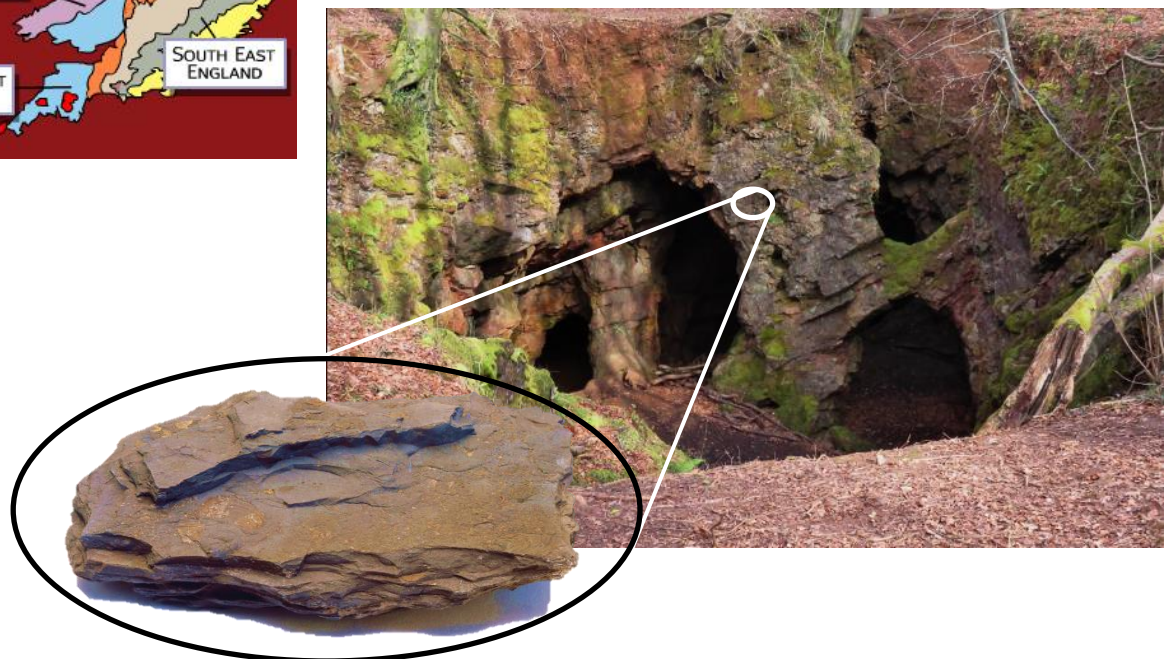
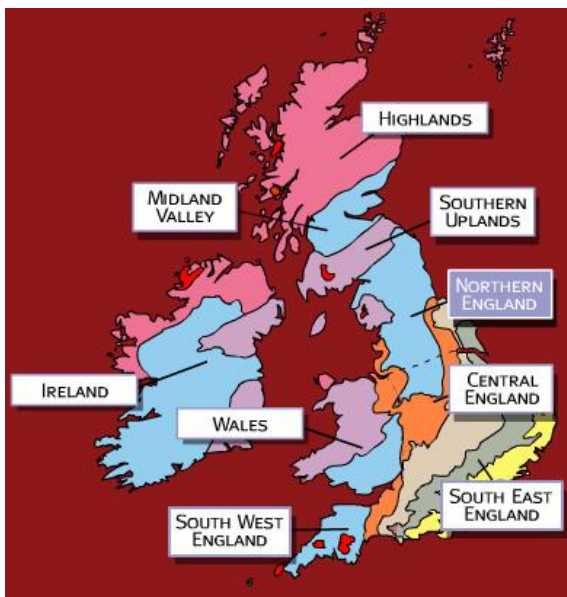
SHOT 5.1: Medium (side view) shot of scientist in doing a scientific reading of the force field

[VIEW ANIMATIC](#)

Sadly, I experienced a major setback with the execution plans as the Natural Resource department informed me that the filming application I sent in would take 12-15 weeks before it gets approved and this project absolutely cannot wait that long. I had to go back to the drawing board to rethink of another location to film. Eventually I decided to film in a friend's house, because I wasn't ready to reapply for another filming location as time wasn't on my side. The repercussion however, was the fact that I had to rewrite the story to suit the new location. I decided to go for another straight-forward story – a lady who on hearing breaking news report of an anti-gravitational force field in her vicinity, goes to witness it in awe.

# RESEARCH II: ROCKS

Because I was going towards having floating rocks, I researched into the kind of rocks found in my predetermined location; and found out that according to Open Academy (2019), the area is made up of sedimentary rocks, particularly Shale and Limestone. I also went to the location to verify my findings.



Due to the unexpected change, I had to carryover the costumes and the equipment decisions and work around the new change.



