

# Dystopian VR

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Major Design Project Portfolio

Ryan Van Dyk

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## Communication and presentation

Communication techniques used in the product include pictures, audio, text and interactive features.

The communication techniques used in the presentation of this document include; Text, images (sketches, renders and digital art), tables and film.

## Project Proposal

English is a compulsory subject that many students, including myself, feel is a somewhat irrelevant, unengaging and unexciting subject. I personally am much more interested in visual and hands-on learning, things English do not incorporate, I also have an interest in technology, games, artwork, 3D design and many other things visual. While I was feeling frustrated about English I saw an article from ABC news, featuring the lack of interest boys have in English at school. Boys' NAPLAN English performance also lags well behind that of girls. This motivated me to look further into making English interesting, for everyone.

## Identification of the need to develop the project

### Initial Research

My initial research included interviewing Manly Campus students, to determine their opinions on English Advanced. Based on the results I then interviewed the teachers and asked if there were any tools or technologies they would like access to, and from that, I investigated Unimersive. Unimersive creates virtual reality content for educational purposes.

### Interview with students regarding English at MSC

I designed a survey for both the year 12 and year 10 year groups and asked them to answer questions about their opinions on English at Manly Campus. I received 81 results in under 24 hours suggesting strong opinions from the cohort.

For survey, see Appendix A.

### *Result Summary:*

Many students dislike and are disinterested in English, however they do believe that it could be made more interesting. 65% of responders wanted a more engaging topic transition, 16% felt it would be pointless and 19% didn't care either way. 21% of responders felt more technology would make English more engaging, 29% of responders felt virtual reality or augmented reality would make it more engaging and 32% of responders thought games would make it more engaging. Well beyond all other choices though, was "content more relevant to the working world" with a whopping 74% of responders believing it would improve English.

There were some common responses provided in the open response section where I asked what students felt would improve the English; these were:

- Less conceptual, more literal
- Teach me how to write correctly, not how to deconstruct a text to find a convoluted hidden meaning.
- More freedom in how I respond

Due to the cohorts strong opinions I decided to interview the English faculty.

## First Interview with English Faculty Teachers Regarding Topic Introductions

### *How do you think technology could be used for teaching English?*

- “It could be used to create interactive... virtual reality (VR) experience for the students, in which case it could be used to create emotionally immersive experiences for the students to ignite their imagination and critical thinking for the topic.”

### *What topic do you believe could be enhanced by Technology?*

- “Dystopia would probably work well with technology or VR due to its differences to the world we know. It will also be helpful as a way to get students excited or interested in the topic, which we have not taught before.”

### *What sort of skills do they need to be learning?*

- Imaginative, persuasive and informative writing.

### *Based off your previous responses, would you be interested in a virtual reality product to enhance the student's learning experience?*

- It would be very cool, I've seen what the year 10's have been doing, and virtual reality looks like a fantastic tool to employ.

### *What sort of situations, themes, experiences, activities and interactivity would you like to be present in a VR dystopian scenario?*

- We would like them to be able to experience, as if from the perspective of a character, a dystopian world that they can explore. We want them to be able to find objects and clues as to what happened to the world they are in, to assist with their informative writing. We want them to have to make a morally challenging decision, which they will have to later justify in a persuasive writing task. Finally we want them to be emotionally immersed in the experience to help prompt their creative writing. This is because the dystopia unit has a focus on three types of writing, imaginative, informative and persuasive.

### *Where would you like this VR activity to be placed in the program?*

- It would probably be best as a hook to get the students interested and excited about the dystopia topic. It will be especially helpful as we have never taught this before and are still trying to figure out how to teach the unit to the students. Although I understand this will take you a long time to create so we'll probably begin using it in 2019 if your project is successful. ... Still as an introductory piece though.

### *Evaluation:*

After this interview it is obvious there is a genuine need for the English staff at Manly Campus to develop an interesting and immersive way to introduce new units of work to further engage students in the content. They have also stated that they would like a Virtual Reality project to work as a topic introduction for dystopia. Stating that it would be even more helpful as they have not taught it before. An introductory activity would be very helpful. The benefits of a VR project are:

- Emotionally Immersive – allows students to empathise with characters
- Introductory activity
- A great and interesting hook into the dystopia unit
- Clear setting
- Excellent stimulus for writing tasks

But such a project would also be limited by:

- Class length
- Has to be available to an entire class at once
- Time

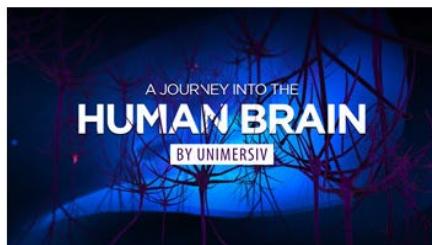
- Skills
- Hardware
- Software

The responses from the survey and the interview present virtual reality as a fantastic option, as both the English staff and students believe English could be improved by better employment of technology, more specifically, virtual reality. From the students the main contender was “content more relevant to the workplace”. However I am unsure at this stage how this could be addressed as the English syllabus largely takes control of that. Further investigation is required.

### Unimersive's educational VR apps



Learn about Dinosaurs in VR



A Journey into the Human Brain



Explore the International Space Station



Anatomy VR



Learn about Stonehenge in Virtual Reality



Explore the Titanic like never before

Figure 1: Six of Unimersive's VR apps

Table 1: Unimersive PMI

Unimensive		
P	M	I
- Very cool	<ul style="list-style-type: none"> <li>- Little use/practicality beyond wow factor</li> <li>- Not relevant to much</li> <li>- Most schools already have models of skeletons and hearts and other anatomy</li> <li>- There are many other free anatomy VR apps</li> <li>- Not available on iphone</li> </ul>	- N/A

### Evaluation

Unimersive have noticed the potential of VR in education, but all their products are very generic, furthermore they have failed to make their content useable on iphones, which make up almost half of the consumer mobile VR market (due to the cardboard's low price tag). Overall, Unimersive have actually failed as developers, they neglected a large part of their target market, did not create original content and do not have any real goal for their products.

### Conclusion from initial research

Student responses have made it evident that there is need for more engaging English classes. Teachers also want something to help them teach and get students interested, and there is a gap in the market for syllabus-relevant VR education. Teachers have expressed interest in employing VR to the topic of dystopia in terms of VR in education. From Unimersive, I have learnt the importance of making sure my product is not a replica of existing content and making sure it has a specific purpose.

## Needs and wants of the target market (students)

- **Aim**
  - I aim to gain a better understanding of the direction and content required to make the product engaging for the students of the target market.
- **Method used**
  1. Designed a questionnaire, ensuring to use a mix of open and closed questions including: students' preferred style of learning, what they believe would make English more interesting, whether they currently found English interesting and if they would prefer a more engaging topic transition.
  2. Posted questionnaire on the Manly Campus year 11 and year 12 Facebook groups.
  3. Analysed responses.
- **Safety Considerations**
  - Survey was anonymous so that students could comfortably make potentially critical comments about the English department.
- **Result**
  - 81 individuals responded to the questionnaire over the period of five days.
  - See *Appendix A: Student Survey* for full results

Table 2: Student result summary 1

Question	Answer(s)	Analysis
Do you find English engaging?	Not at all: 23.5 % No: 23.5 % Somewhat: 35.8% Yes: 11.1% Very much yes: 6.2%	A mere 17.3% (14/81) responders find English engaging
What types(s) of learning do you prefer?	Visual: 61.7% Aural: 24.7% Verbal: 35.8% Hands-on: 48.1% Logical: 48.1%	Aural and verbal, the two primary methods of teaching English, are the least popular. Visual is the most popular
Would you prefer a more engaging topic transition?	Not at all: 8.6 % No: 7.4 % Somewhat: 18.5% Yes: 33.3% Very much yes: 32.1%	65.4% (53/81) of responders want a more engaging topic transition
What could make English more interesting?	Content more relevant to the working world: 74.2% VR/AR: 29% More technology: 21% More movies: 35.5% Podcasts: 11.3% Games: 32.3%	29% say VR

- **Conclusion**
  - The target market wants an engaging and visually oriented topic transition. This result conforms with my own wish of the English course.
- **Applications of Conclusion**
  - I will share the results with the client (the English faculty staff) to assist in determining their needs and wants.

## Second interview with English Staff

- **Aim**
  - I aim to gain a better understanding of the direction and content required to make the product helpful for teaching by determining the client's needs and wants in regards to the product..
- **Methods used**
  1. Develop a series of questions using the ‘who/what/when/where/why/how’ format.
    - **What happened?** Choose based on what would best suit the syllabus. E.g. rebellions, wars, heatwaves, floods, most people vanished, all computers broke, nuclear fallout, etc.
    - **Where should it be set?** e.g. A four-way intersection in a town/city/desert, a pathway on the riverside (maybe with a skyline of a ruined city on the horizon), on the harbor bridge, etc.
    - **When did the event happen, how long has it been since?** e.g. 10-20, 30-40, 50-70, 150-220, 5 years, etc.
      - And what features have changed, if necessary.
    - **What should the salient/main features be?** There can be more than one as it is a spherical environment. E.g. A damaged petrol station, a crashed plane, a single plant, etc.
    - **How did the user/character get there?** Why is the user/character in this location?
    - **How should information be presented to the user?** e.g. Old government warning flyers taped to buildings, the character's journal (e.g. a book, a holographic display), the character's podcasts, PA system, etc.
    - **Who is the character?** What motivates them? Maybe they have a photo of something or someone. How old is the character (as a range). Are there any side characters that influence the main character?
    - **Should the scene look photo-realistic or stylized?** e.g look like google street view or...
    - **Do you have a preference on anything I forgot to ask or any suggestions/requests?**
  2. Email the questions to the client and ask them to consider the English program when responding.

### • Result

The client responded by highlighting their answers and key points as follows.

- **What happened?** Choose based on what would best suit the syllabus. E.g. rebellions, wars, heatwaves, floods, most people vanished, all computers broke, nuclear fallout, etc.
- **Where should it be set?** e.g. A four-way intersection in a town/city/desert, a pathway on the riverside (maybe with a skyline of a ruined city on the horizon), on the harbor bridge, etc.
- **When did the event happen, how long has it been since?** e.g. 10-20, 30-40, 50-70, 150-220, 5 years, etc.
  - And maybe what features have changed if necessary I think it would be best if the war/rebellion/event was recent so that remnants of the old way of life are still evident in the landscape
- **What should the salient/main features be?** There can be more than one as it is a spherical environment. E.g. A damaged petrol station, a crashed plane, a single plant, etc. A four way intersection of a city/town could have maybe a creepy abandoned school or playground, a supermarket, a bombed out building...
- **How did the user/character get there?** Why is the user/character in this location? To find food/supplies.
- **How should information be presented to the user?** e.g. Old government warning flyers taped to buildings, the character's journal (e.g. a book, a holographic display), the character's podcasts, PA system, etc. Is a voice over possible? Like a voice over of the character's inner thoughts? Like what you might get in a video game?

- Who is the character? What motivates them? Maybe they have a photo of something or someone. How old is the character (as a range) 18-22ish so that the age is close to the students using the product. Are there any side characters that influence the main character? Could be searching for food/supplies for his or her family back in the shelter? One parent and a young sibling?
  - Should the scene look photo-realistic or stylized? e.g look like google street view or...
  - Do you have a preference on anything I forgot to ask or any suggestions/requests? Can you use music to also establish mood/setting? Something a bit eerie/discordant, etc.
  - The client also provided the program and resources currently developed on a website. The current topic on dystopia is within the “reading to write” unit.
- Conclusion
    - The client’s needs are very specific. This is the optimal outcome as I can focus on the client’s needs while still easily catering for the users’ wants.
    - Having read the program the role of the product will be to introduce, the students to the dystopia topic, by engaging and immersing them, thus igniting their interest in the dystopia and inspiring them to learn the unit and investigate the texts.
    - The resources assembled suggest a need for motivation and inspiration to improve the students creative writing within the unit.
  - Applications of Conclusion
    - Create a narrative, preliminary scene sketch and early storyboard for the product, based off the client’s and user’s wants and needs.

## Justification

From both the research conducted and personal experience it is clear that a more engaging and immersive experience is required to maximise students’ interest in English. A by-product of this should be increased student motivation and effort to learn course content, which, in turn will maximise the efficiency of time spent in the classroom for both the teacher and the students, thus achieving improved education outcomes.

## Motivation and purpose

English is a compulsory part of the NESA HSC and at Manly Campus (MSC) students are required to take Advanced English which is unexciting, overly conceptual and generally difficult to find engaging. I would personally appreciate a more engaging and exciting style of English lesson, at the very least, to help me concentrate of motivation beyond fear of not getting into the course I want at university. As such, I believe that if I were to develop a product to help make some part of the English process at MSC more engaging and exciting, it would greatly benefit students to come by boosting their motivation and interest. I have a great interest in technology and its potential and a similar view on virtual reality to the interviewed English teachers, so I hope to be able to employ my skills and passion technology and digital creation to improve students and teachers schooling experience In short, I want create a product that will hopefully be helpful, memorable and enjoyable to future students at MSC, because that is something I wish I had access to.

## End user and target market

The year eleven students of 2020 and the English staff will be the end users and are the target market, the end user also includes all year eleven students after that until the next change of syllabus. The product is to be employed by the English faculty at Manly Campus, as such they are the client.

## Design brief

Based on initial interviews, for the product to solve the problem of unengaging and monotonous English topic transitions at MSC while also meeting the client’s requirements, it must:

- Create preliminary interest in an English topic.
- Allow students to explore and interpret meaning by themselves.

- Provide stimulus to improve student's practical abilities and knowledge.

By doing this the solution should give students' initial motivation to learn about the new topic as well as differentiate it from previous topics, consequently allowing the students to learn in a more efficient and enjoyable way.

### Design parameters

In order to be effective within the classrooms at Manly Campus (MSC) the PSE must be developed with the following in mind:

- Development time – Time to design and produce the PSE is restricted by the NESA deadlines, my own prior commitments, and computer speed.
- Cost of development – The cost incurred by the production of the PSE will primarily come from the tools required. A high performance computer can cost upwards of \$2000.
- Skills and knowledge – The skills required for the development of this PSE are skills that I am only beginning to learn and could compare to trying to learn multiple languages at once and then attempting to work as a translator for communication between those two languages
- Tools – The range of tools, both hardware and software I have access to will significantly impact my efficiency and the polish of the final product. For 3D asset production I have access to Autodesk Maya and Mudbox. For app creation I am limited to free engines, this means I will use Unreal Engine 4 or Unity
- Size – The product must be small enough to be portable, meaning small enough to be installed and used on the minimum specification device.
- Human resources required – The undertaking of this project will take massive amounts of my time in order for me to create anything worth using. It will also require feedback and instruction from the English faculty, as well as testing and evaluation done by users and experts.

