CGI REPORT

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Contents

Environment

Choosing the location

The location I have chosen to model for this unit is the Clifton Observatory's 360 glass cafe [1]. I chose this cafe above, perhaps, other cafes as I thought that it reflects the Clifton aesthetic pretty well and for the fact that anyone who has visited the Clifton Suspension bridge, has probably visited this cafe! I also like the fact that the cafe has a mix of traditional and modern design qualities, with the stone wall juxtaposed with *almost* 360° glass!

Left: a shot of the observatory, 360 glass cafe, and rooftop cafe [3]. Right: a shot of the 360 glass cafe from outside (taken by me).

I am also lucky to have a friend who works at the cafe so it was one I frequented and associated deeply with the city of Bristol.

Photographing & measuring the location

After undertaking the CGI project, I only visited the cafe a few times. The first time was to exhaustively photograph and measure the soon-to-be objects in the scene. I measured the surfaces via my phone's Measure app [2], and took lots of photos of the interior from different angles. I also photographed certain surfaces to try and find similar textures online. I, then, exported all of these photographs to my laptop where I went and named each individual file with the key objects captured therein to easily find them later on. Solely off taking these photos, my main render perspective began to manifest itself, see images to the right.

Left: "main.HEIC", a shot of the cafe from the main perspective I undertook.
Middle & Right: some of the photos I took with the measurement app, measuring: the small bench, the wall.

Refer to Appendix 10 for more photographs of the location.

Modelling

Phase 1: the "blocky" model

After taking all 108 photos measuring and capturing different perspectives of the cafe, I was still not very confident in my Maya skills and was very overwhelmed looking at the blank grid. So, I took to a *'modelling' software* I know very well; The Sims. I created the cafe's interior and exterior from scratch on The Sims 4 [4], as this was something I knew very well to do. Then, I looked at the building from bird's-eye-view and took screenshots to create a floor-plan. I drew this floor-plan by hand on paper, and then imported it as a plane onto Maya to begin my "blocky" model (see Appendices 1, 2).

I tweaked the floor-plan once or twice by changing the size of objects I had precise measurements for, e.g., the benches. Then, off of the final floor-plan, I began creating polygon primitive cubes. I, initially, tackled creating the main, larger objects on the floor-plan, i.e., excluding decorations, food/drink and miscellaneous clutter. I divided the scene into sections, and did the same for all aforementioned 108 photos. Here are the sections I created that are still available as groups in my final *.mb* file, where LHS and RHS stand for left/ right hand side:

- **LHS counters and fridges**
- **benches/tables**
- **stools**
- **walls, roof, floor, poles**
- LHS windows
- RHS windows
- menu and air conditioner
- backroom (kitchen area)
- RHS hanging shelf

The objects modelled during this initial "blocky" phase were those that are in bold, and I modelled them in the most basic, easy way I could, and knew how to, at the time:

1. Starting off with a polygon primitive cube
2. Sub-dividing it via its inputs in the channel box or inserting edge loops
3. Extruding faces

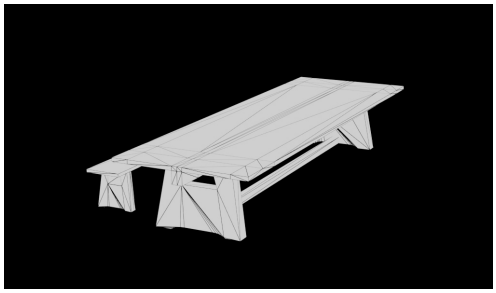


Figure 1: Wireframe render of the LHS bench and seat

I started off my modelling with the benches as they were what seemed to take up the most space on my floor-plan sketch. I have retained most of the topology I initially created for the bench up to the very final render. As you can see in Figure 1, the table truly consists solely from sub-divided components that were extruded outwards. The seat was created in a similar way but as a separate object. The bench is quite rigid in its nature and so I didn't feel the need to overcomplicate its design.

The stools, however, were much more complex. And to be very honest, I don't think I was able to fully replicate them even in my final render. But when modelling the stools in this initial phase, I took on the same development process as the benches; subdivide, extrude, repeat if necessary. This proved to be very problematic as I later realised when

Figure 2: Short stool

I tried to smooth the stools. As can be seen in Figures 2 above, the stools, in real life, have a cylindrical hole in their centre; the seat is cubic in nature; however the legs are curved and thin. Since I had '*boolean difference-d*' a cylinder out of the seat of the stool when I tried to smooth the entire model (as, at the time, the entire stool was one sole object), it created a very problematic face structure, see Figures 3 and 4. Thus, I ended up remodelling this object as separate sub-objects in Phase 3.