# SHOT 2: CINEMATOGRAPHY

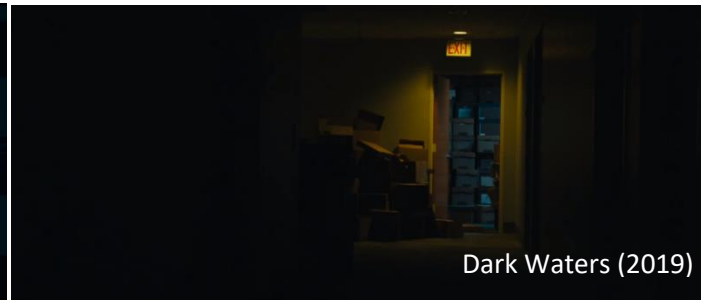


Shot 2 was going to be a sneak peek into the catastrophe going on. I planned on having a piece of rock floating in the scene; which will only be visible on the reflection of the window, as well as the shadow being casted on the wall. Although, it will reveal a bit of the ongoing situation, the intention is to draw the eyes of the viewer towards the character, whilst she is observing the situation.

I adopted the 'Rule of Thirds' when filming this shot; an idea I got from a shot in 2019's 'Dark Waters'. As seen below, the eye is automatically drawn towards the window with the light, because of its contrast as well as the moving elements behind the window. Other examples of its use include 2014's 'Kingsman: The Secret Service'.



Dark Waters (2019)



Dark Waters (2019)



Kingsman: The secret Service (2014)

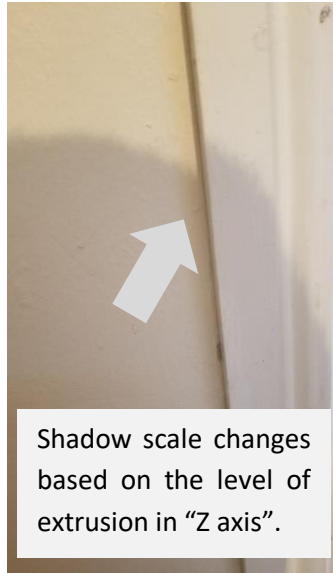


# SHOT 2: RESEARCH

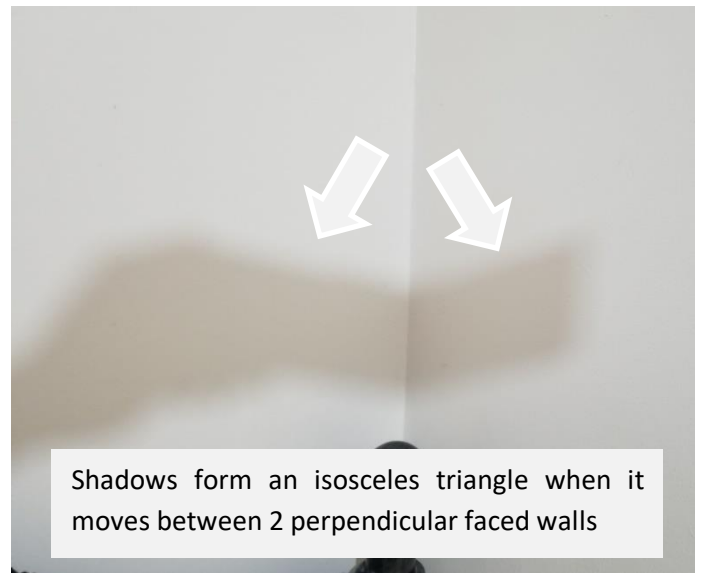
I made a few observations on this shot – The windows are partly reflective and partly transparent, the actress although was putting on a red outfit; was also barely visible. I made an in-depth research into the look/appearance of shadows and its properties, in relation to surfaces as well as its interaction with (partly transparent) reflections; so as to mimic it in my composition.



Shadow angle is dependent on light source and surface



Shadow scale changes based on the level of extrusion in "Z axis".



Shadows form an isosceles triangle when it moves between 2 perpendicular faced walls



When the shadow is blocking direct light, you see a clear cut difference; with reflection becoming more visible.



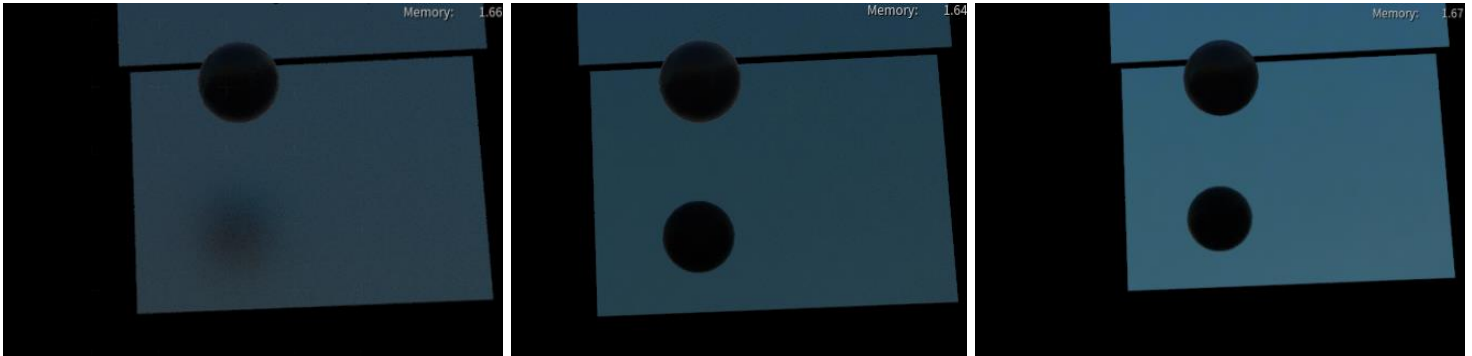
When a reflective object is being lit by indirect ambient light, the image captured by a camera from a distance shows a mirror-like reflection. This result depends on how lit the reflected object is.