## Areas of Investigation

Table 3: Areas of investigation

<b>Areas</b>	<b>Proposed method of investigation</b>	<b>Relationship to need/solution</b>	<b>What I hope to find</b>	<b>Suggestions for &amp; evidence of further action</b>
<b>Wants/needs of client and target market</b>	Online surveys, interviews and casual conversations	The wants and needs of the client and target market are the reason a product will provide a solution	Required project direction and criteria for success	Ensure development focus is to meet the needs of the client market Consultation with client on pages 41, 55 & 64
<b>Possible presentation mediums</b>	Online surveys, interviews, observation and online research	The presentation medium changes the restraints and processes of development as well as the way the end user will interact with it	A suitable and cheap presentation medium that can be employed by a school.	Investigate cheap and mobile VR kits like the Google Cardboard Pg. 24 – 25
<b>Restraints created by presentation medium</b>	Online research	The restraints will affect what the final product can be, thus affecting the course of development	A medium with restraints that work with the tools and skills I have	Keep restraints in mind when developing each part of the solution and make a list of preferred mediums Pg. 26 – 27
<b>Possible (software) tools</b>	Online research	Will define what presentation mediums can be used and the workflow, as well as the skills required for development	A comparative analysis of the many tools on the market, allowing me to understand which tools are optimal in my context	Use tools that are compatible with presentation medium(s)/device(s) and that I have some preliminary skills with Pg. 33 – 36
<b>Tool Techniques and Human Resources</b>	Online research and expert advice (including help threads)	I need to be able to use my development tools efficiently in order to create a quality product within the time restraints	A wealth of knowledge, from forums, newsgroups and community members providing information and advice	While looking around, keep an annotated list of URLs to particularly helpful websites and communities Pg. 36 – 37
<b>Sources of help/support</b>	Online research and reaching out	If I get stuck on something, tool related, idea related or even concept related, a second or third opinion can help get me out of a rut and allow	I hope to find that experts, the target market, the client, my peers, my teacher and my family are willing to answer questions I have about possible direction	Keep note of who provided what information so you can ask further about it later and make sure you understood them correctly Pg. 36 – 37,

		development to continue	and ideas as well provide support	
<b>Existing solutions</b>	Online research and consultation with teachers	If there is already a solution that meets all the criteria almost exactly there is no need to develop a new one, merely raise awareness	A lack of solutions that solve the problem	Continue the development of the solution with confidence Pg. 17 – 18
<b>Applications made with chosen medium and similar tools</b>	Online research and analysis of existing applications	It will help me understand what can be achieved with the tools I am using as well as provide inspiration	Inspiration and creative use of the capabilities of the development program and presentation medium	Keep note of particularly impressive applications of the tools used Pg. 17 – 18
<b>Client and target market opinion</b>	Surveys, questionnaires and interviews	It will help provide feedback on how well I met their wants and needs, as well as how to better meet them	Constructive feedback on how to improve the product, as well as issues I missed or overlooked	Communicate with client and target market often. Consultation with client on pages 3, 4, 6 – 8, 41, 55 & 64
<b>Advanced English Syllabus</b>	Talk to teachers and read NESA website	A prime factor in how English is be taught	A flexible way to include the content	Make sure PSE can be used to teach syllabus Pg. 64
<b>User Experience</b>	Research and analyse existing applications	Any digital product must look good and work seamlessly	Techniques and inspiration to optimise product	Continually look out for techniques and tricks to optimise the user experience. Pg. 31 – 32 and production

## Evaluation

Research and communication with the client and target market is critical to keep the development of the solution moving in the right direction. Research of the different software and hardware options that can potentially be used for the presentation and development is vital in determining constraints and opportunities in how the user receives and interacts with the product, as well as what it is. If I fail to properly research any aspect of the PSE, from development options through to presentation mediums I will likely fail to meet the needs and constraints provided by the client, the tools, the presentation medium and the target market, making the solution obsolete before it is even finished and thereby not a solution.

## Criteria for success

Table 4: Criteria for success

Criteria	Importance (1-5)	Method to evaluate success	Standard I expect to achieve
<b>Functional</b>			
Relevant to the syllabus	★★★★★	Make sure PSE fits criteria set by interviewed teachers	The solution should help students achieve syllabus criteria
Appropriate for school environments	★★★★★	Get the principal or deputy to check it off	PG rating
PSE is useable within Class Time	★★★★★	Check that all features of the PSE be fully utilised within 50 minutes	Solution useable within one class
Solution can be used by an entire class	★★★★★	Attempt to get 30 people to use the PSE at once	I expect the solution to be useable by at least 30 people
Minimal impact on phone resources	★★★★★	Data calculation for computer vs phone and a measure of power used.	The phone should be affected significantly less than the computer
Works with school's existing resources	★★★★★	Check the PSE is compatible with school's resources	The school should not have to purchase any additional resources
Engaging and enjoyable	★★★★★	Allow a group of teachers, year 11 and year 10 students to trial it and then interview them for their thoughts	I expect everyone to respond with a generalised "it was interesting" or "I enjoyed it"
Easy and intuitive to use	★★★	User feedback form	I expect all users will be able to use the solution without any difficulties
<b>Aesthetic</b>			
Aesthetically pleasing	★★★★★	Interviews, and general questions to those who see the solution	I expect it to be aesthetically pleasing
Wow factor	★★★★★	User feedback form	I expect users to be pleasantly surprised, at the very least
<b>Environmental</b>			
Minimal Impact	★★★★★	Cradle to grave analysis	I expect a near-zero impact

## Criteria Analysis

The five-star criteria, relevant, appropriate and brief, must be met or the product will be unusable within the classroom, thereby failing to provide a solution to the problem discussed in the design brief. The four star criteria are highly important, but failure to fully meet them won't make the product unusable, rather, it will make it significantly less effective. The only three star criteria is "intuitive and easy to use". The reason for this is that, if the product is somewhat complex or confusing, the user can be provided with instructions on how to use it, thereby keeping the product and its other aspects useable and effective.

# Project Management

## Proposed Time Plan

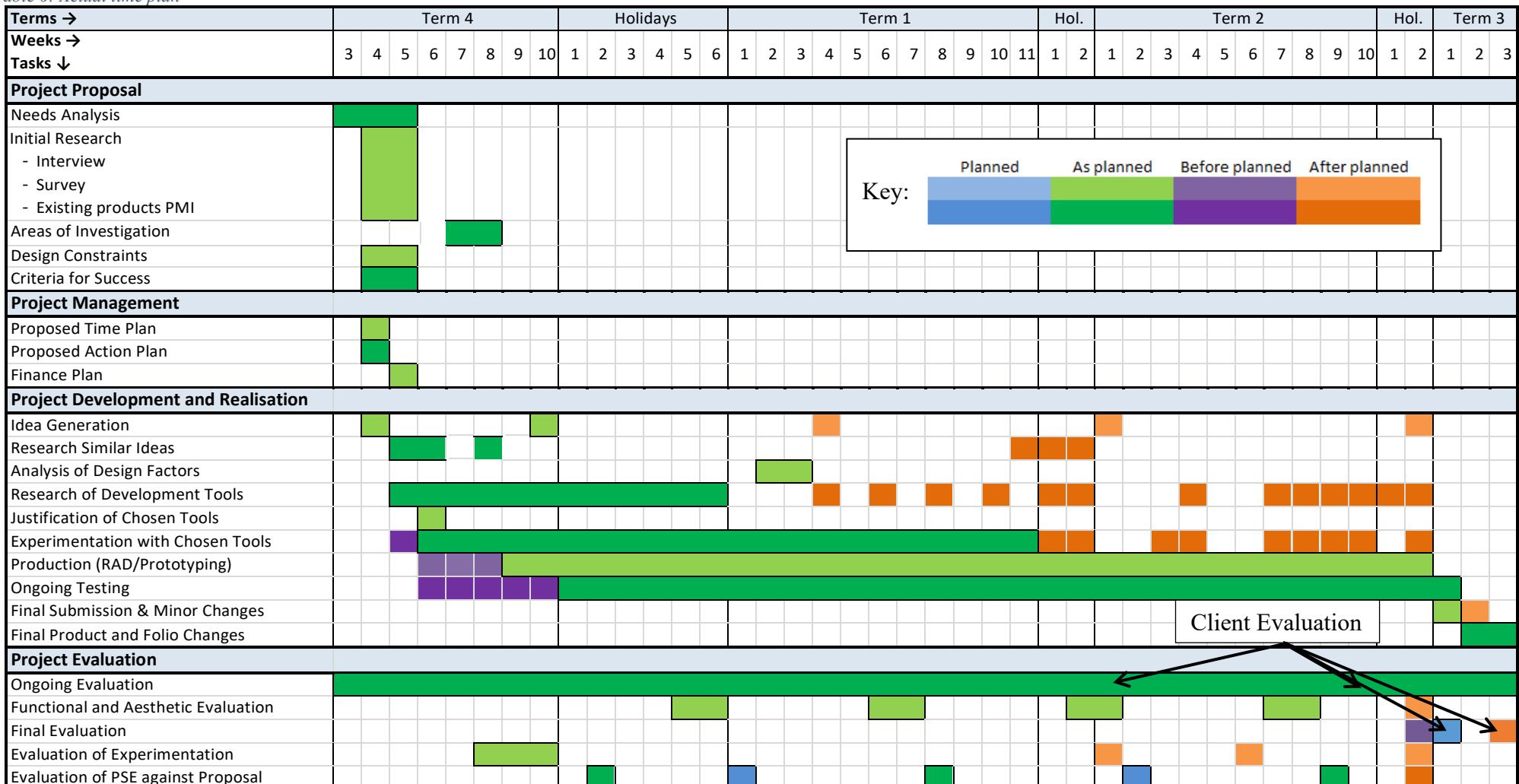
Table 5: Proposed time plan

Terms →	Term 4					Holidays			Term 1						Hol.	Term 2					Hol.	Term 3														
Weeks →	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	11	1	2	1	2	3	4	5	6	7	8	9	10	1	2	1	2	3
Tasks ↓																																				
<b>Project Proposal</b>																																				
Needs Analysis																																				
Initial Research																																				
- Interview																																				
- Survey																																				
- Existing products PMI																																				
Areas of Investigation																																				
Design Constraints																																				
Criteria for Success																																				
<b>Project Management</b>																																				
Proposed Time Plan																																				
Proposed Action Plan																																				
Finance Plan																																				
<b>Project Development and Realisation</b>																																				
Idea Generation																																				
Research Similar Ideas																																				
Analysis of Design Factors																																				
Research of Development Tools																																				
Justification of Chosen Tools																																				
Experimentation with Chosen Tools																																				
Production (RAD/Prototyping)																																				
Ongoing Testing																																				
Final Submission & Minor Changes																																				
Final Product and Folio Changes																																				
<b>Project Evaluation</b>																																				
Ongoing Evaluation																																				
Functional and Aesthetic Evaluation																																				
Final Evaluation																																				
Evaluation of Experimentation																																				
Evaluation of PSE against Proposal																																				

The time plan will assist in keeping track of progress and tasks to be completed.

## Actual Time Plan

Table 6: Actual time plan



Idea generation kept taking place as development progressed and I became aware of new things I could and could not do. Research of similar ideas happened again to find alternative ways to achieve goals. I kept having to learn more about my development tools. As such the research continued well beyond what was planned. The same thing happened with experimentation of chosen tools. I started experimentation, production and testing early because I was eager to get started. Final changes happened later than planned because I kept finding ways to improve the folio and product. Evaluation was continuous and extended as I didn't initially document as effectively as I should have. The client evaluations happened at stages of significant product progress.

## Action Plan

This is a sample of the action plan employed during the development of this product to assist in breaking down and rationalising tasks throughout key project stages. It also helped rationalise the gantt chart.

Table 7: Action plan snapshot

Week	Proposed Task	Actual completion	Reason for difference
3 (T4)	- Identification of need, initial research, evaluation and justification	- Identification of need, initial research, evaluation and justification	- There was no difference
4	- Market research and identification of end user and target market - Proposed time and action plans	- Proposed time plan - Market research and identification of end user and target market - Begin actual time plan	- I do not know how to write an action plan. So I researched and completed it later.
5	- Design Brief - Design parameters - Criteria for success - Finance plan - Begin actual time and action plans	- Design Brief - Design parameters - Criteria for success	- I was unsure of what would need to be purchased to make the solution so the finance plan could not be developed
6	- Interview for ideas - Further research of other VR applications	- Finance plan	- Got a better idea of what needed to be purchased
7	- Sketch/Brainstorm Ideas	- Sketches and brainstorm	
8	- Evaluate initial ideas - Begin early development	- Begin experimentation	- Initial ideas and early development were unable to be pursued due to a lack of knowledge
9	- Evaluate progress and process	- Created proposed and actual action plan	- Finally consulted teacher using correct terminology

## Proposed and Actual Finance Plan

Table 8: Finance plan

Sourcing			Cost to me (\$)			
Item	Supplier	Payer	Estimated	Actual	Est. Total	Total
<b>Hardware</b>						
8 core CPU	Intel	Me	799	799	799	799
Motherboard	Asus	Me	389	389	1188	1188
16GB DDR4 RAM	Corsair	Me	300	300	1488	1488
250GB SSD	Samsung	Me	219	219	1707	1707
Computer Case		Me	100	100	1807	1807
<b>Other</b>						
Premade Assets	UE4 Market	Me	50	0	1857	1807

Estimated prices provided by PCpartpicker.com. The reason for difference in the UE4 market is because I did not end up purchasing any assets and this is partly because I used Unity in the end instead of UE4 (Unity does have an asset store though).

# Project Development and Realisation

## Initial ideas and sketches

- **Aim**
  - To find out specific pieces of information and test ideas.
- **Methods used to Research and Test**
  - 3D modelling, rendering, drawing, and digital art.