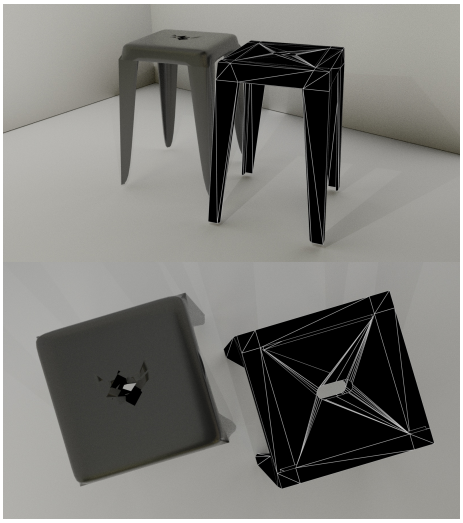


Figure 3 & 4: Wireframe and shaded render of the old stool model

Then, for the LHS counters and fridges I followed a similar process to the bench, i.e., subdividing my basic cube surfaces and extruding the necessary faces. However, I learned from my struggles with the stools and decided to keep most components of the counters and fridges as separate objects. That is to say, I made outer shells, doors, interiors, even ice for the fridges, as all separate objects; then grouped them accordingly. I utilised the distance tools meticulously for these objects to create precise and symmetrical models.

Building on the floor-plan, I realised I hadn't yet implemented any walls and/or any structural details. So I proceeded to add all the 4 surrounding walls of the cafe, as well as the roof details. Adding the roof details really made the location come to life, I saw the bare structure of the cafe come to life in my Maya model (see Appendix 3), motivating me to move onto my next phase.

Phase 2: the more detailed model with basic texturing and lighting

Having modelled what took up the core chunk of my floor-plan mockup, I could now move onto the more decorative objects, which were often times more challenging to model. In this phase, I added basic lights and textures onto my existing objects in an effort to help visualise what my render could look like (see Appendix 4), whilst using said render as a motivator to keep modelling and texturing. I also experimented with curves and created the following objects, if not some of their subcomponents, via EP curves, lofts and sweeps thereof.

The first object I modelled with EP curves was the arched window, which I modelled by initially creating a cubic EP curve with nine points, as seen in Figure 5 on the right. Then, I created a sweep mesh of type polygon, increased its scale profile to make it thicker, increased the x-axis scale of the created sweep polygon, and created a smaller duplicate of the polygon to fit inside the larger sweep. I duplicated the arch instead of just increasing its thickness to give the window some more dimension.

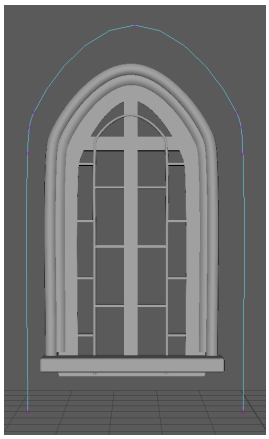


Figure 5: Arched window and its EP curve

After becoming somewhat familiar with curve tools thanks to the labs, by modelling the arched window, and consulting some online tools, i.e., [6], I moved onto a more

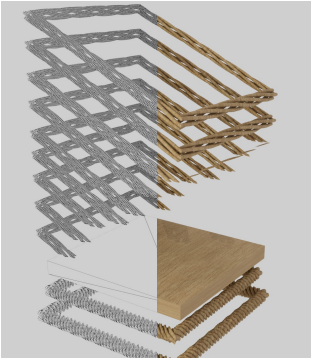


Figure 6: The separated layers of the wicker basket

complex model which would benefit form the use of curve tools; the wicker basket. For this object, I created a Polygon-based sweep mesh off of a primitive square plane. I reduced the scale profile, set radial distribution on, and implemented some twisting, tapering, and interpolation thereof. Once I was satisfied with the look of my basic rectangular sweep, I deleted its history and created a smaller duplicate to layer for the bottom part of the basket. For the sides and back of the basket, however, I rotated the mesh downwards and duplicated with transform (moving each layer upwards). To achieve the look that can be seen in Figure 6, I created a Polygon primitive cube that sat right below the very bottom wicker sweep layer, and *'Boolean-difference-d'* the overflowing sweep layers. And to finish off the basket, I added a polygon cube primitive as the base. To illustrate my process, I separated and distanced the layers from each other to create Figure 6, and show how the boolean affected each layer differently.