Executing any of these effects requires 3D track information; which I did using a model builder and a camera tracker after which I exported the alembic scene into Houdini.

# SHOT 2: FX

My first goal was to get the reflection right and I achieved this using a lot of trial and error. I modeled a flat geometry at the exact position as the model builder card and experimented with the principled shader properties until I got a decent look.

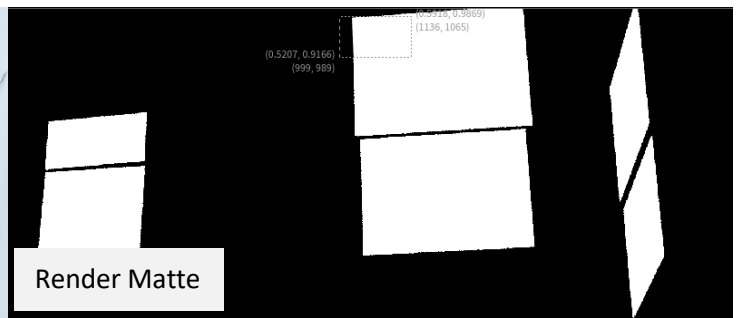


## PROBLEM SOLVING

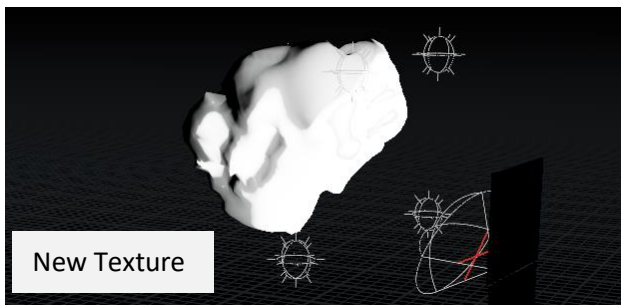
I still wanted to keep the idea of having a piece of rock floating because my friend/course mate (Tsvetelina) had already modeled and textured a rock for me. To that effect, I had the rock at a specific angle; relative to the sphere and away from the render camera. This gave me an excellent result after animating but unfortunately, the reflection pass doesn't come with an alpha. Doing a luminance key gave really strange results at the edges and I ended up re-rendering the geometry with a plain white texture (and make it properly lit around the edges); which I later used to pull out a matte for the reflection pass.