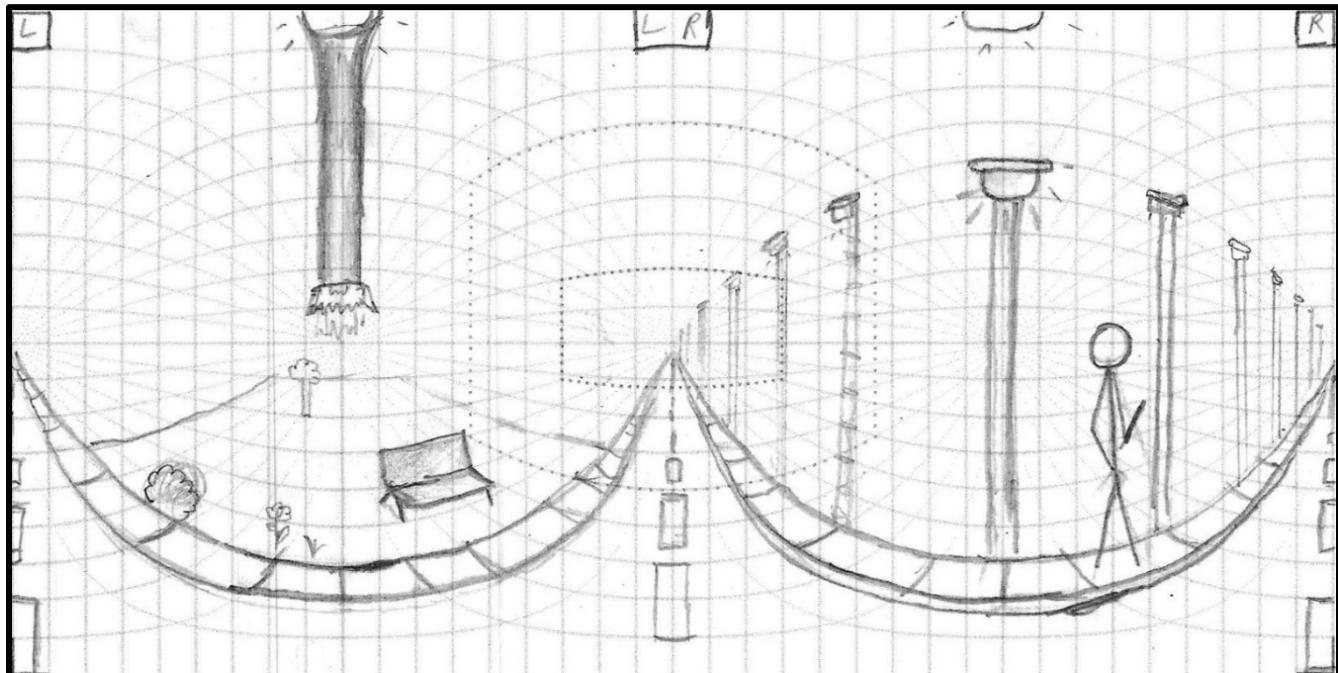


Figure 2: A drawing on a template of an unwrapped sphere to experiment with perspective and concept proofing in 360 degrees.

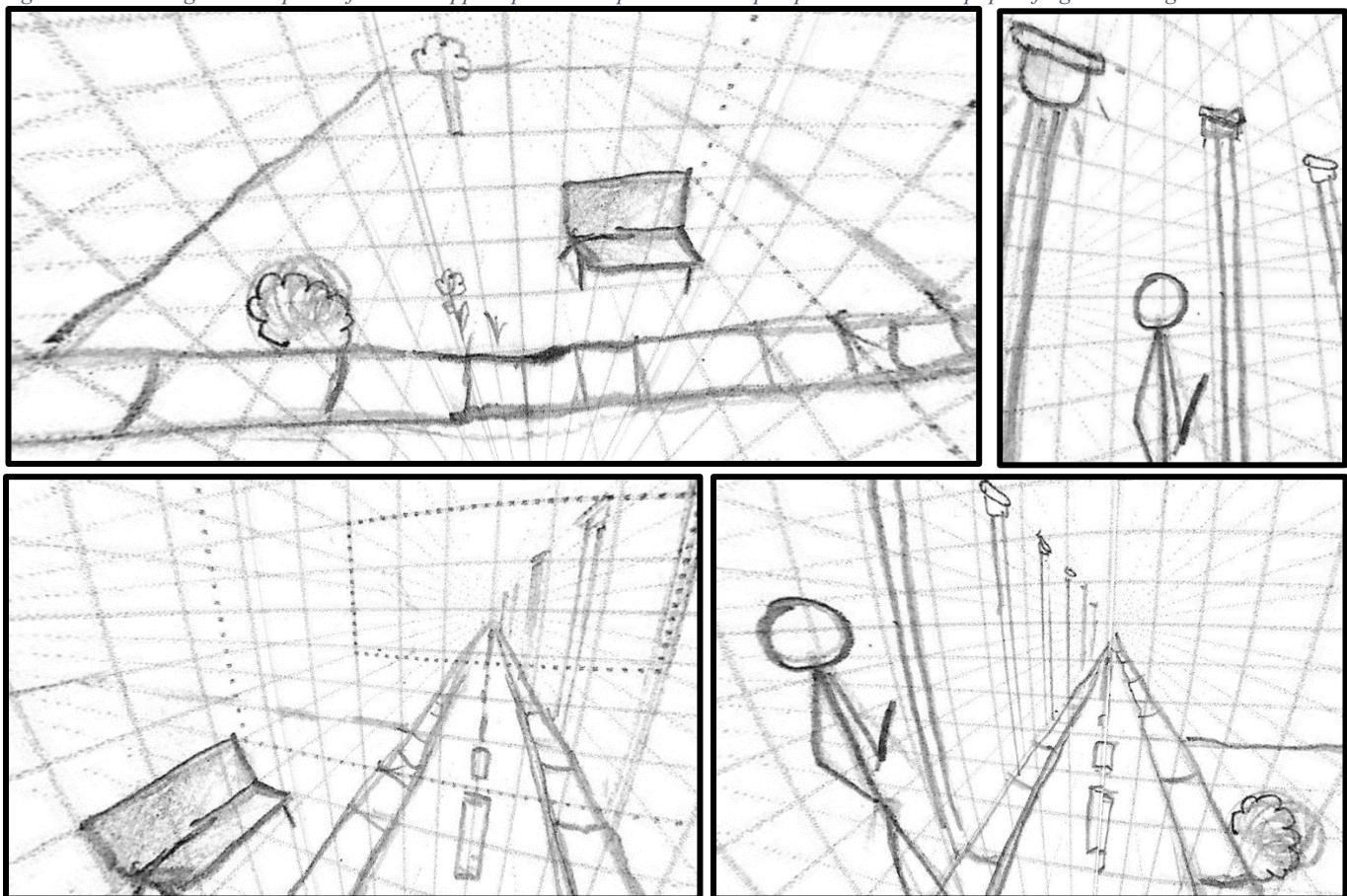


Figure 3: Screenshots of wrapped sketch in GoPro VR

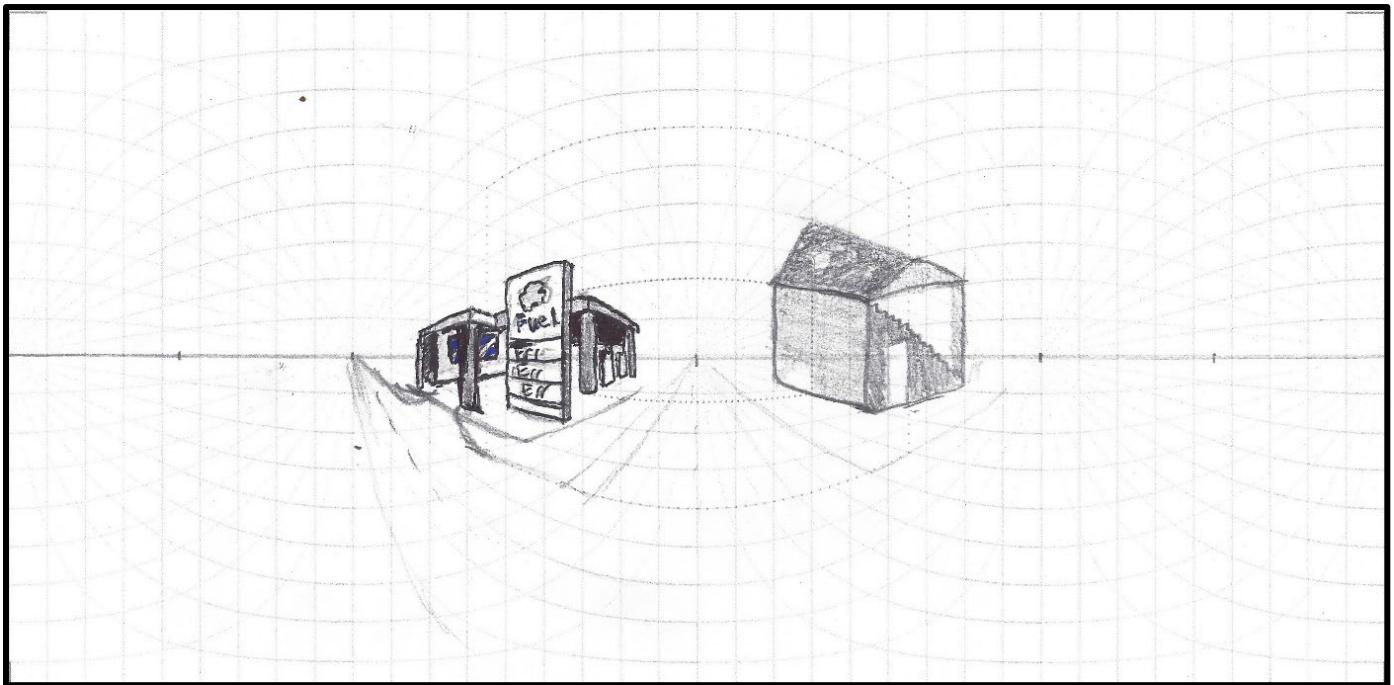
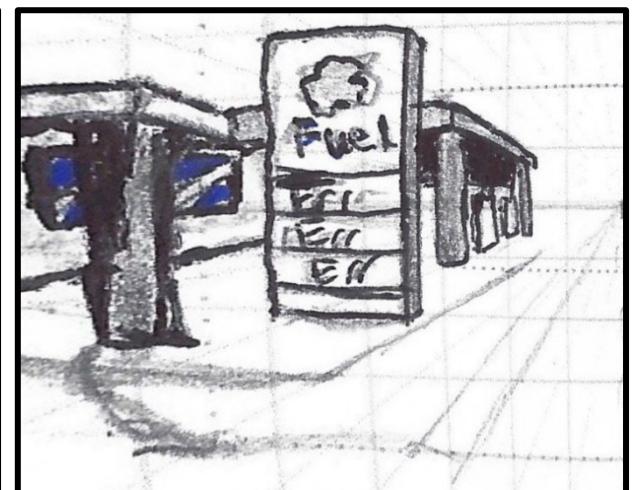
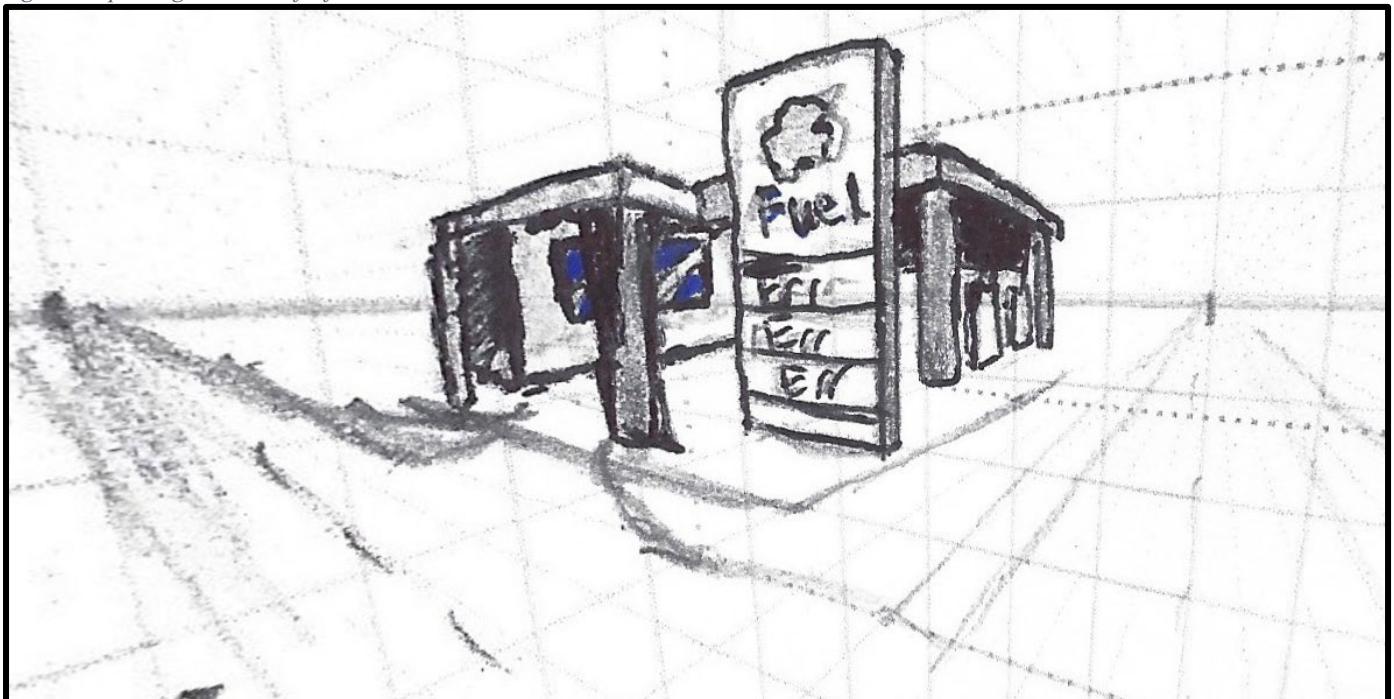
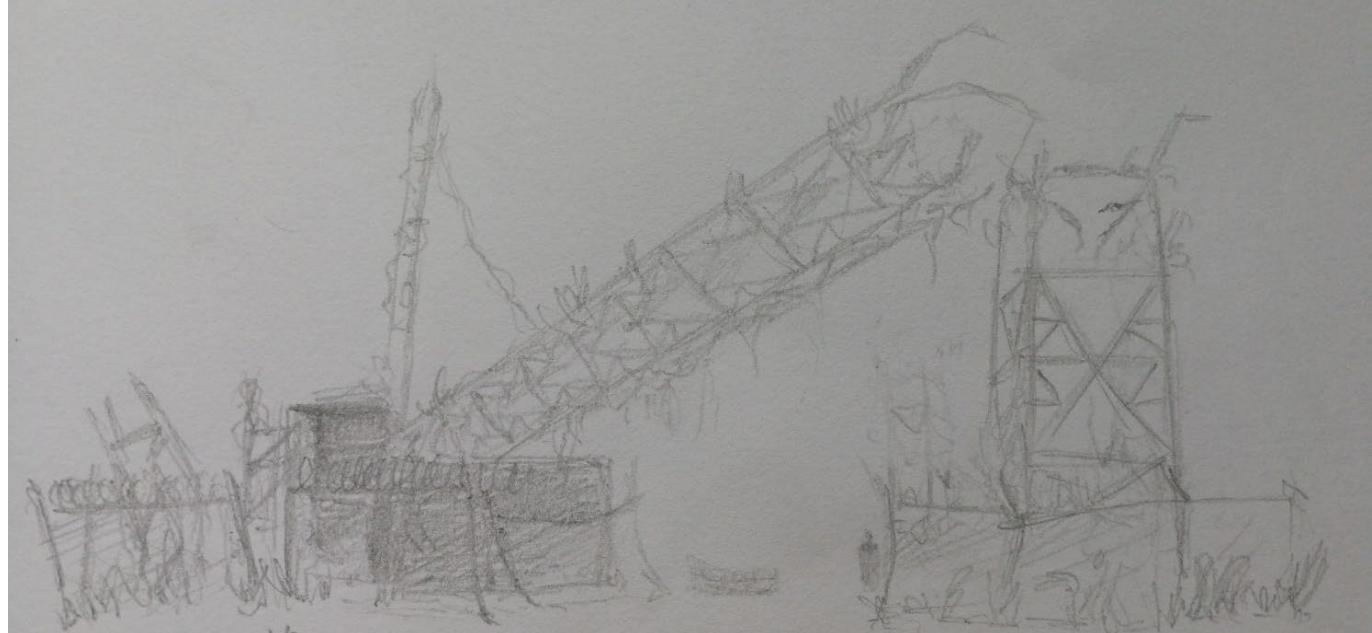