Another object I utilised sweep meshes for was the tall stools, which have a curved back, as seen in Figures 7 and 8. For this, I employed a similar process to that of the arched window. However, for the back support of the stool, I had to use another surface tool; loft. I did this by creating the 4 linear EP curves seen circled in red in Figure 8, and lofted them. I used the loft tool in particular because, as seen in Figure 7, the back support of the stool is curved in its centre but has a slight perpendicular straight edge at its intersection with the seat. Thus, I used the top 3 EP curves to create the curve, and the last 2, in combination, to give it the *flat* look.

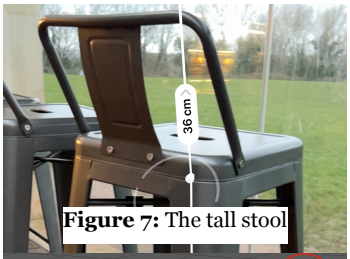


Figure 7: The tall stool

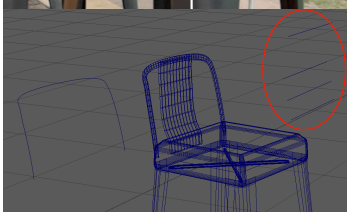


Figure 8: Wireframe of tall stool and its curves

I utilised curves and surface operations often when creating my decorative models. Here are some of the other objects (Figures 9 & 10) I created via sweep meshes of EP curves; the chocolate flake for the hot chocolate and rope for hanging stars (via wire sweep mesh with distribution and twist), mug handle and wiring for the wicker baskets (via basic polygon sweep mesh).

Figures 9 & 10: Renders showcasing: chocolate flake, wicker baskets (& wires), mugs, ropes.

On the other hand, I continued employing the modelling process outlined in Phase 1 (*subdivide, extrude, repeat*), but added more complexity to create more *rigid* and *realistic* models. This *'complexity'* is actually not something challenging, but just me creating *irregularity* in the models by going into vertex mode (with or without soft select on), and moving the vertices around! And where relevant, bevelling and/or smoothing

the final objects. Below are some of the objects I modelled using the 'blocky' pipeline of *"subdivide, extrude, repeat"* but with added irregularities, and how those were implemented.

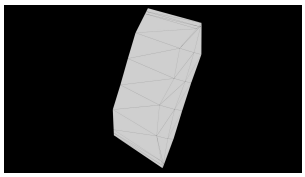
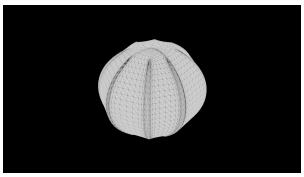
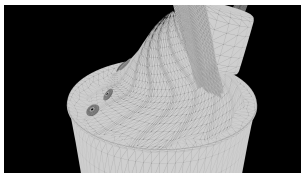
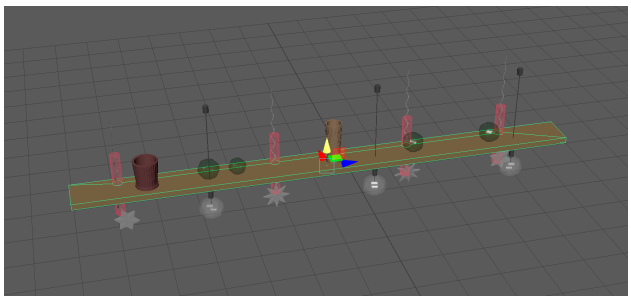
Object	**Potato chip bag**	**Glass vase**	**Whipped cream** ***(on hot chocolate)***
Wireframe of object			
How irregularity was created	Transform edges and vertices at sides to create a 'clinched' look	Subdivide faces and extrude to create a less 'perfectly spherical' look	Soft select & transform vertices (rotation) to create melting look

Figure 11: Table showcasing objects which were made to be more realistic via certain operations.

Having become much more confident in my modelling skills, I decided to attempt modelling the stools once again, as mentioned in Phase 1 they were not very accurate to the real life stools. This time, I decided to keep the seat and legs separate. And when modelling the legs, I created one initially, then mirrored instances of it to have them all be linked. Thus, I could experiment with different rotation angles, vertex placement, etc., and all of these operations would be reflected in all 4 legs just by changing the one initial model.