Reflection Pass



Render Matte



New Texture



Matte result

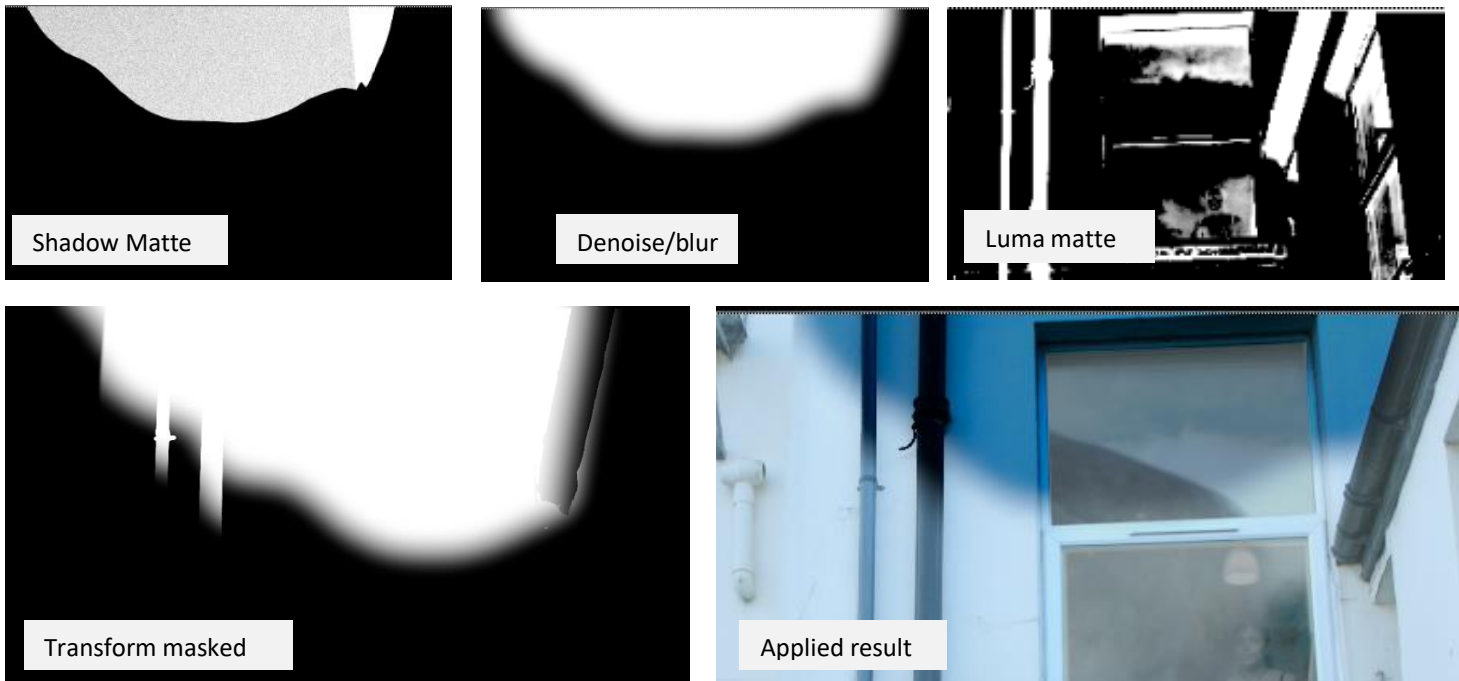


# SHOT 2: COMPOSITING

Similar to the window shot in dark waters, I made the window (with the character) more contrast, with the rock less visible; while I made the window above her less contrasted with the rock more visible.



From experience, I've learnt to treat shadows as separate elements and based off that school of thought, I treated the shadow as a different element. I made a rough model of the building and created a shadow matte and used it as texture. This gave me an excellent result within an hour of render time. Although the render came out with a lot of grain, I knew I could fill it in Nuke using an erode node. Compared to the wall, the pipes on the building are closer to the camera (therefore, the shadows should look bigger); so I used a luma key to separate the shadows and perform the sizing of the shadows.



As a final bit of finessing, I added 2D fog into the scene, in which I projected in 3D space to using the already tracked camera and point cloud.

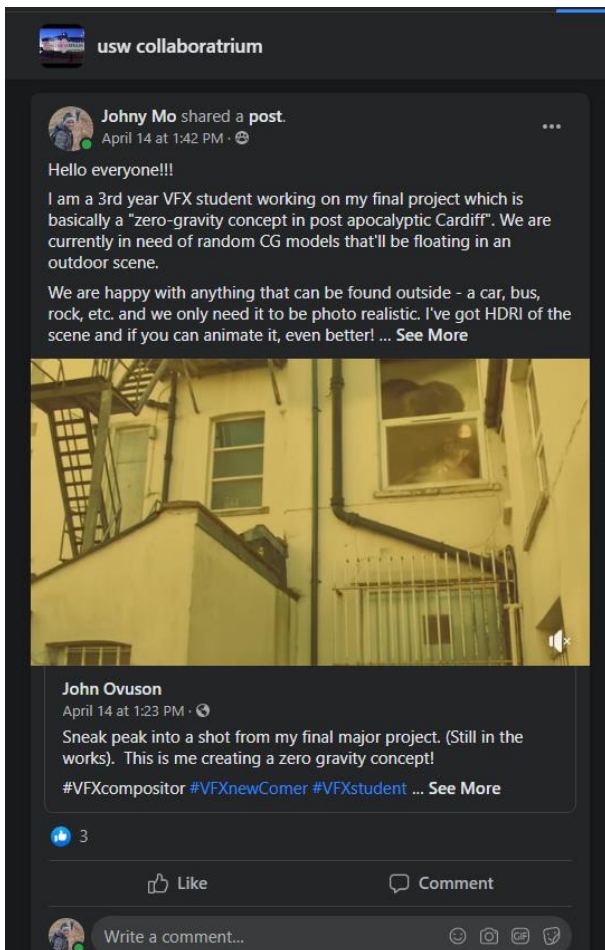
# SHOT 3: CLEAN UP

As at time of documentation, clean up and paint/prep is one of my strongest skills. However, this shot came with its challenges. Apart from the moving cars around, there were some minute details that needed fixing and I was sure to attend to every one of them.

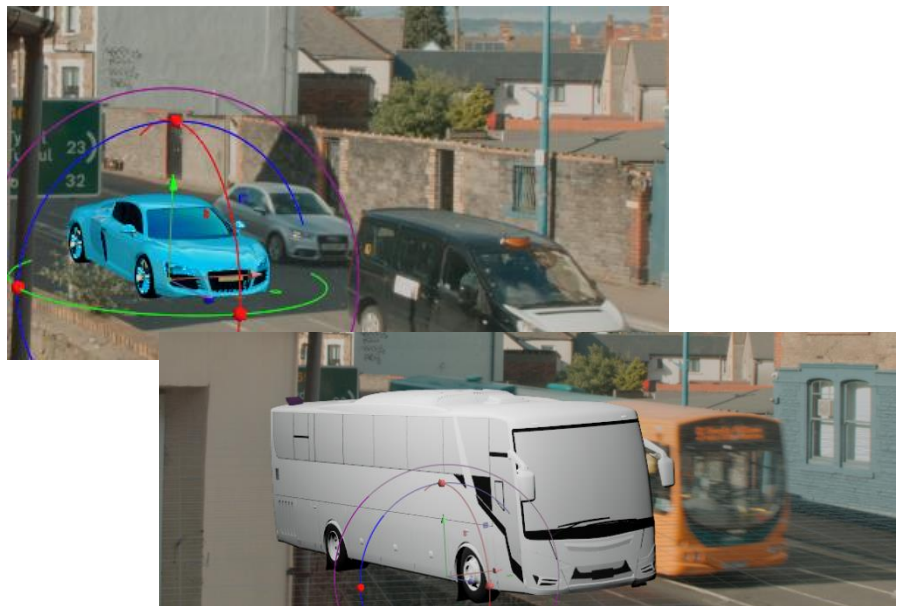


Surprisingly, I couldn't do a projection for this shot. The camera tracker tracked the scene like it's a flat surface (due to the fact that it was filmed through a window). I ended up using a 2D track with lots of frame-by-frame painting. Eventually, the job was done successfully. The plan at this point was to focus on the cleanup, whilst someone else models random objects that'll float within the scene. That way, I can jump straight into compositing once I'm done. At this point, I hadn't decided on what kind of object would float and where; I was taking more of an open approach because I wanted to work off the strength of the potential animator.