Figure 4: Sphere-grid sketch of a fuel station and a house



*Figure 5: Screenshots of the wrapped sketch in GoPro VR*



*Figure 6: Early building sketches*



Figure 7: First sketch of "helipad"

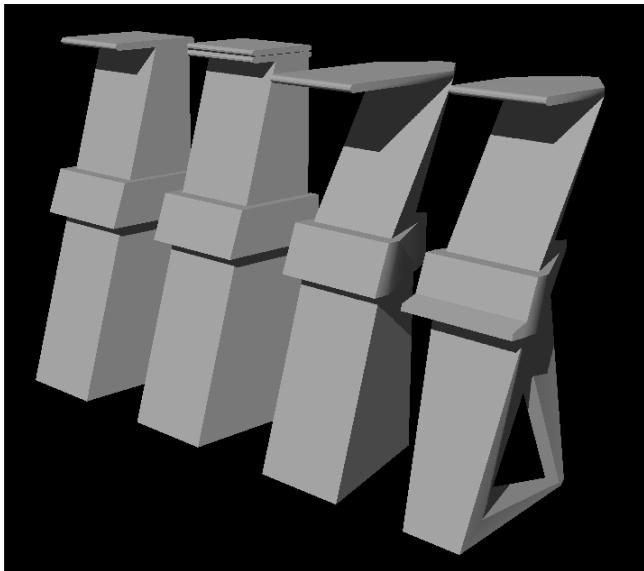


Figure 8: 3D iterations of "helipad"



Figure 9: Texturing experiment on "helipad"

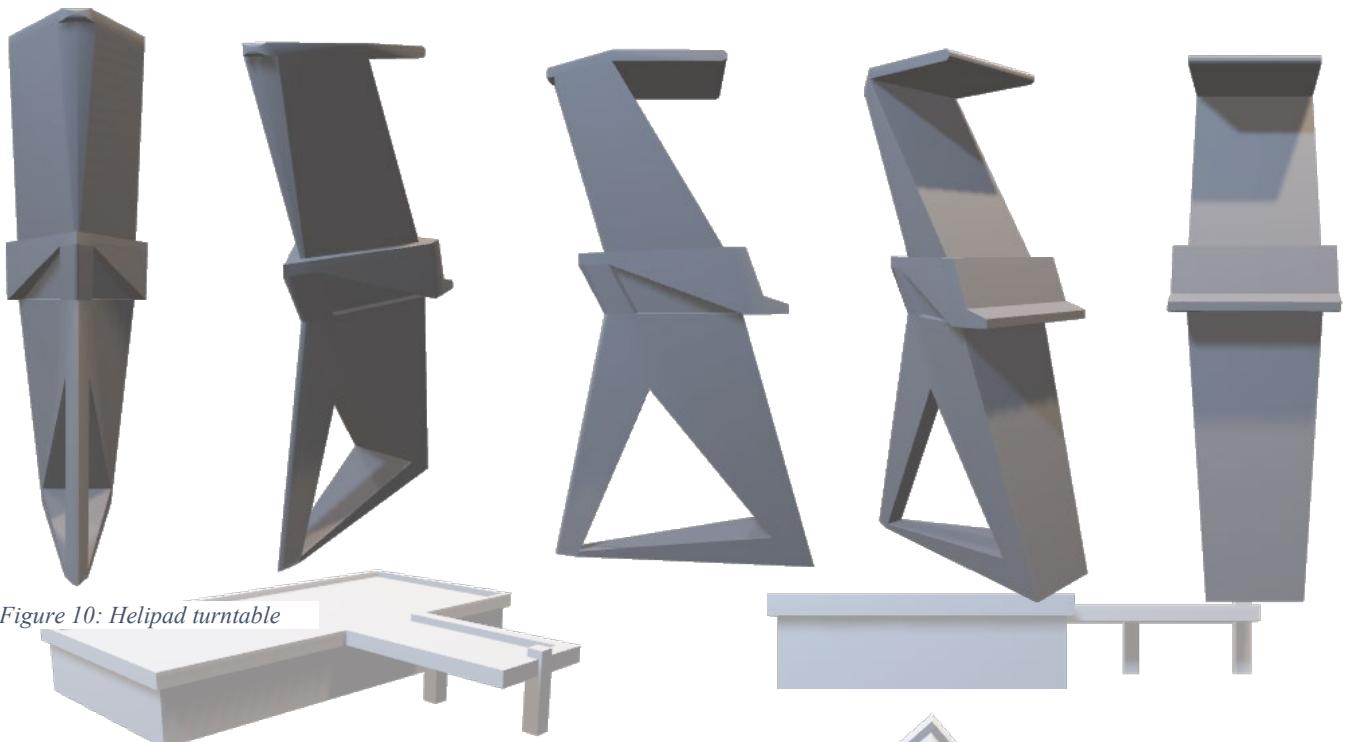


Figure 10: Helipad turntable

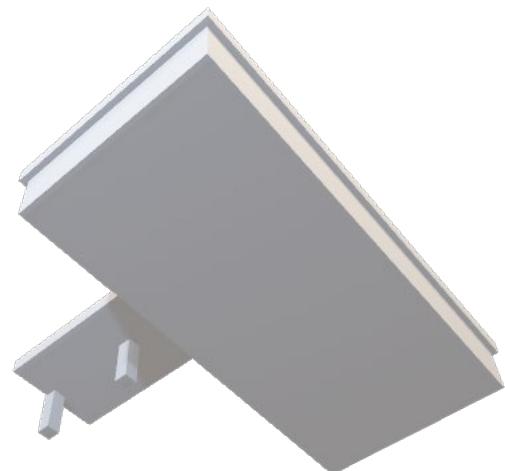


Figure 11: Multiple views of initial servo

## Sources of help/support

- **Aim**
  - To find mentors and people who can help give the project direction and provide inspiration.
- **Method**
  - Outreach and online
  - Sent connection requests to all the individuals involved in the Animal Logic Ready! Work experience program from December 2016
  - Asked the head of human resources at Animal Logic (Natasha Hagerty) if they could put me in contact with individuals who have experience with the VR pipeline
  - Contacted Mr. Hewes, a primary school teacher who uses VR to assist his teaching.
- **Result**
  - Connected with the head of human resources at Animal Logic who agreed to connect me with experts who may be able to assist me.



Not a bother. I'll see who I can put you in contact with. I know a few great lighters. I'll touch base with them and get back to you. If I'm not back to you by mid next week just send me a reminder message and I'll get onto those contacts.

Figure 12: Screenshot of response from Natasha Hagerty

○ <https://leehewes.wordpress.com/>

- **Conclusion**

- Individuals recommended by Animal Logic will be able to assist me.
- Mr. Hewes has valuable knowledge and experience in the field of VR for education.

- **Applications of Conclusion**

- With their mentorship I should be able to overcome creative barriers far more easily and proceed with actual development sooner.



Figure 13: Photo of Lee Hewes and his class

## Epigraph – The RAD Approach

The production process used during this project was the rapid application development (RAD) approach. RAD is a software development approach and is covered in the Software Design and Development HSC course. Samuel Davis' stage six software textbook states that "The RAD approach allows useable systems to be built within a small amount of time". The characteristics of the RAD approach include:

- Fourth generation language (The emphasis is on what is to be done rather than how it is accomplished)
- A lack of formal stages
- Communication between the developer and the client
- Continual feedback from users will be the main method of determining requirements
- A short time period
- A small-scale project (The development of my MDP is considered small scale)
- Low budget

The reasons this has been appropriate for the development of my project was my lack of skills, especially at the start of the project. The fourth generation language means that I can focus on what I need to do and learn how to do it as I go, this allowed me to develop a variety of new skills as I progressed through project development.

The lack of formal stages means that experimenting, prototyping and final production are less defined, which is suitable as I am making a product with many different individual parts, that each have various separate process that must done before they are finished. The fact that I am creating a software product also means that, with the application of version control, I can experiment and test on the most recent product without fear of breaking it. This allows for a smoother and more blurred transition from prototype to final product for each component. As I had a client during the production of the project I frequently deferred to them to ask small questions and what they would prefer in certain scenarios. The RAD approach was also appropriate as it was constrained by a short time period, a low budget while also being a small scale project.

The biggest disadvantage of the RAD approach is that quality and functionality is sacrificed for speed, however this isn't a significant issue in the case of this project due to the Google Cardboard's limited functionality and mobile device's restricted processing power.

The impact of the RAD approach on this documentation (largely due to its lack of formal stages) has been that the research, experimentation, testing and production of the product are intertwined.

## Research, Experimentation and Testing

### Existing solutions

- **Aim**
  - To find virtual reality content developed for the Cardboard that can be used as inspiration
- **Method**
  - Online research
- **Result**
  - I found hundreds of educational virtual reality applications for Cardboard but none to teach students about dystopia.
  - <http://virtualrealityforeducation.com/google-cardboard-resources/> had the below list of apps written on its website with a short description of each experience. The descriptions have been removed due to space restraints.

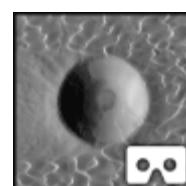


**Tilt Brush**

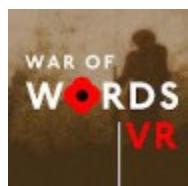
Gallery



**In Mind VR**



**Mars is a  
Real Place VR**



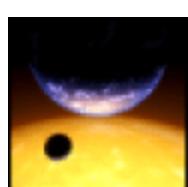
**War of  
Words VR**



**Paris VR**



**Within -  
VR**



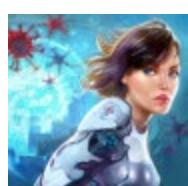
**Titans of  
Space**



**Virtual  
Tour Google Cardboard**



**Orbulus**



**InCell VR**



**Discovery  
VR**



**Bosch VR**

Figure 14: Assorted VR apps

Some of these apps are educational, some are creative, some are informative and some are games. Some of them are a mix, however none of them focus solely on a dystopian earth. The apps did however provide inspiration for the scene. Tiltbrush provided some great concept ideas, discovery VR has some great locations, war of worlds VR had some fantastic assets and Mars is a Real Place VR conveyed the oddness of a barren landscape very effectively.

- **Conclusion**
  - Despite the large number of applications available, none feature the dystopia unit in a way that meets the needs of the English syllabus, thus, no solution.
  - Some of the above apps allowed me to understand ways to create mobile friendly content.
- **Application of conclusion**
  - As there is no solution I will continue to make my own.

## Inspiration images

- **Aim**
  - To determine what sort of world/scenario I should make based upon the clarifications of my client brief and when looking at the time allowed compared to my abilities and the limitations of the Cardboard.
- **Method**
  - Online research and evaluation
- **Results;**
  - Example landscapes

*Table 9: Inspiration images*

	Cityscape/Urban	Town/Country
<b>Overgrown</b>	 ii	 iii
<b>Barren</b>	 iv	 v
<b>Destroyed</b>	 vi	 vii

- **Conclusion**
  - Will have to be a simple landscape as the complex landscapes are too resource intensive.
- **Applications of Conclusion**
  - A barren environment mixed with the ‘destroyed town’ box is the best option as it will have high visibility, be immediately barren. Any information that needs to pop will be made to stand out due to the lack of large structures and other noise.