Figure 12: Final version of stools rendered

Having used booleans validly and without problematic topologies in both the wicker basket and remodel of the stool, I decided to further utilise this operation to difference out holes in the LHS wall for the windows, and in the RHS shelf for the hanging stars to pass through, as they do in real life.



Figures 13 & 14: Boolean operation of cutting out holes in the RHS shelf, and render of the resulting object.

Phase 3: the final, detailed model with full texturing and lighting

Entering my third and final phase, I was working towards a fully textured and lit scene by continuously *considering* rendering — the camera perspective, the lighting, and etc. Thus, I created a new perspective camera for rendering, my 'renderCam', and bookmarked a few perspectives thereof (see Appendix 5 for

renders). It is also important to note that I had an Arnold Sky Dome Light included in my scene at this point that was being used to very simply light the room.

Texturing

UV Mapping

In terms of modelling at this phase, I had developed all objects and added basic shaders thereto (e.g., metal for the stools, glass for windows) and, where relevant, downloaded texture maps from PolyHaven (see list of textures under the References). And so, a lot of my process in this phase was me UV mapping the allocated textures well. I utilised an array of tools within the UV editor and toolkit to help best align the textures to the relevant objects. For certain objects, especially those where only a certain angle of them can be seen from the renderCam, and they have complex topology, e.g., drink cans (see Appendix 6) and the cutlery tray (see Figure 15), I created the UV map with camera-based projection. Whereas, for objects like the walls, floor and menu, which had simple topology, I used planar projection, and resized the texture map accordingly (see Appendix 7 for the UV mapping of the floor).

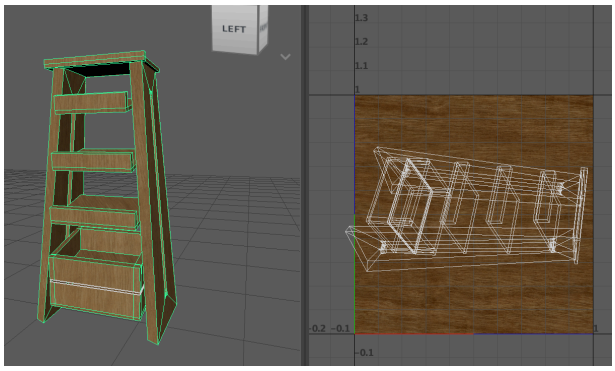


Figure 15: The UV mapping of cutlery tray

Figure 16: Textured render of snacks and drinks

Figure 17: The wood texture from PolyHaven on different models

Shaders

For the textures of the LHS wall and floor, I employed shading tricks I learned from [7] and applied bump maps and roughness via input files from PolyHaven (see References for all textures).

Figure 18: Textured render of empty room.

On the other hand, for shaders I created myself (off of the StandardSurface material), I experimented most with transmission and roughness. I created a glass shader with the transmission set to 1.0, IoR to 1.1, and both diffuse and specular roughness to 0.0, in order to give a subtly reflective, fully transparent look to my RHS windows, *which hold significant real estate in my render perspective, and so I wanted them to look as glossy as possible under static rendering conditions*! However,

to fully recreate the real-life look of the RHS windows, I created another shader called 'glass accents', which I set to have 0.42 transmission, 1.0 IoR, and 1.0 specular and diffuse roughness. Then I applied the 'glass accents' shader to certain faces of the RHS windows object, and added the circle details on top to create the look available in my final render and visible in Figure 18.

Another prominent shader that I created myself was that of the syrup bottles located in the back-end of my static render (see Figure 19). In order to create the glossy, translucent look to the syrup *within* the bottles, I selected the faces which would be the syrup and assigned a texture with the following noteworthy values: diffuse roughness: 0.0, specular roughness 0.2, anisotropy: 0.8, transmission: 0.478, which in combination allowed for the relevant faces to look *translucent* and *liquid* yet *viscous*.

Figure 19: Textured render of kitchen area.

Through creating many native shaders as well as UV mapping certain textures into the color channel, I quickly learned how to use the Hypershade window, and more importantly, how to validly duplicate shaders. I realised I had to attach a standard surface shader output node to the duplicated shader. As a result, I could easily create many color-variations of detailed, complex shaders — which I did a lot of for the snacks, drinks, and clutter items.