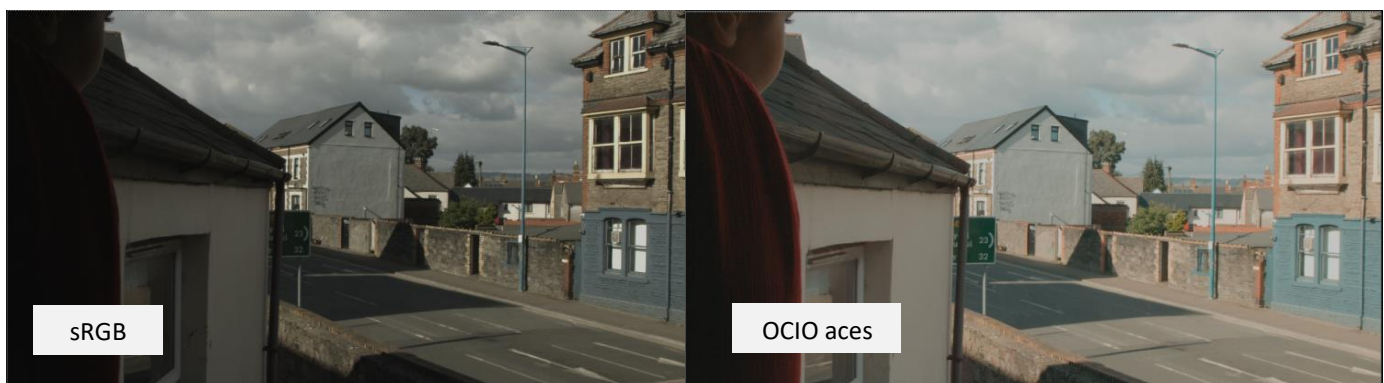
# SHOT 3: SETBACK



Shot 3 was supposed to be my 'money shot' and although I reached out to people via the 'collaboratrium' I got no response after 2 weeks and I decided to face the road alone. Although my friend who made the original rock was available, she was busy with her own project and couldn't model and animate another CG in time. I ended up going to TurboSquid (no date) to find free models I can integrate and I used the original plate to compare and be certain of the right size of the model. To be on the safe side, I rendered many layers of the beauty pass as well as a CryptoMatte of all the materials.



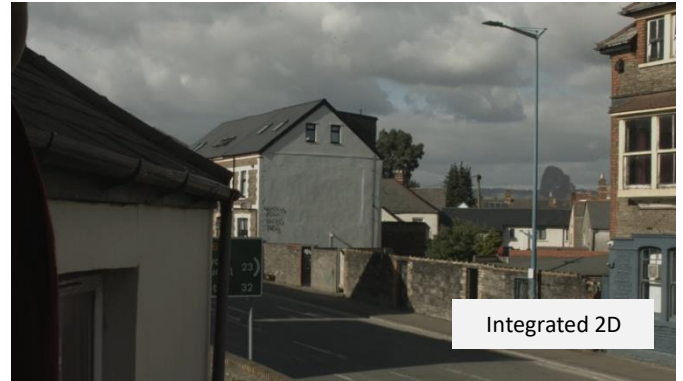
I came across the OCIO aces color space and I thought I'd give it a shot so as to facilitate my integration in Nuke. I found the color space really interesting!



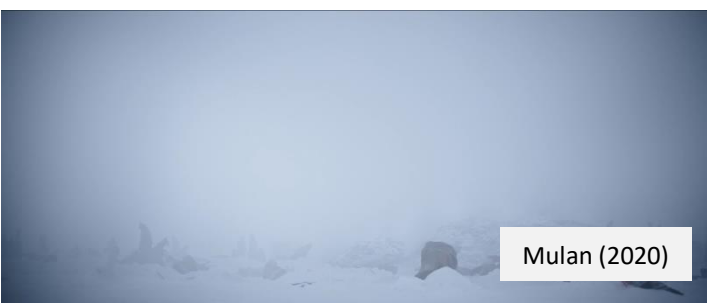
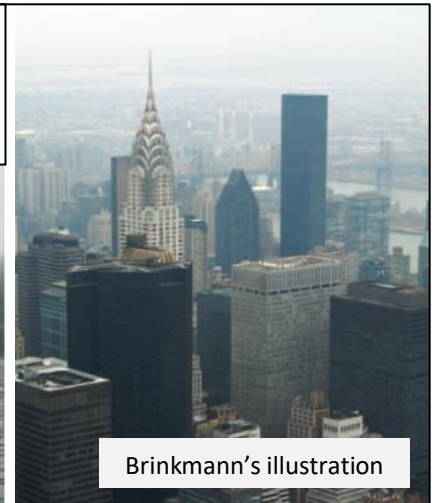


# SHOT 3: COMPOSITING

I couldn't help but notice some sort of cognitive lines in this shot, leading towards a certain point in the frame. Based off that, I decided to do add an element just at the meeting point and I ended up reusing a frame from the CG in shot #2 and do a subtle 2D animation.