## Possible presentation mediums

- **Aim:**
  - To determine which VR head mounted device (HMD) will be used to present the product.
    - This will greatly affect the workflow and final product due to the limitations of available systems.
- **Method**
  1. Spoke to the TAS to identify which HMD's were already owned by the school.
  2. Compare headsets owned by the school and two other headsets. Consider their “level”, cost, minimum hardware requirements (as defined by the HMD’s manufacturer), cost of the respective hardware requirements, functions and portability. Using these as a guide, assign practicality rating, from low to high.
  3. Release a poll to determine smartphone ownership.
- **Safety Considerations**
  - Virtual reality headsets can cause; nausea, eye strain and neck strain.
  - They must be set up in a space clear of any physical obstacles as they blind the user to their surroundings.
- **Other considerations**
  - The price and/or mobility of the medium must not make the medium impractical for school use.
  - Ideally, the medium(s) must be useable by 30 people at once.
- **Results**
  - The school currently owns a class set of ‘Google Cardboard 2.0’ (Cardboard) headsets, an ‘Oculus Rift Developers Kit 2’ and an ‘Oculus Rift’ (Oculus).
  - There are a large number of mediums that vary greatly in price, quality and practicality for school use.
  - Most headsets are too expensive, require too much computing power or are too large to be practical

*Table 10: A comparison of some HMDs. [1]*

Name	HTC Vive	Oculus Go	Google Cardboard 2.0	Oculus Rift
Image	 <i>Figure 15: HTC Vive</i> <small>viii</small>	 <i>Figure 16: Oculus Go</i> <small>ix</small>	 <i>Figure 17: Google Cardboard</i> <small>x</small>	 <i>Figure 18: Oculus Rift</i> <small>xi</small>
No. Owned	1	0	30	1.5 (DK2 is a half)
Grade/Level	High-end	Mid-level	Entry level	High-end
Minimum requirements, equivalent or better is okay.	<b>GPU:</b> Nvidia GTX 970 <b>CPU:</b> Intel i5-4590 <b>RAM:</b> 4 GB <b>Video Output:</b> HDMI 1.4, DisplayPort 1.2 <b>USB Port:</b> 1x USB 2.0 <b>Operating System:</b> Windows 7 SP1, Windows 8.1 or later, Windows 10	None	iOS 8 or newer Android Jelly Bean or newer (A smartphone)	<b>GPU:</b> Nvidia GTX 970 <b>CPU:</b> Intel i5-4590 <b>RAM:</b> 4 GB <b>Video Output:</b> HDMI 1.3 <b>USB Ports:</b> 3x USB 3.0, plus 1x USB 2.0 <b>Operating System:</b> Windows 7 SP1 64-bit or newer

Cost of requirements (AUD)	>\$1000	\$0	\$250	>\$1000
Features	Room-scale positional tracking, two remotes, tethered to PC	Mobile, one remote, standalone	Mobile, one button, requires phone	Room-scale positional tracking, two remotes, tethered to PC
Price (AUD)	\$1000	\$250	\$15	\$600
Practicality	Low	High	High	Low to mid (as we own 2)

- **Conclusion**

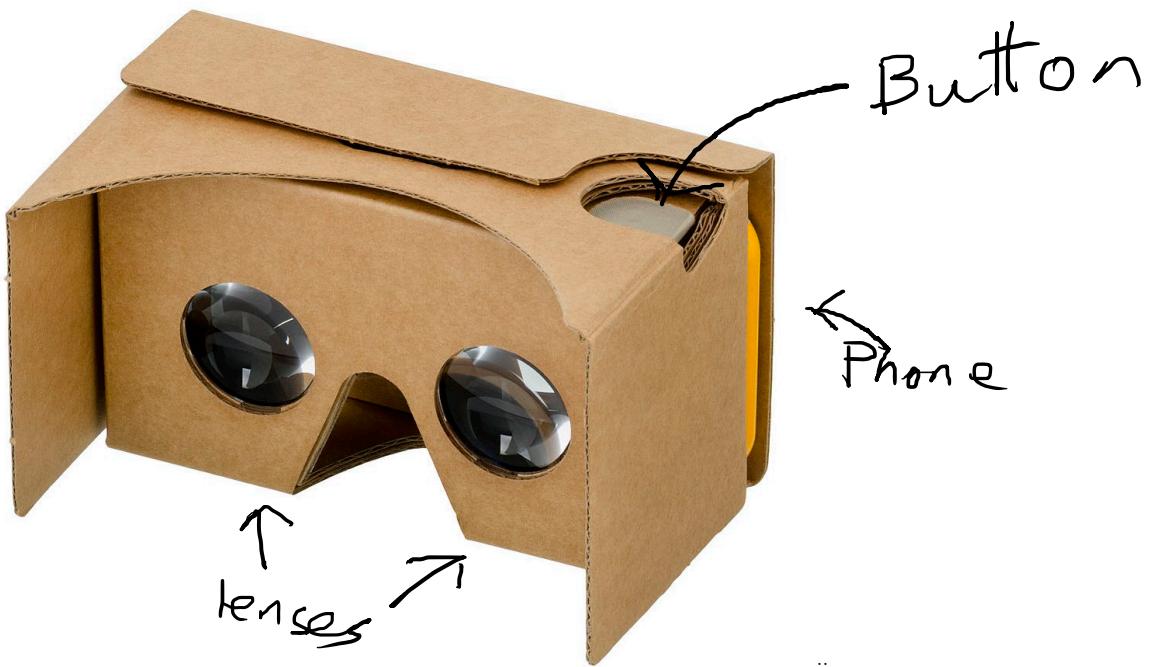
- The medium used will be the Google Cardboard 2.0 because the school already owns a class set. My observation is that almost every student has a smartphone that meets the minimum requirements of the Cardboard and those that do not can borrow one. Furthermore, cardboards are lightweight, versatile, mobile and cheap. Their main drawback is that their performance is restricted by the phone's hardware.

- **Applications of Conclusion**

- Further research must be conducted to identify the capabilities of the presentation medium.

## Capabilities of presentation medium

- **Aim**
  - To determine the capabilities of the presentation medium (the Cardboard) and how to best accommodate them. E.g. processing power, sound, etc.
- **Method**
  1. Investigate how the Cardboard communicates with the user (output) via observation.
  2. Investigate how the user communicates with Cardboard (input) via observation.
  3. Investigate what the user must do to use the Cardboard via observation.
  4. Investigate the implications of using a personal mobile device as the processing unit.
- **Result**
  1. The Cardboard has two methods of communicating with the user; aurally and visually.
  2. The user has two methods of interaction with the Cardboard, namely, gaze (phone gyroscope detects which direction user is looking) and a button, which is located on the top right of the device.
  3. In order to use the Cardboard the user must hold it to their face.



xii

Figure 19: Annotated Cardboard

4. The processing power of the Cardboard is provided by personal mobile devices (such as smartphones), as such, the Cardboard will perform differently per device. The oldest iPhone that can be used with the Cardboard is the iPhone 5. However, despite being able to run Google Cardboard apps the iPhone 5's screen is not large enough, as such the minimum spec phone that the product will be developed for is the iPhone 6. The iPhone 5 is also quickly becoming largely obsolete. On the topic of obsolescence, smartphones become obsolete relatively fast, as such, it would be better to design the product for a device just above the minimum requirements in order to maximise the accessibility of the product with minimal impact on quality.
- **Conclusion**
    - Interaction between the user and the Cardboard is limited.
    - Specific pipelines and techniques must be employed in order to make a product that is both effective, within the abilities of the Cardboard and varying abilities of the mobile devices that may be used.

- The mediocre processing power of smartphones will greatly affect the assets and visual techniques used in the product. For example; complex dynamic lighting and effects will not be useable within the product.
- **Applications of Conclusion**
  - Ensure that the user interface (UI) is familiar and intuitive enough to be used with the limited inputs of the Cardboard, this will require further research.
  - Due to the limited power of mobile devices all aspects of the product must be developed with optimisation (to reduce the processing power required) in mind. This will require further research, experimentation and testing.
  - Create the product to work effectively on the iPhone 5s and equivalent devices, with the minimum requirement being an iPhone 5. Target iPhone 6 and equivalent devices as the recommended specification, anything above that will run the at a higher quality (good thing).

## Techniques to minimise processing power required without degrading quality (optimise)

- **Aim**
  - To find techniques and strategies to ensure the product runs at a smooth and consistent framerate while also looking photorealistic.
- **Methods**
  - Online research including forums and tutorials.
    - Optimizing graphics performance.  
<https://docs.unity3d.com/Manual/OptimizingGraphicsPerformance.html>
    - The animators journey <http://animatorevolve.blogspot.com.au/2015/11/low-poly-modelling.html>
  - Mentor/expert consultation.
- **Result**
  - Optimisation methods for 3D environments include the employment of:
    - Prebuilt lighting – Calculates where light from all sources falls and creates shadows, building light live is extremely resource intensive and requires powerful computers to output a high quality images at an acceptable framerate.
    - Texture and animation baking – After building the lighting, the shadows are saved as part of the objects texture, rather than an overlay, further reducing computing power required.
    - Low-poly models – Each 3D asset's shape is defined by polygons that create a net of the model, more polygons means more detail, but it also means that more processing power is required.
    - Normal and bump maps – An image that defines how the model should reflect light and some finer details of its surface. When these maps are placed onto a low-poly model they make it appear as if it was high-poly.



Figure 20: Poly and Map example.

- Level of detail – Objects in the distance are replaced by simpler versions that look the same when viewed from afar.

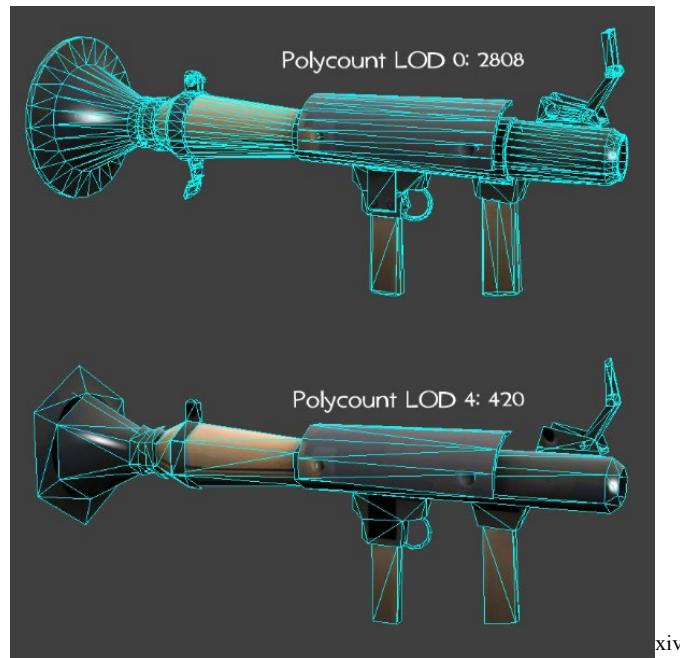


Figure 21: Level of detail example

- Object culling – The camera ignores objects that are hidden behind other objects.
- Skysphere/skybox – An image that wraps around the environment, normally consists of the sky, the ground and the background/horizon.

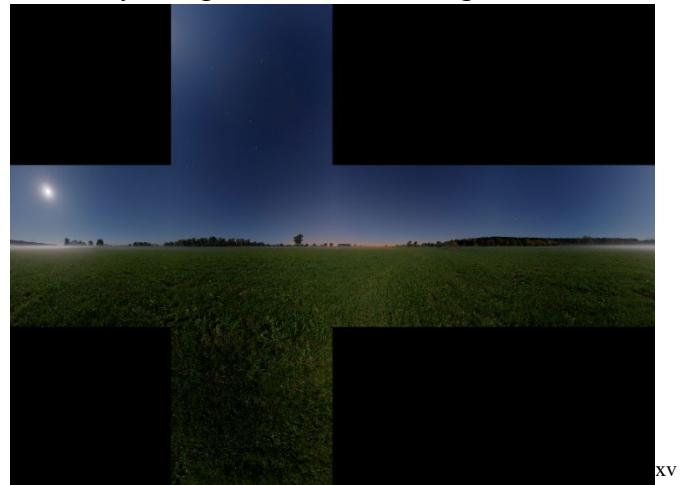


Figure 22: An unwrapped skybox

- **Conclusion**
  - There are ways to make a photorealistic scene without overusing hardware resources by employing the techniques listed above.
- **Applications of Conclusion**
  - Test to see what is most achievable and the best method of approach for the product.

## The best way to optimise the product

- **Aim**
  - To determine the most effective and achievable method of creating a photorealistic environment for use with the Cardboard.
- **Method**
  - Investigate and evaluate other mobile VR products e.g. VR apps and 360 video.
- **Results**

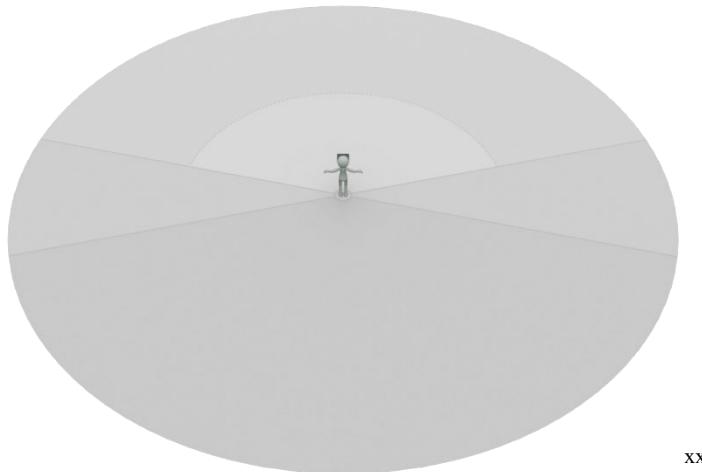
Table 11: VR product PMI

Comparison of three mobile VR products			
Product	Plus	Minus	Interesting
InMind VR (Cardboard)	Photorealistic Interactive via gaze	Stuck on a rail	Uses photospheres (the galaxy background), low poly modelling, mapping and textures to achieve photorealism. It also employs many other optimisation techniques
 xvi			
Figure 23: InMind screenshot			
Photosphere	Photorealistic	Zero interactivity	Wraps a distorted image into a sphere. This is the same way a photosphere works, therefore, this image could be used as a photosphere.
 xvii			
Figure 24: A photosphere of Venice			
360 Videos – Mega coaster: Get Ready For the Drop (360 Video)	Photorealistic  A film, which means moving elements.	Zero interactivity	Virtual heads up display elements (HUD) were overlayed to show information
 xviii			
Figure 25: 360 video thumbnail			
 xix			
Figure 26: A screencap of a HUD element			

- **Conclusion**
  - Images and film are a great way to show detail in the distance or in scenarios where the player cannot move as they require the least processing power from the device when compared to every other optimisation technique.
- **Application of Conclusion**
  - Photospheres will be employed to show most of the world and the few interactive parts of the scene will be placed in space. It will achieve the illusion of space and realism so long as the player does not move as this will disrupt the effect.