Figure 20: The smoothed vases and light bulbs.

As the very final touch to my model, in terms of topology, I bevelled and smoothed objects where relevant to give a more realistic look to them. For example, I bevelled the jutting out bottom parts of the windows to give them a more uneven, rough look in combination with the shader applied to it. Conversely, I smoothed other objects by increasing their subdivision count, I did this for round glass objects like vases and light bulbs (see Figure 20). Now, I was ready to render.

Rendering

Lighting and camera design

When it came to the lighting of my model, I had plans from the very start of the project to take advantage of the entirety of the RHS wall being windows, and create a sunrise and/or sunset animation. Thus, I knew I would be utilising directional light in my animation from the get go. I also didn't want to use my Sky Dome [9] for natural lighting, and wanted the emphasis to be on the directional light, so I set it to *not* illuminate by default. I also drew inspiration from a set of sunrise/sunset images I found online, available in Appendix 8, and a Maya lighting tutorial [15].

Static render

However, for my static render, I wanted to focus more so on replicating the real-life, artificial lighting in the cafe. For this, I utilised point lights to illuminate the back-end of the cafe (the kitchen area), and area lights in the display fridge. I tried to replicate the peach and yellow hues, respectively, in these two areas of lighting. And, I believe, had a pretty good result by the render of my final static image.

Although I couldn't spot any additional artificial lighting in the cafe, in real life, I added two point lights with subtle yellow hues to accentuate my models and their textures. I did this, as opposed to e.g. setting the Sky Dome to illuminate, as I wanted to retain control over the hues and positioning of my point lights, to be able to dictate which models were best-lit and which were more so hidden in the shadows. Furthermore, I added an additional spot light above the circular table to draw more attention to it and the hot chocolate on top. I believe all of the artificial lighting I added to the static render created for a well-lit midday scene, with the anterior table and display case at the forefront due to: the spot light and camera positioning for the former, and the intense yellow hues for the latter. However, I also believe the rest of the scene is easily observable and allows for viewers to zoom-in and view other objects, with no significant dark spots, thanks to the additional point lights. I rendered the static image out at an AA of 40, with adaptive sampling on, and increased light samples to 10.

As for the renderCam perspectives, lightly touched upon at the start of Phase 3 (see Appendix 5 for variations), I went for the one located at the centre of the room, looking slightly down at the objects because it's the one that allows for the greatest amount of objects to be in clear eye-sight for viewers.

Animation

As aforementioned, for the animation, I wanted the key lighting design to be the sunrising/setting. I ultimately decided to portray the sunrising and then beginning to set but not fully setting in the 10 second animation (both to not overwhelm viewers with the quick, drastic color changes and for the fact that I don't think I'd be able to fully create such an animation under time and rendering constraints). I did this by adding a directional light with a strong yellow hue, and rotating it 180 degrees throughout the first few seconds of the animation. Additionally, I key framed the Sky Dome's color balance value to have an increasingly pink-ish hue throughout the entire 10 seconds. This is more visible in my additional video render accessible at Appendix 9, and through my Blackboard submission, under the filename *"additional animation"*, which was rendered at a lower AA setting but higher transmission value for the glass shader than the official submission. It is important to note and mention here that for my main video submission, I lowered the transmission value for the glass in order to not have to render the sky dome at its full quality at each frame, as I was worried about the render time. Furthermore, I designed and created both animations so that as the sun began to set, the artificial lighting in the room turned on.

As for the camera, I wanted to portray the story of a customer walking through the cafe, taking in their surroundings, and ultimately reaching the display fridge, where they would place their order. Thus, I did just that! I bookmarked where I wanted my core focuses of the animation to be, i.e., the starting and ending frames. Then, I scrubbed through the time slider and key framed the camera moving through the room, later adding further transforms to the render camera, i.e., to replicate the customer looking up and down the walls. After key framing these perspective changes, I let the animation play on loop and refined it to make it

more fluid and true to life. Ultimately, I rendered the official video submission at an AA sampling of 10, with adaptive sampling turned on to 5.

Animation

I wanted to create a similar animation to that of isometric bedroom designs [e.g. 5]. Having done the camera animation first, I could easily visualise which objects would be in the viewer's perspective at what moment, and I utilised that knowledge to have the relevant objects appear from the floor, ceiling, or LHS/RHS walls depending on where the objects were. For example, for the counters in the background, them appearing from the floor made the most sense as they would move as a unit vertically. Whereas, for the hanging RHS shelf and the decorations thereon, it made more sense to have them appear from the ceiling. And for the decorations, in particular, I made them *grow and extend* out of the ceiling, instead of simply moving in/out of view.