Brinkmann (2008) pointed out that fogs could give a good sense of distance between objects and this technique was used in 2017's Kong: Skull Island as well as 2019's Rim of the World and Mulan (2020).



# SHOT 3: INTEGRATION

I added layers of 2D fog using a noise and tracked each layer of fog to the area it should appear.



After texturing the bus using basic colors in Houdini, I tried to recreate the scene and its lighting and reflections from the HDRI I captured on set. I rendered out the CG with multi-pass layers, as well as a Cryptomatte ID. I also rendered the shadow mattes as 2 different files – a shadow matte for the floor as well as the bus; after which I matched it to the existing shadow in the scene.



After rendering the bus out of Houdini, the look of the bus was nowhere near satisfying. I had to add more textures using projection techniques onto the backed animation (rendered out as an alembic scene). I also added bumps and used the projection textures to mask the smooth reflections.



# SHOT 3: CG 2.0

Eventually, my friend/course mate (Tsvetelina) was able to texture a bus model to look like an actual Cardiff bus. I was happy to start the 3D integration from the scratch – This implied having to take the new model and assets into the (setup) scene in Houdini and re-render a shadow matte.



CG Asset



Road shadow matte



Matching bus on plate

I couldn't help but notice that the glass on the CG wasn't capturing some reflection, so I took the alembic file into Houdini and rendered the glass element only. Also I did a 2D projection of dirt and crack on the model. Finally, I created bump maps in Nuke to give the model a more 3D look.



CG glass error



New glass pass



Dirt & Glass Projection



Bump Boss



Relight + Additional Texture

As a final touch to this integration, I added lights on both lamps of the bus (using the Cryptomatte ID); with one lamp being fully on, and the other being partially dim. This was to further fuel the sense of anomaly/disaster.



# SHOT 3: CREATIVITY

All digital effects at this point were based on photorealism and I wanted to throw in a bit of creativity. To that effect, I decided to add a bit of lens flare (caused by the active light on the CG against the lens). Based on that, I did a bit more research on real lens flares as well as stylized lens flares.



Alanis Morissette - Big Sur



Shadow n bone S1:E4



Iron man

Based on what I saw, I decided to do a less pronounced flare because it was filmed during the day.

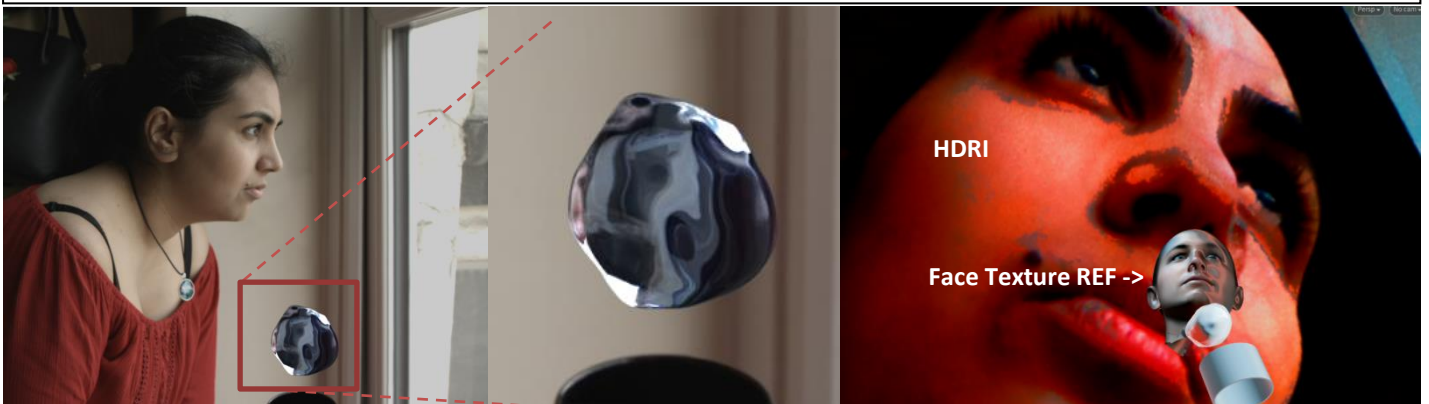


# SHOT 4: ANIMATION

I belong to the school of thought that believes VFX is meant to amplify practical effects so when filming this shot, I inculcated the use of wires to give the illusion of zero gravity after which I painted out the string. Although this seemed like a straight forward shot, I wanted to make sure that it looked as close to realistic as possible. I added a bit of glint on the pendant and I also looked into how fluids react when exposed to zero gravity; turns out fluids don't have the ability to wet/splash solid objects as displayed below. Also the fluid keeps its wobbly nature and its attributes appears as though it's semisolid in nature.