## How to prototype for VR/VR development pipeline

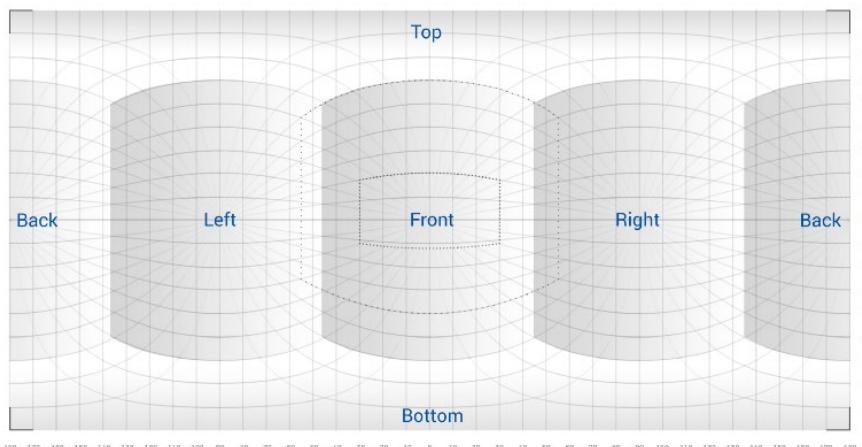
- **Aim**
  - To find appropriate workflows for the prototyping and development of the product.
- **Method used to research**
  - Online research with search terms including but not limited to:
    - How to prototype for VR
    - VR development pipeline
    - VR pipeline
- **Results**
  - 4 systems that could be used were found in Tessa Chung's article; "Strategies for VR Prototyping" <https://medium.com/@indiecontessa/strategies-for-vr-prototyping-810e0d3aa21d>
    1. A storyboard tool with the different viewing areas on it



xx

Figure 27: A storyboard layout for VR

2. Sketches using a 360° Panorama Grid tool



xxi

Figure 28: Annotated 360° panorama grid

3. 360° Prototyping using 2D assets
4. Prototype with 3D assets

- **Conclusion**
  - The storyboard and grid are fantastic tools plus the process seems effective and makes sense overall
- **Application of conclusion**
  - Future prototyping will employ the above steps and tools.

## Testing VR compatible images

By rendering various photospheres I was able to learn how to create basic lighting as well as how to go from the viewport with a simple overview of the scene to a rendered, lit and coloured photosphere.

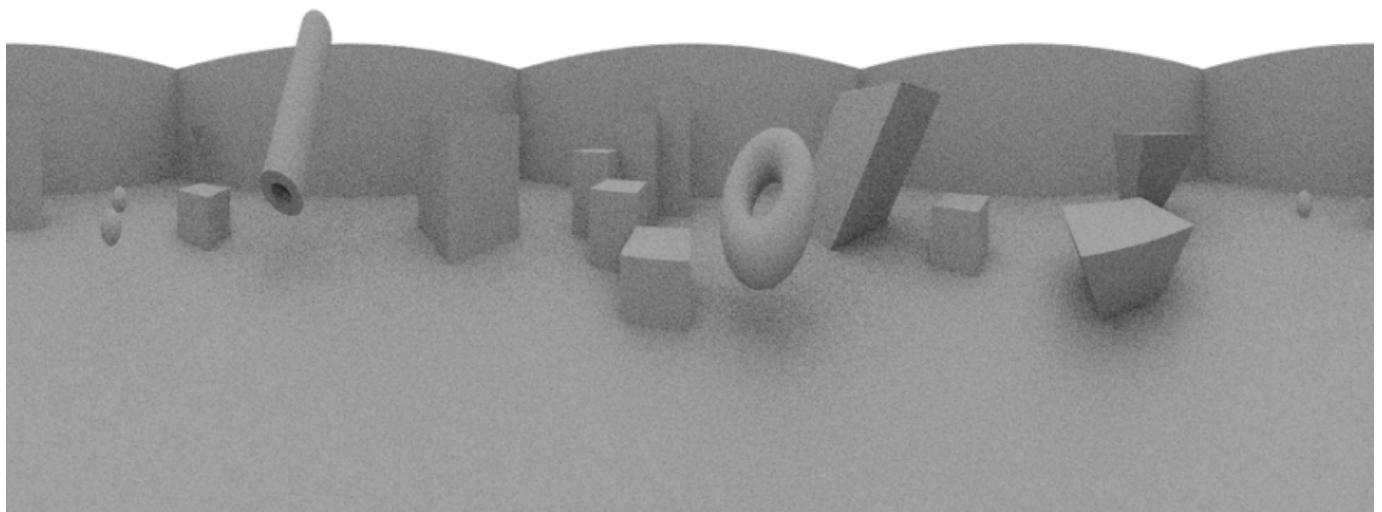


Figure 29: Rendered photosphere experiment

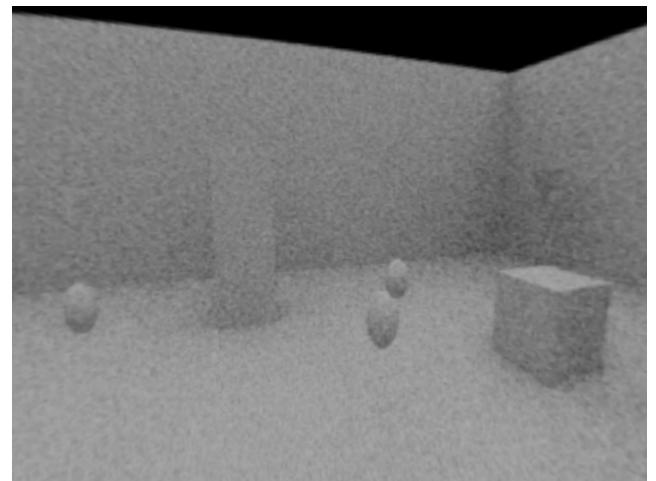
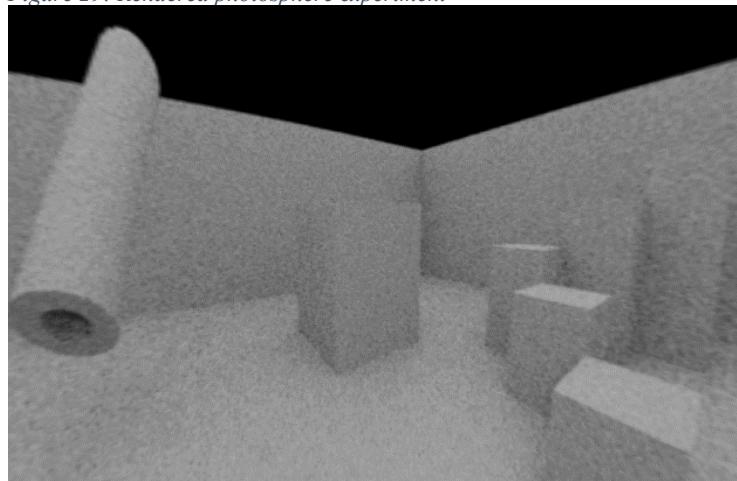


Figure 30: Screencaps of photosphere 1



Figure 32: 2nd rendered photosphere experiment (V1)

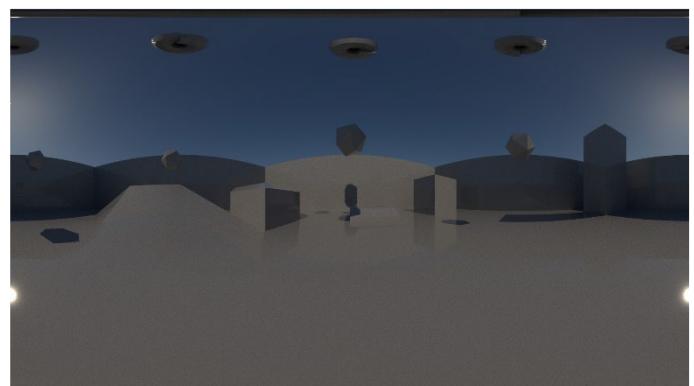


Figure 31: 2nd rendered photosphere experiment (V2)

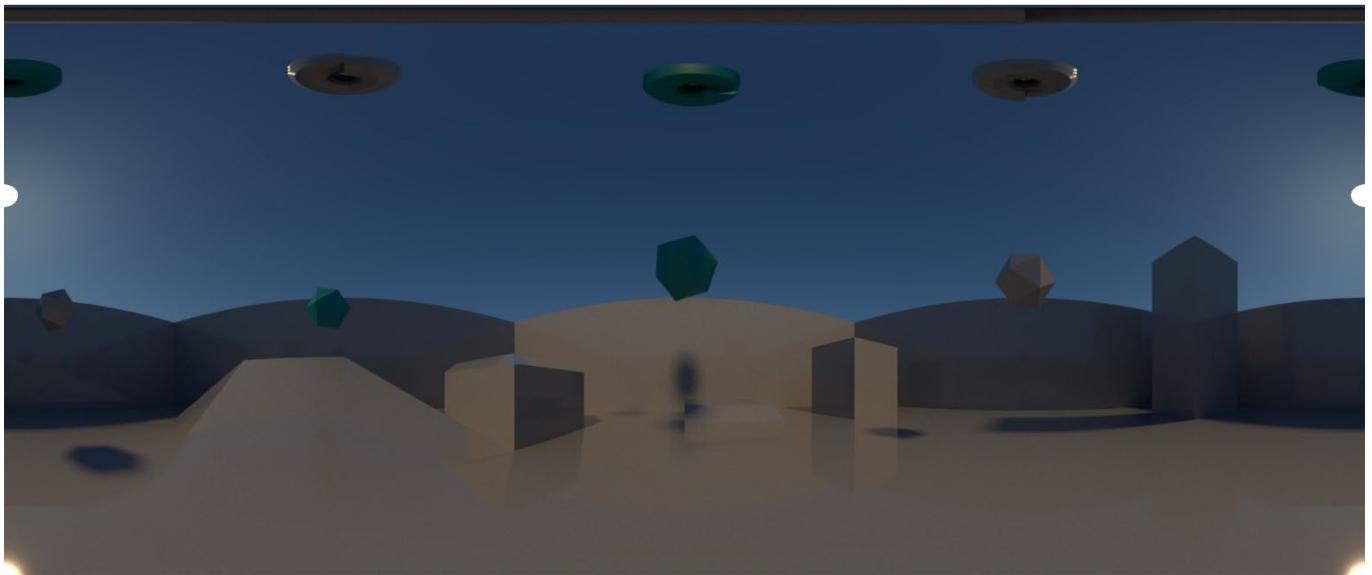


Figure 33: 2nd rendered photosphere experiment (V3)

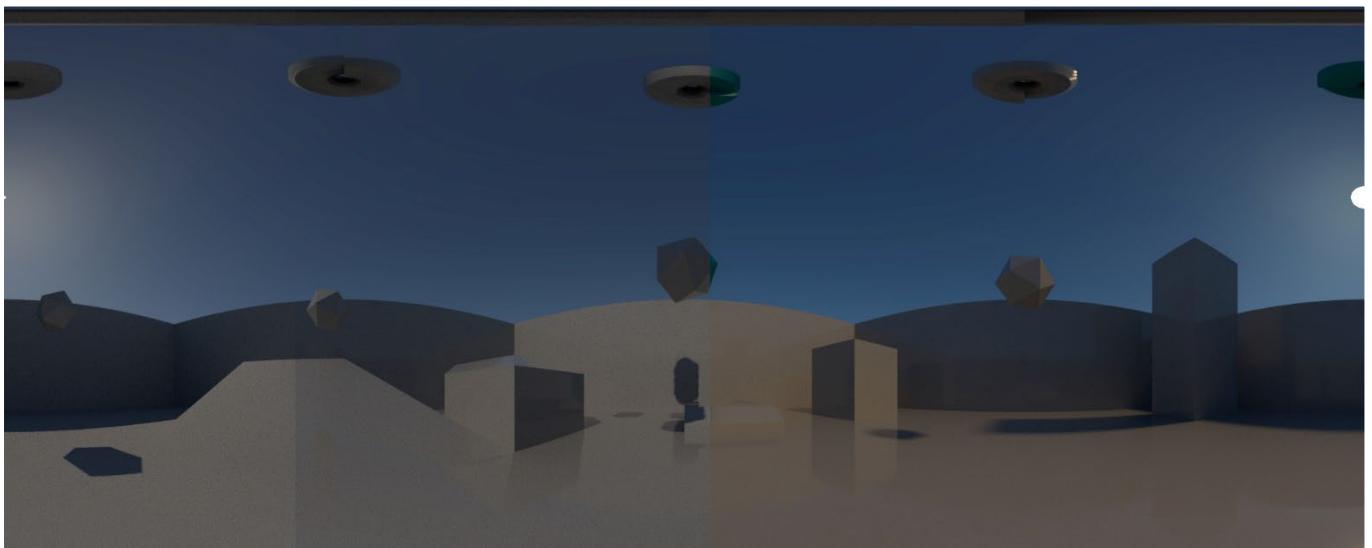


Figure 34: 2nd photosphere experiment iteration comparison



Figure 35: Screencaps of wrapped photospere 2

## Conclusion

- Photospheres are looking good, lighting is photorealistic, texturing is difficult.
- Panels have many settings, and each pixel can have a multitude of variables acting upon it, and the required aesthetic of the scene is hugely demanding.
- Every face of every object can be modified in resolutions up to 8k and this, combined with the number of options in each panel as stated above, is overwhelming

- **Application of conclusion**

- Use photospheres, learn how to texture, improve 3D modelling skill.
- Set limits on time dedicated to each object, this will be determined by the object's distance from the camera and, often related, importance in the scene. This means that foreground objects will be the most polished while background objects will be less so, but due to their distance from the camera it shouldn't be noticeable.

## Possible final build tools (software)

- **Aim**

- To find the most efficient and appropriate software for the creation of my product.

- **Method used to research**

1. Performed Google searches for VR development engines.
2. Compared the four engines that I saw most often.

- **Results**

- There are a massive amount of 3D Game and VR development tools available to the public for free, however the 4 that stood out were Unity 5 (Unity), Unreal Engine 4 (UE4), A-frame and Sketch. Further research showed Unity and UE4 were more appropriate than the other options.



xxii

Figure 36: Unity logo



UNREAL  
ENGINE

xxiii

Figure 37: Unreal Engine logo

- **Conclusion**

- Choosing between these two was very difficult, what made up my mind in the end was the community of Unity users. Unity has far more tutorials, active help forums and documentation which will help me greatly during my project.

- **Application of Conclusion**

- All the arranging of assets and code will take place within the Unity engine. Everything I make will have to be compatible with Unity. I will also have to familiarise myself with Unity's interface.