When implementing the animation I solely utilised key framing, but I edited my key frames via the graph editor at many instances. I developed my animation in a similarly iterative process to the modelling I outlined in previous sections. That is to say, I had animations I rendered out in very low quality that I reflected and made notes upon, and subsequently implemented those changes to the next round and repeated. A key change I made at each phase of animating was slowing down or speeding up certain objects' appearance, e.g., the tables and stools are the first objects to appear, but in the first render of my animations they took too long. And for an animation that is only 10 seconds in total I definitely thought a *noticeable* amount of animations should be happening within the very first few seconds.

It was notably difficult to keep a consistent tempo of animation throughout the entire video, and so the iterative animating process definitely allowed me to tackle the issue of tempo in stages, i.e., slow down and speed via scaling graphs when required. I also moved around key frames along the timeline via batch cutting and pasting (shift selection), this also allowed me to apply similar animations to different objects or groups thereof without having to key frame all over again. With that mentioned, the groups I defined throughout the modelling phases came in very hand at this stage, as I could batch animate objects, e.g., the tables all coming up at the same time. For other animations, like the stools and clutter on the LHS counters, I made the creative decision to not animate via groups as I wanted them to rotate about their own individual axes, and create more unique frames.

Evaluation

Personal reflection

Overall, I thoroughly enjoyed taking this unit, and I believe the processes I employed throughout my outlined phases allowed me to *model, texture, and animate* the objects with little to no friction when switching over between the aforementioned development pipelines. Another facet of my modelling phase that I would take with me to future work in a similar area would be the fact that I retained almost all *original models* of objects. That is to say, before combining or even bevelling/smoothing/etc. my objects, I made a copy of it with its history intact, and added it to a group called "Original Models" which I could refer to at any moment

if any operation created problematic topology and I wanted to retrace my steps. This worked especially well for objects I created by combining sub-objects, as I could delete the history on one copy and work freely without an abundance of channel box attributes, and retrace any steps if/when required.

In terms of models I think I did particularly well (see Appendix 11 for side-by-side table), I would mention the glass shaders on the RHS windows and the skylight, especially the dimensionality of the latter with the extruded faces in combination with the subtle sheen of the shader. As for the animation, I think the movement of the camera was able to both capture different perspectives of the scene not focused upon in the static render, and portray a semi-realistic customer 'point-of-view' perspective.

Future work

Of course, my renders and models aren't perfect and given the time and resources there's an array of objects, textures and animations I would like to add/edit, and maybe even employ differently than how I did throughout this unit.

"If I had more time..."

- Increase the level of detail and accuracy in the shaders.
- Increase the level of detail in clutter and decorative items, i.e., add more food models and textures.
- Implement a longer and more realistic day-night animation, have the Sky Dome more visibly reflect the time of day and render under higher quality.
- Implement more complex animations on an individual object basis, i.e., skin stools and have them walk into the scene.
- Include objects and sections of the location excluded from the final render, e.g., model the kitchen area in more detail, add plants.

"What I would do differently..."

- Model complex objects in a sectionalised fashion, i.e., model separate sub-objects and combine later to be able to more freely edit each sub-object, while not being restricted to maintain perfect topology in the combined polygon.
- Visit the location more often, develop at the scene, to be able to closely observe shapes and textures on demand. I wasn't able to do this often as I preferred to work on lab machines, and the cafe doesn't have many available power sources.

References

(1) Clifton 360 Cafe's website. Available at: https://cliftonobservatory.com/bristolcoffeeshop-360cafe/

(2) The Measure App. Available at: https://apps.apple.com/us/app/measure/id1383426740

(3) The Clifton Observatory. Available at: https://cliftonobservatory.com/

(4) The Sims 4. Available at: https://www.ea.com/games/the-sims/the-sims-4

(5) Isometric bedroom animation. Available at: https://youtu.be/QIBJQHQor68

(6) Wicker basket tutorial. Available at: https://www.youtube.com/shorts/TRMgeEwAIEg?feature=share

(7) Master Assigning Textures to Shaders in Maya. Available at: https://www.youtube.com/watch?v=_nN2ER7wP8I

Textures

(8) Wood texture. Available at: https://polyhaven.com/a/kitchen_wood

(9) Sky Dome texture. Available at: https://polyhaven.com/a/scythian_tombs_2

(10) Floor texture. Available at: https://polyhaven.com/a/red_sandstone_pavement

(11) Stone wall texture. Available at: https://polyhaven.com/a/rustic_stone_wall_02

Rest of source images folder is available upon request, but other texture images like coke and beer cans were taken from Google.