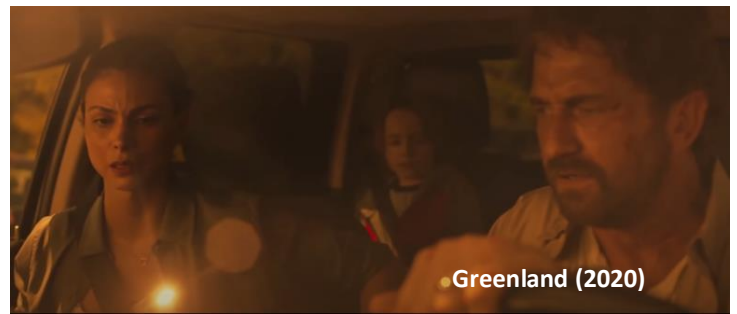
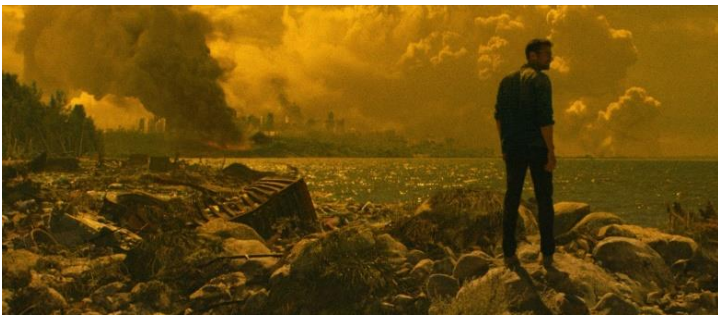
Interestingly, Houdini had a water shader and I applied it to the animated object. Surprisingly, the reflection was inverted and/or mirrored. I thought it was a bug and I looked closely at the reference videos (above and below) and discovered that that's one of the physical attributes of water.





# COLOR GRADING

Color is an essential part of visual effects and I was sure to consider this during my editing. I started by looking into shots from disaster movies and how they were graded with the sole aim of spotting the trends. I also looked into similar genres – Horror, paranormal etc.



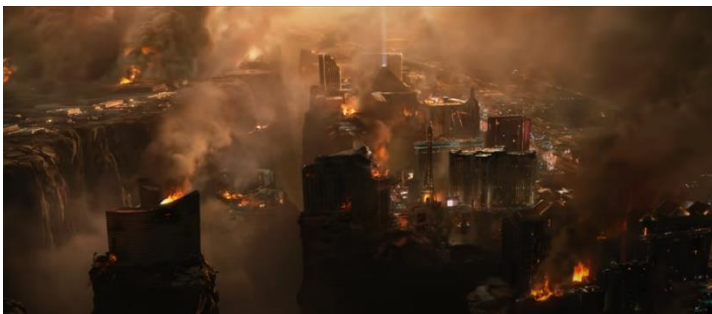
Greenland (2020)



Batman v Superman (2016)



Justice League: Synder Cut (2021)



The Impossible (2012)



Rim of the World (2019)



The Sorcerer's Apprentice (2010)



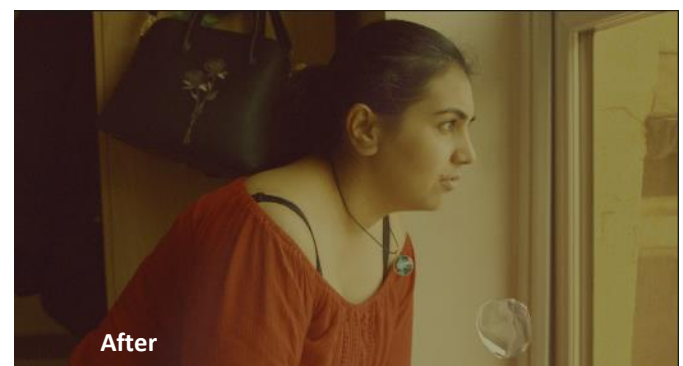
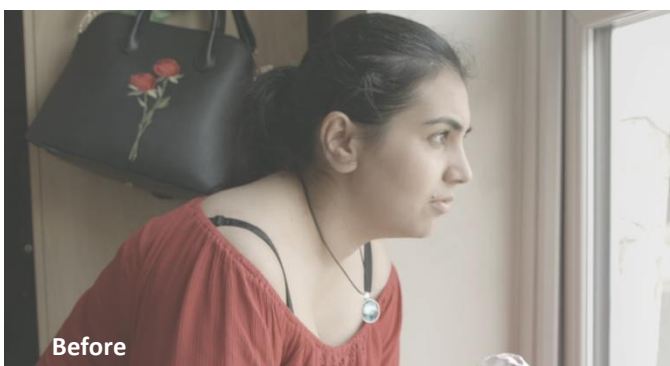
# COLOR STORYTELLING

Following a few disaster films I have seen, I revisited the shots to peruse how it was color graded when 'all is well'; compared to when the disaster struck. From the screenshots below, it is quite evident that the grading on the left appear more vibrant and contrasted, while the grading on the right have much less contrast, appear less saturated, and are tinted towards a certain color.