## Possible development tools (software)

- **Aim**
  - To find the most efficient and appropriate software for the creation of my product.
- **Method used to research**
  - Prior experience
  - Online research
- **Results**

Table 12: Potential development software evaluation

<b>Software Name</b>	<b>Role in Project</b>	<b>Evaluate</b>
Autodesk Maya  xxiv <i>Figure 38: Maya logo</i>	Modelling of virtual objects, creation of environment and rendering of the skydome	A fantastic vertex based modelling and animation tool with animation and photorealistic rendering (via Arnold) features
Autodesk Mudbox  xxv <i>Figure 39: Mudbox logo</i>	Texturing virtual objects	Great for editing and optimising quad-based models, otherwise broken
Autodesk Fusion 360  xxvi <i>Figure 40: Fusion 360 logo</i>	Modelling of virtual objects	A great sketch-based CAD tool that can export vertex models, the measurements are really helpful for scale.
Adobe Photoshop  xxvii <i>Figure 41: Photoshop logo</i>	Texturing virtual objects and editing 360 images	An industry grade pixel-based image editor, will be really helpful.
Google Street View App  xxviii <i>Figure 42: Streetview app logo</i>	Taking 360 photos and viewing them on mobile	Good for experimentation and prototyping.
GoPro VR player  xxix <i>Figure 43: GoPro VR player logo</i>	Viewing 360 images and videos	Good for experimentation and prototyping
Mixed Reality Viewer  xxx <i>Figure 44: MRV logo</i>	Quickly preview 3D models	Comes with windows PCs so its just easy to use

- **Conclusion**
  - All programs in the table above will be used during product development.
- **Application of conclusion**
  - Learning to use and using the above tools in such a way that I am able to develop an efficient workflow between them and the skills to be able to create a high quality product.

## Tools techniques and human resources

- **Aim**
  - To find advice, websites and forums that will be helpful when creating and modelling the virtual objects and creating the environment.
- **Method**
  - Search online for forums and tutorials
- **Result**
  - There are many sites, potential connections and forums that can assist me as I develop my project. These include Unity's official forums, the Autodesk forums, countless youtubers and even blogs.

Table 13: Potential development resources evaluation

<u>Tools</u>	<u>Role in Project</u>	<u>Evaluate</u>
<b>Hardware</b>	<b>Modelling and testing</b>	
Windows PC	Runs all the software	Vital
Scanner	Digitisation of sketches	Digitises sketches
iPhone 6 or newer	Testing product	The “minimum spec” platform
Android phone running kitkat or greater OS	Testing product	The “minimum spec” platform
Google Cardboard	Testing product	The presentation medium
Oculus Rift DK2	Previewing and testing product	Used to review the look of the scene in VR without the need to export to mobile
Graphics Tablet	Assist in modelling and texturing	Speeds up asset creation drastically
<b>Instructional Websites</b>	<b>Learning</b>	
Autodesk knowledge network <a href="https://knowledge.autodesk.com/support">https://knowledge.autodesk.com/support</a> - /maya - /fusion - /mudbox - /arnold	Learn how to use Maya, Mudbox, Fusion and Arnold	Really helpful with very specific and direct information
Unity 5 websites	Learn how to use Unity 5	Provides information on how to use Unity and is vital
Adobe websites	Learn how to use Photoshop	YouTube tutorials were generally better
<b>Forum Websites</b>	<b>Learning and asking questions</b>	
Autodesk Maya Forums <a href="https://forums.autodesk.com/t5/maya/ct-p/area-c2">https://forums.autodesk.com/t5/maya/ct-p/area-c2</a>  <b>Maya Forum</b> Welcome to Autodesk's Maya Forums.	Learn how to achieve specific outcomes in Maya	An excellent resource with a massive amount of specific information, all accessible by a quick search. Users can also ask questions which will be quickly answered by the community

Autodesk Mudbox Forums	Learn how to achieve specific outcomes in Mudbox	Fantastic site because of the immensely helpful community
Autodesk Fusion Forums	Learn how to achieve specific outcomes in Fusion	Fantastic site because of the immensely helpful community
Unity Forums <a href="https://forum.UnityEngine.com/">https://forum.UnityEngine.com/</a>	Learn how to achieve specific outcomes in Unity	The Unity forums have an active community and a plethora of information about the engine.
Stack exchange	Learn how to achieve specific outcomes where coding is involved	Really helpful with a knowledgeable and helpful community
<b>Videos</b>	<b>Learning</b>	
Maya tutorials	Learn good practices and how to overcome specific problems in Maya	Easier to follow than text but also takes longer
Mudbox tutorials	Learn good practices and how to overcome specific problems in Mudbox	Easier to follow than text but also takes longer
Fusion tutorials	Learn good practices and how to overcome specific problems in Fusion	Easier to follow than text but also takes longer
Unity tutorials	Learn good practices and how to overcome specific problems in Unity	Easier to follow than text but also takes longer

- **Conclusion**
  - All appraised sites have been used already, and many other sites will be used during project development for specific purposes.
- **Applications of Conclusion**
  - An annotated bibliography will be kept in the journal to keep useful and relevant sites organised.

## User experience + ergonomics and safety

- **Aim**
  - To learn how to make a product that is safe and has a comfortable and intuitive user experience (UX).
- **Method**
  - Online research.
- **Result**
  - The google cardboard has a field of view of about  $90^\circ$ .
  - The Cardboard effectively blinds the user, so it is important to make sure it is used in an environment free of obstacles.
  - Nothing in VR should be placed within half a meter and nothing important should be placed further than 20m.
  - $75^\circ$  is the comfortable viewing angle from sitting, left and right.
  - Text should be just over half a meter away.

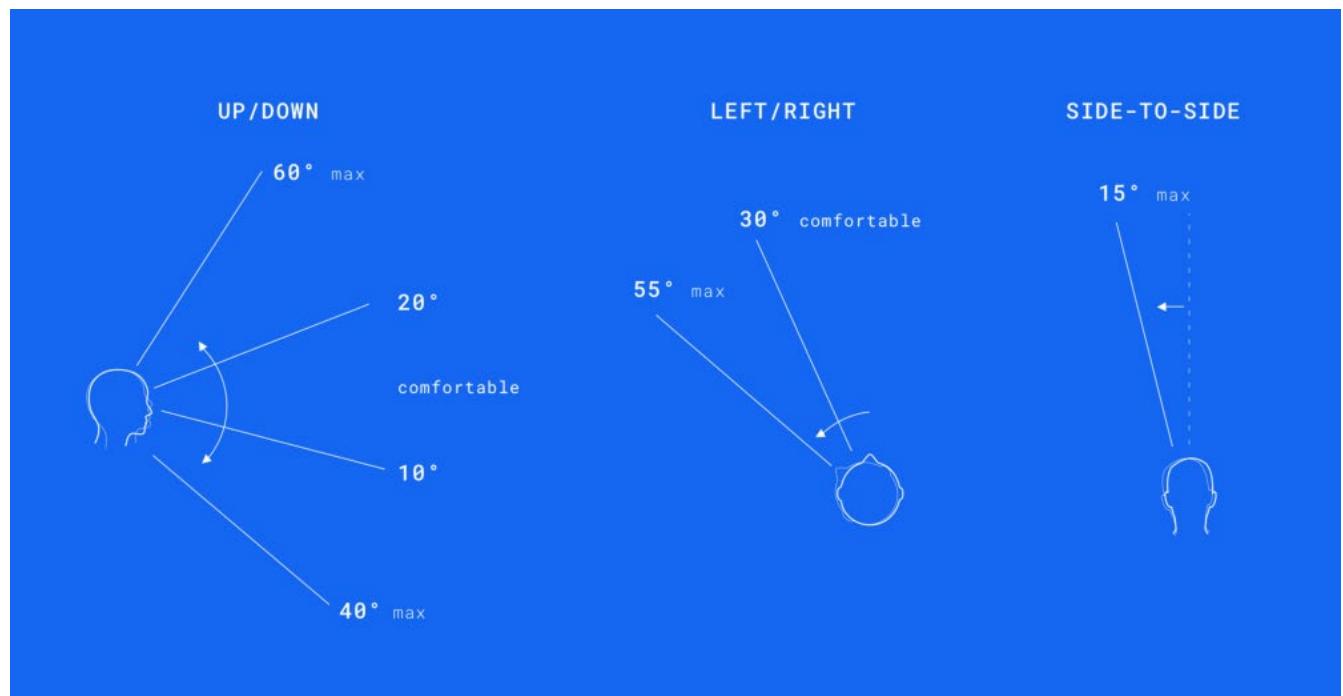


Figure 45: Comfortable viewing angles

- **Conclusion**
  - Ensure that the guidelines are followed wherever possible to maximise intuitiveness and safety of the product.
- **Applications of Conclusion**
  - Restrict most relevant and important information to within the comfortable viewing angles.

## A single static object from start to finish

- **Aim:**
  - Process undertaken to add a single **static** object to the scene
- **Method**
  - Recount steps with prototype
- **Results**
  - Design and build object in fusion 360 or Maya
    - If made in fusion, export as a .fbx file and bring it into Maya
  - Place object in correct location
  - UV map object
  - Create UV textures for object in Maya or Mudbox or Photoshop
  - Add any necessary lights and/or FX to object
  - Render full photosphere, this currently takes around an hour to output a single 8000 x 4000 photosphere, but the time will increase as complexity is added to the scene.
  - Import into Unity
- **Conclusion**
  - Creating an object is a time consuming process and it is important that there is a clear goal in mind when creating it to avoid wasting time.
  - It is also important to be mindful of:
    - Render time
    - File Size
    - Unity's restrictions
- **Application of conclusion**
  - Continue building

## Building a complex object

- **Aim**
  - To identify how long it takes to design, create and fully texture complex objects.
- **Method**
  - Build a complex object in Autodesk Maya
- **Result**
  - A Pot with disturbed water in it

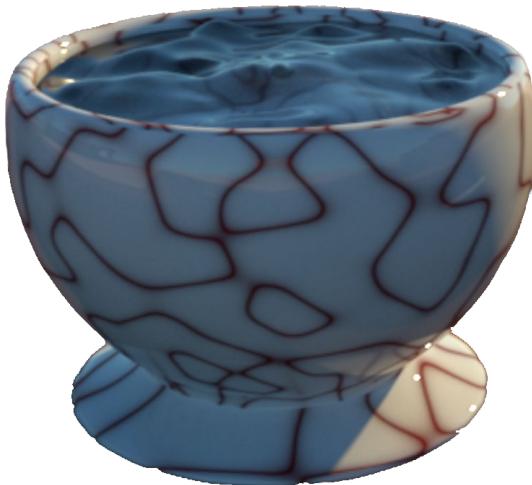


Figure 46: A render of the completed pot

- 
- **Conclusion**
  - Time: 6 hours
  - List of objects that need to be built and textured:
    - Petrol Station
    - Playground/Swingset
    - Billboard
    - School
    - Sky
    - Road
    - Terrain
    - Smoke and other FX
    - Assorted smaller objects
- **Applications of Conclusion**
  - The time taken to make the pot was far too long and as such my workflow must be reviewed and optimised from the blank canvas in Maya right through to implementation in Unity.

### Evaluation

The pot took significantly too long to create, as such the methods used to create such items will have to become more efficient or simply faster, cutting corners where possible, for example, there is no need to make the rear of the object, which cannot be seen by the viewer, high quality or complex.