Other YouTube tutorials referred to

(12) Autodesk Maya 2020, Substance Painter - Stylized Cake Slice. Available at: https://www.youtube.com/watch?v=SMDCSFlWEwI

(13) Autodesk Maya 2018 Tutorial - Easy Potato Chips Bag Modeling. Available at: https://youtu.be/QbfSrx6mRPg

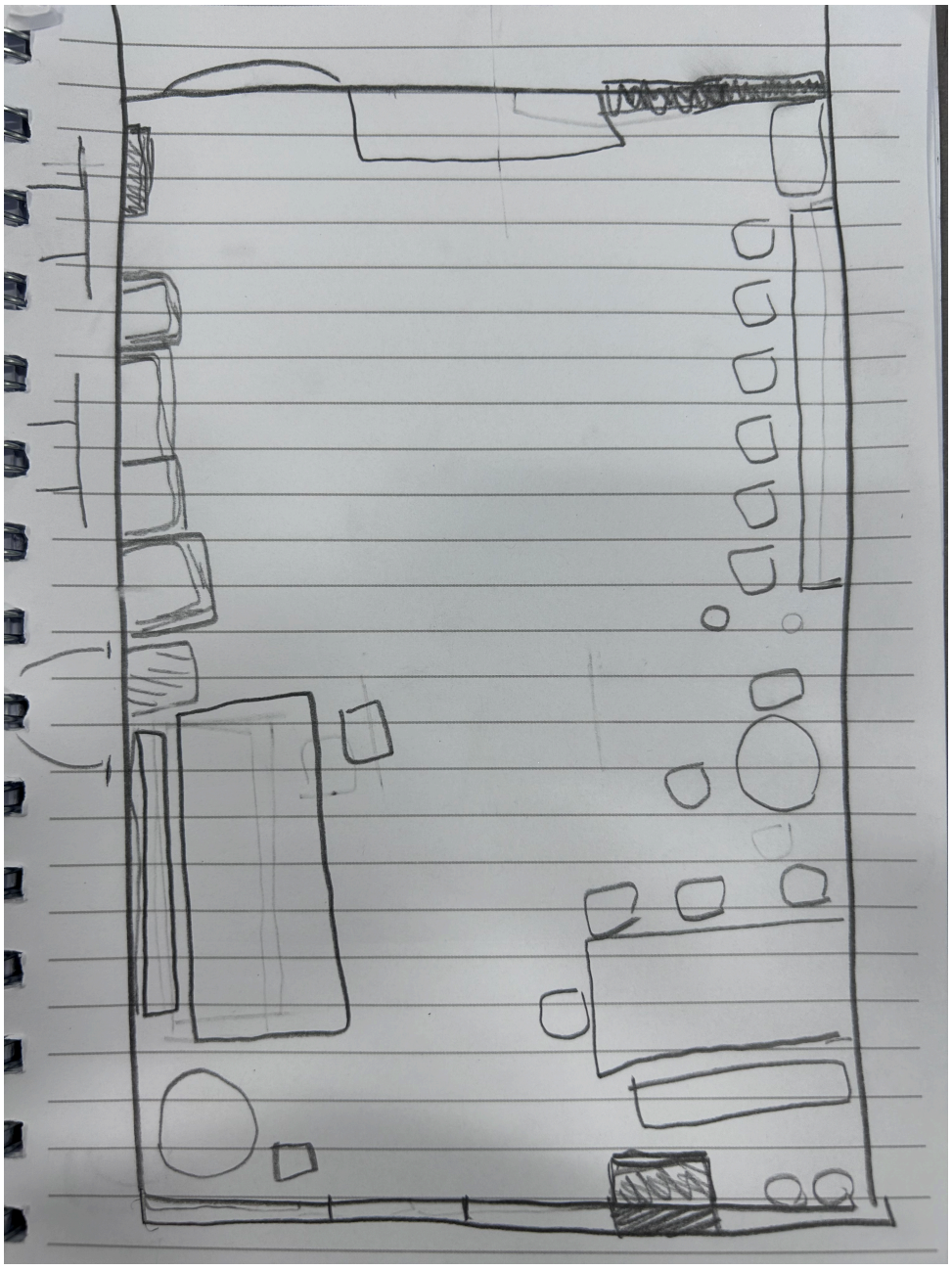
(14) Maya modeling cream for cake, Ice cream. Available at: https://youtu.be/8RjwWxM-C9E