# COLOR DECISION

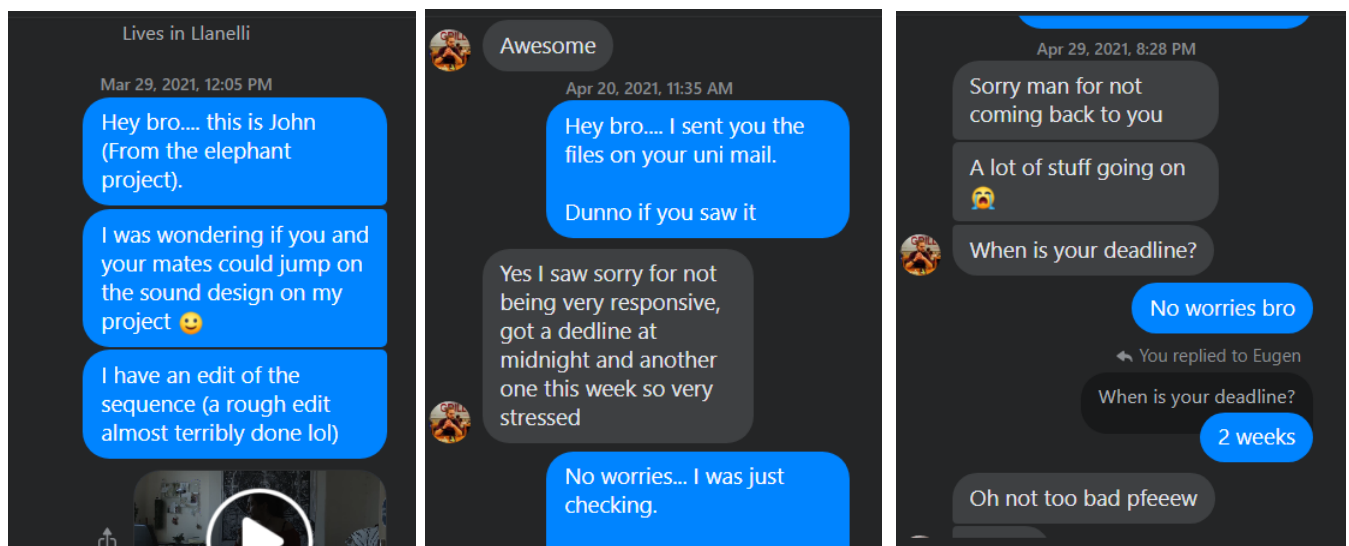
In the end, I decided to adopt the look from the 2 disaster movies that were close to the concept I was going for – How it ends (2018) and Greenland (2020).





# SOUND DESIGN

Sound is also a core part of filmic language and I was sure to take this part seriously. I contacted someone from the sound department and although he promised to do the sound design after I sent him the locked edit, he never showed up with anything.



So as to not risk getting disappointed, I decided to source online for royalty free background music and asked a friend to do the voiceover for me. I also downloaded a voice changer app that tweaked the voice into sounding like it's coming off a phone.

I was also sure to be creative with the sound design. As the scene cuts from shot 1 to 2, I increased the whooshing wind sound and reduced the voiceover sound and vice versa as it goes into shot 3. This is to give the audience the sense of being in the same world as the character.



# SELF REFLECTION

This project has truly been an exciting one. Looking back at the hurdles and setbacks and how I ultimately conquered them makes me very proud. Virtually all shots in this project will make it into my showreel. As a final university project, I had to recall a time in September 2018, when I started off as a first year VFX student with no idea of how to use any VFX software (let alone where I want to specialize in!). I also recall a time in July 2019 when I was complaining to a friend on how much I hated Nuke and its node based system; and now, Nuke is my favorite software. I am thankful to God for His grace and blessing upon me!

I have come to understand and appreciate the fundamental importance of research in VFX; particularly for anyone going into photorealistic compositing. Although there is room for creativity, the main task of a compositor is to push a shot as close as possible towards the 'uncanny valley'.

I am quite grateful to my friends and course mates who have helped me in the past to model and texture; as well as giving me tips and ideas based off of my regular conversations with them.

Finally I am deeply grateful to my tutors – Jack Philips, Tom Tachell, Geriant Thomas and Dr. Peter Hodges for their significant role in accelerating my development as a VFX student and as an artist. There's no way I'd become as comfortable as I am without their momentous support and constant help.

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*Ant Man* (2015) Directed by Peyton Reed [Film]. United States: Walt Disney Studios Motion Pictures.

*Batman v Superman: Dawn of Justice* (2016) Directed by Zack Snyder [Film]. United Kingdom: Warner Bros. Pictures.

*Dark Waters* (2019) Directed by Todd Haynes [Film]. United States: Focus Features.

*Gravity* (2013) Directed by Alfonso Cuarón [Film]. United Kingdom: Warner Bros. Pictures.

*Greenland* (2020) Directed by Ric Roman Waugh [Film]. United States: STX Films.

*How it Ends* (2018) Directed by David M. Rosenthal [Film]. United States: Netflix.

*Justice League: The Snyder's Cut* (2021) Directed by Zack Snyder [Film]. United States: HBO Max.

*Kingsman: The Secret Service* (2014) Directed by Matthew Vaughn [Film]. United States: 20<sup>th</sup> Century Fox.

*Kong: Skull Island* (2017) Directed by Jordan Vogt-Roberts [Film]. United Kingdom: Warner Bros. Pictures.

*Mulan* (2020) Directed by Niki Caro [Film]. United States: Walt Disney Studios Motion Pictures.

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