(15) Maya 2024 - Basic Light Animation. Available at: https://youtu.be/ko8glN4pHPU?list=PLgcsPKQ2_jZj0A00EOWylUwZi7SRtBTf5

Appendices

Appendix 1 — The Sims mockup

Appendix 2 — The floor plan



Appendix 3 — Phase 1 render

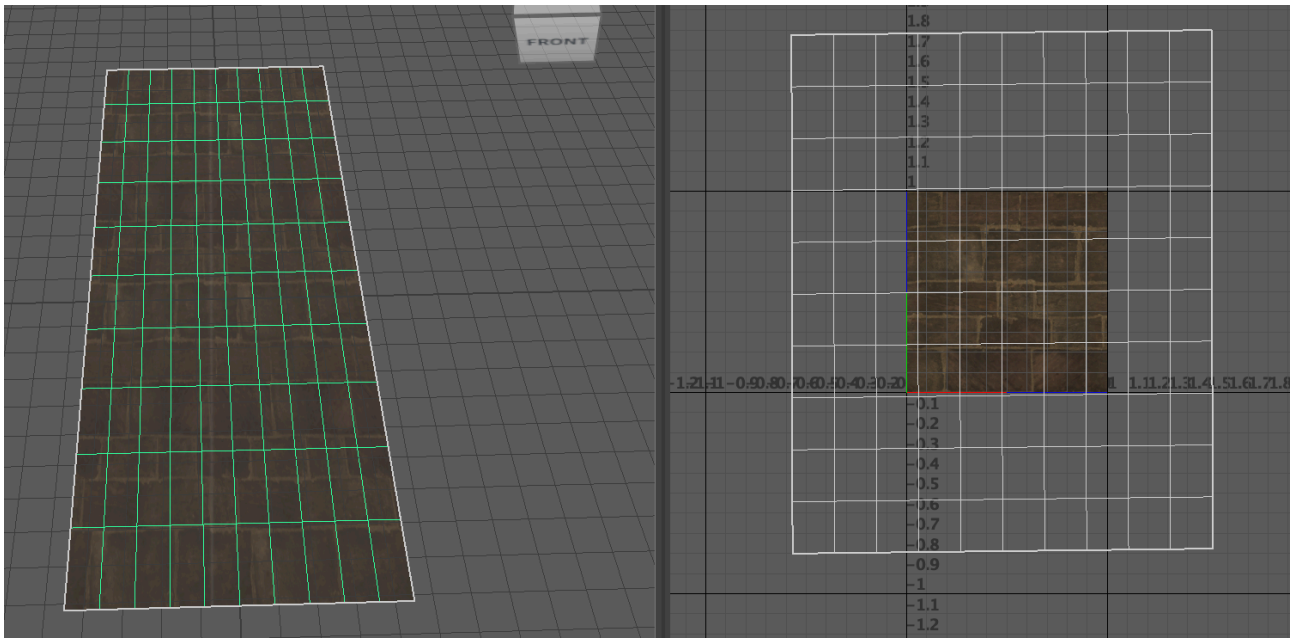
Appendix 4 — Phase 2 renders

Appendix 5 — renderCam perspectives

Excludes final perspective chosen for static submission

Appendix 6 — Drink cans' textures

Appendix 7 — UV mapping of floor



Appendix 8 — Lighting design references

Above, available at: https://i.pinimg.com/originals/30/6e/e5/306ee550723395faad05c7475418e6d7.jpg
Below, available at: https://thomasdjalloul.artstation.com/projects/Z5VQqx

Appendix 9 — Additional video render with more transparent glass

Available at: https://uob-my.sharepoint.com/:v:/g/personal/tx21026_bristol_ac_uk/EU2V-Q8uS-ZMipZ-5Aq3crEBdHIC8pb0duhDX9O0K5Bikw?e=zewzlG

Appendix 10 — Photographs of location

Appendix 11 — Side-by-side comparison of real life location and model