## Development of final design plans and drawings

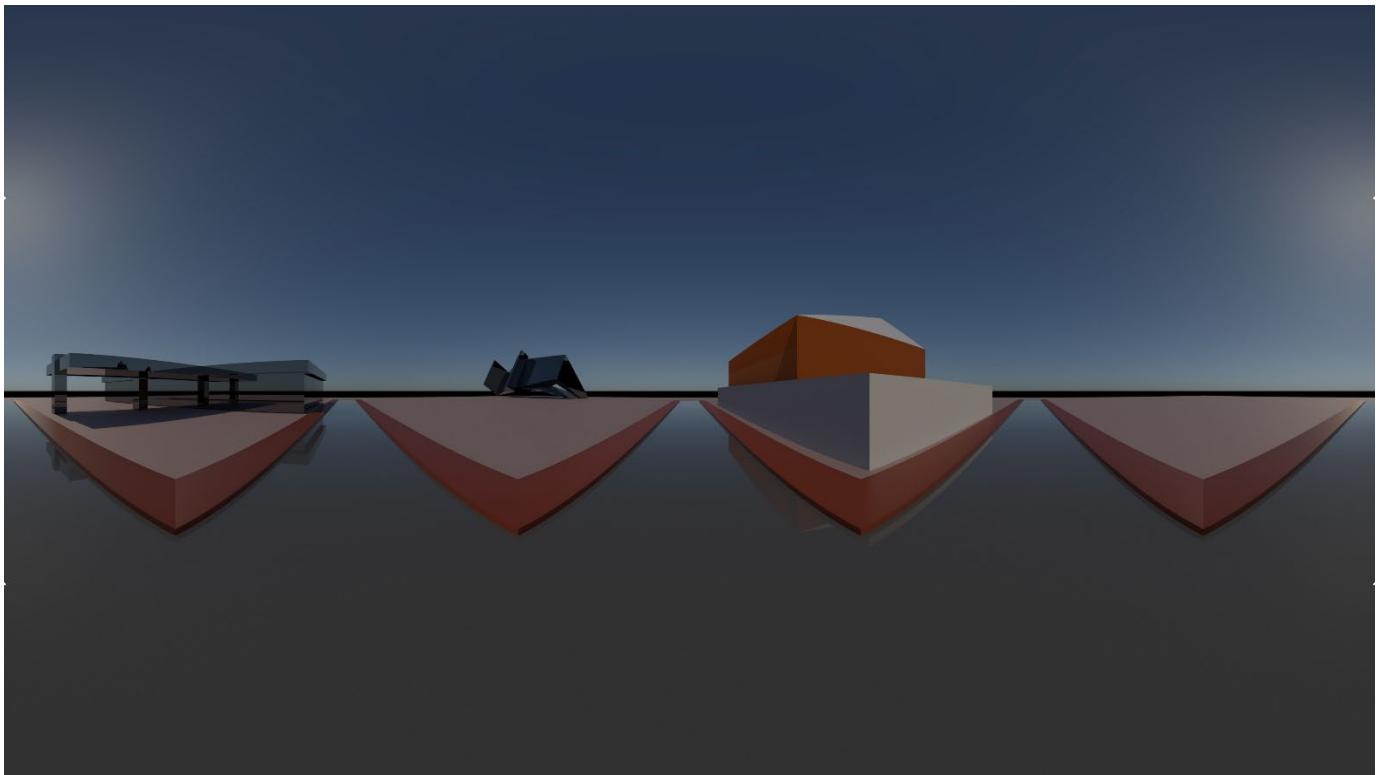


Figure 47: (Unwrapped) First crossroads photosphere

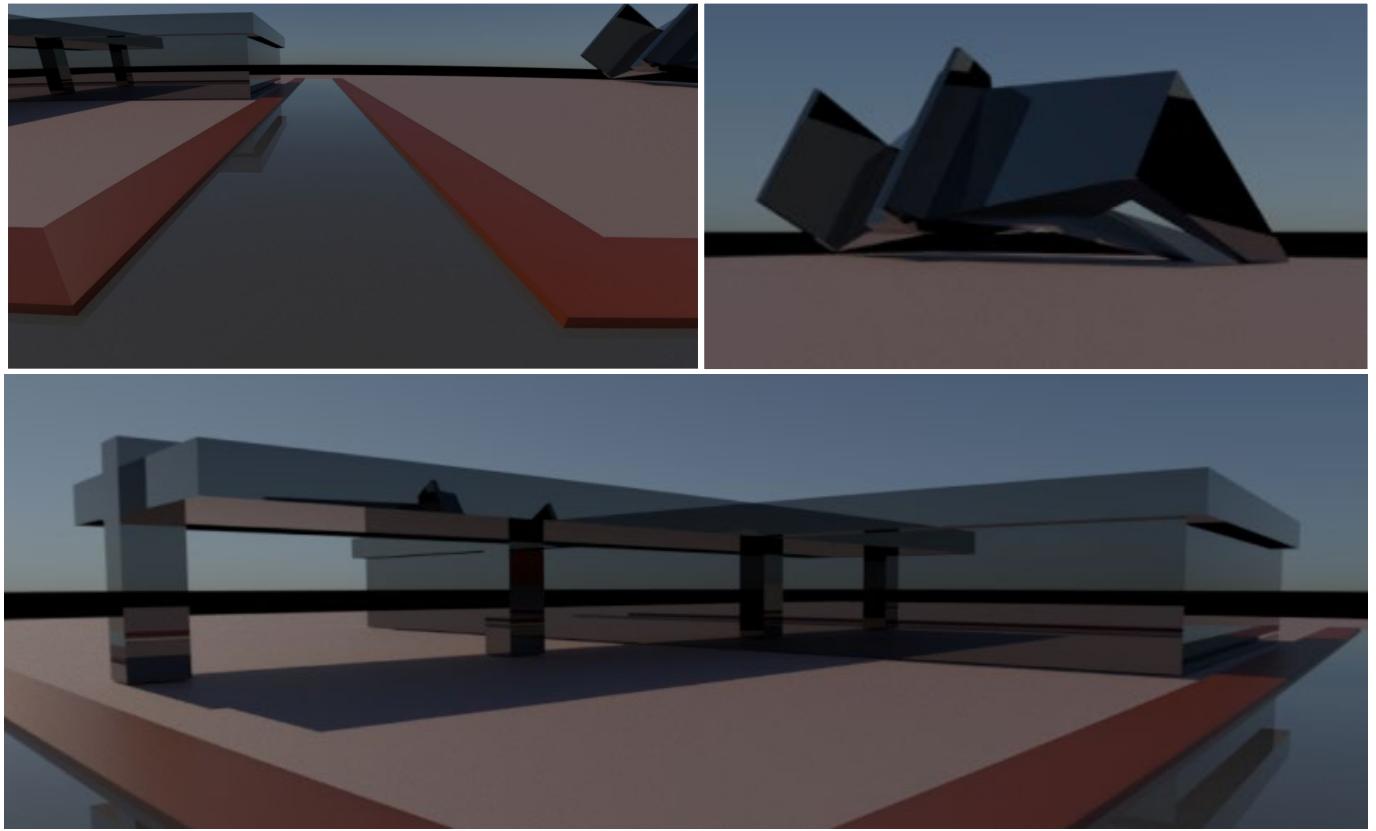


Figure 48 Rendered blockout V1

### Evaluation

The above structure(s) are reasonably simple and together took over two eight to make. See film *Petrol station*. I am concerned that more complex structures will take longer to make so I'll have to test the time and processes required to make complex objects. As well as improving my skills in all areas of virtual creation in order to increase efficiency and quality of asset creation.

## Third interview with English staff

- **Aim**
  - To finalise preliminary narrative and ideas to make the product helpful for teaching in the client's eyes.
- **Method**
  - Used the results from the first email with the client to create the narrative and scenario.
  - Emailed the client to validate the idea. The contents of the email sent are as follows:

Set at a **4-way intersection** at **dawn/dusk** (a crossroads, symbolises choice, change, direction, freedom) in a small town, which people normally only pass through to get somewhere else. There are **8 main features** in this scenario, the **horizon/skyline** at the end of each road and whatever is placed on each corner.

- The corners will respectively have:
  - **An empty (maybe destroyed) school.** This can represent hope to rebuild and potential for better life in the future as it is a place of learning... or it could represent the absolute suppression of people and the lack of any better possible future as the places of learning have been forgotten/destroyed.
  - **A ransacked fuel station;** representing and communicating the ways of the past and the cause of the wars, being over petrol, oil, fossil fuels, etc.
  - **A large billboard** advertising something that represents excess e.g. sports cars, cruises... or maybe some political campaign for some green group who want to fix the environment, or the current people in power with the billboard destroyed as those not living in the city were seeing their rivers dry, forests fall and their crops die.
  - I'm not so sure for the last one... **maybe a bombed playground**, bits of it lying around, with a creaking swing being one of the few intact objects (because that tends to be eerie)
- The skylines
  - Between the **school** and the **fuel station** - Some hills.
  - Between the **fuel station** and the **billboard** - The current Utopia, either thriving (lit sky) or destroyed (smokey, fire-ee sky) depending on whether or not there is a Utopia
  - Between the **billboard** and the **playground** - Eerie and oddly purple/grey... for example bones, representing death and stagnation.
  - Between the **playground** and the **school** - Hints of green (life, rebirth, growth... (maybe the school will be called phoenix school)). The sun will be rising.
- **Result**
  - Response from client: "Preliminary ideas sound good to me."
- **Conclusion**
  - The ideas presented in the email meet the needs of the client.
- **Applications of Conclusion**
  - Develop the product using the ideas established in the email.

## Degree of difference

There are no other solutions that have been designed in accordance with the English syllabus. There are very very few VR applications designed to be used in highschool classrooms. The solution is completely original and there are no other VR solution for introducing the Dystopia Unit. The low cost of the product to schools is also a major factor that differentiates it from other solutions. The optimisation to reduce power use and maximise availability also differentiates my product. In summary what really differentiates my product is the medium and the accessibility.

## Clouds

I originally wanted to have clouds, fog, and dust visible in the scene, pre-rendered but I was unable to achieve this. Reasons included:

- The fog component provided by Maya is not compatible with a 360 degree camera as it uses straight vertical planes to determine thickness and location, as such, the fog would only appear on one side of the scene in a suspiciously straight line.
- One of the cloud types shown in the examples of Maya is not compatible with 360 degree cameras as they have square edges, and clouds don't end equidistant from a centre point in the shape of a square. So when I tried to implement the clouds it looked off.
- The other cloud example provided produces light for in order to colour itself, this messes with the lighting of the scene and looks unnatural.

There were many other issues with clouds and smoke but eventually I decided that I was not making any significant progress so I made the decision to exclude clouds and fog from the scene.

However, inside Unity there is a premade asset called “dust storm”, I may end up using this, it depends on whether or not the aesthetic of the scene is suitable for it though.

## Justification of Final Ideas and Resources

The resources and ideas that will be used to produce and guide the production of the product are in the table below. Each resource has been picked with the intent to improve the quality of the product and its ability to meet the criteria for success. The ideas were chosen through creative design processes, research and interviews with the client and target market, in order to best meet the wants and needs of both parties.

*Table 14: Justification of ideas and resources*

Elements to consider	How and why it was used	Links to criteria for success	Impact on safety and the effect on environment
Final Design	The scene will be realistic	Wow factor	None
	The scene is set at a four-way intersection due to the implications of the 'crossroads' and the way in which it can be used to clearly display eight elements (four buildings and 4 skylines)	Appropriate for school environments  Relevant to syllabus  Engaging and enjoyable	There is a clear centre and equal visibility in every direction, reducing the user's impulse to move.
	Setting will be at dawn/dusk as that signifies change in some way	Aesthetically pleasing	None
	Front right corner has an abandoned and derelict school, representing a halt in learning and advancement	Easy and intuitive to use	None
	Back right corner has a playground with a few poles and a creaking swing, creating a spooky environment and representing the lack of childhood	Easy and intuitive to use	None
	Front left corner has a derelict petrol station, highlighting what caused the problems and the past	Easy and intuitive to use	None
	Back left corner has a billboard featuring propaganda, either against or for the reason the world devolved	Easy and intuitive to use	None
	Left skyline will have a city (destroyed or prosperous)	Easy and intuitive to use	None
	Background music will be dissonant to help assist in spook. There will also be the swing	Immersive and enjoyable	None

	creaking (spook) and wind effects (immersion).		
Tools (software)	Fusion 360 as it is a quality 3D creation software	Aesthetically pleasing	None
	Unity 5 as it performs better than other engines on mobile devices	Product is useable within Class Time	Uses power when it runs the program
	Maya is great for asset creation and rendering	Aesthetically pleasing	None
	Mudbox assists in asset creation	Aesthetically pleasing	None
	Photoshop assists in asset creation and render cleanup	Aesthetically pleasing	None
	GoPro VR Player assists in prototyping	Aesthetically pleasing	None
	Mixed reality viewer assists in prototyping	Aesthetically pleasing	None
Tools (hardware)	Wacom Intuos pro to assist in asset creation	Aesthetically pleasing	More differing hand movement and therefore less strain
	Scanner is needed to digitise sketches	Engaging and enjoyable	None
	Oculus Rift can be used to help quickly test and prototype	Easy and intuitive to use	Blind during use
End user devices	Google Cardboard because they are cheap and accessible and environmentally sustainable	Solution can be used by an entire class  Works with schools existing resources	Blind during use  Minimal impact on environment (made of glass and cardboard)
	Their own smartphone because most students have them	Easy and intuitive to use	The phones used can become obsolete or may change size in the future creating the need for replacement Carboards
Materials	Digital data used to create original designs for use in the final product as it responds well to client brief and user needs.	Relevant to syllabus  Useable by entire class  Safe	Warning can be included  Cardboard is recyclable

## Evaluation of Relevant Design Factors in relation to Project Proposal

Table 15: Evaluation of relevant design factors

	<b>What should be addressed</b>	<b>How it has been addressed</b>
<b>Appropriateness of the design solution and need</b>	The solution should address the needs of the users and client in being a creative and informative hook lesson on dystopia.	The solution utilises VR and the immersion it brings with it to create interest in dystopia for the user.
<b>Function</b>	The solution must run at a smooth framerate without crashing, track gaze direction and execute functions based off that without error.	Bugs identified in prototypes have been removed. Testing has allowed optimal performance to be achieved.
<b>Aesthetics</b>	The solution must appear realistic	Photo-textures and baking
<b>Cost</b>	Cheap enough for a school to afford	Uses the Google Cardboard and students' phones
<b>Ergonomics</b>	No strain during use	Main features are within the comfortable viewing angle
<b>Use of the design</b>	To simulate the students' interest	Employed VR and immersion
<b>Sustainability</b>	Create minimal waste	Application of Cardboard as main component.
<b>Energy</b>	Keep resource use and waste minimal	Developed largely using solar power from home and the schools photovoltaic panels.
<b>Recyclability</b>	Make sure no physical materials in the product are unrecyclable.	Zero waste at the end of lifetime
<b>Safety</b>	No epilepsy or trauma inducing images	No flashing and no disturbing pictures of people
<b>Quality</b>	The product must be of a high enough quality that it runs smoothly on the intended device, looks realistic and doesn't have any glitches or crashes.	The application of techniques found during experimentation have minimised the computer resources required to run the product.
<b>Durability</b>	Product should be working effectively for longer than it is likely to be used	As a piece of software the product can be updated where necessary, making its lifespan theoretically infinite.
<b>Obsolescence</b>	Last a significant amount of time	The product will become obsolete to the English syllabus when it next changes, however it will remain perfectly functional and valid as a teaching tool for a long time after that changes.

## Prototyping and Production

### Processes that will take place during production

1. Blockout
2. Modelling - including the sketch
3. Texturing and adding details
4. Lighting and environment
5. Rendering
6. Image cleanup
7. Unity import
8. Controls
9. Toggable text buttons
10. Audio - directional and ambient
11. Other additions added in Unity
12. Building to device

Screen recordings were made throughout the production of the product, the recordings have been edited to show a time-lapse of some of the various processes. The *School* video that shows the most of the process

*School* shows steps 2-5.

*Billboard* shows texturing and UVs (3).

*Swing* shows modelling and texturing (2 & 3).

*Helipad* and *petrol station* both show two different types of modelling.

### Blockout

A blockout is equivalent to a sketch for a painting or a storyboard for a software product. The blockout normally takes place after concepts are finished to communicate size, scale, positioning, movement and timing to the viewer. The specifics of ‘blockout’ process do change depending on what is being developed but the goal of it will always be the same, to communicate the vision to the client and developer(s) without committing time to something that may be changed. This allows all planning to be finished before detailed development begins.

### Modelling

Modelling is one of the more timely processes during production as I have to build convincingly sized and scaled 3D objects. The films *helipad* and *swing* describe the step-by-step process of modelling. Every single item in the scene, except for the buttons, text and the lens flare visible in the app, has been manually modelled.

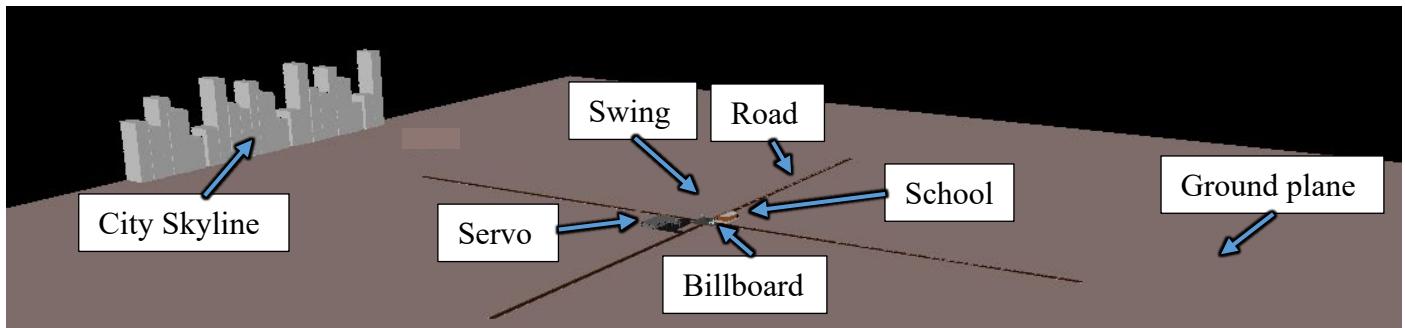


Figure 49: A screencapture (screencap) of the blockout in the viewport

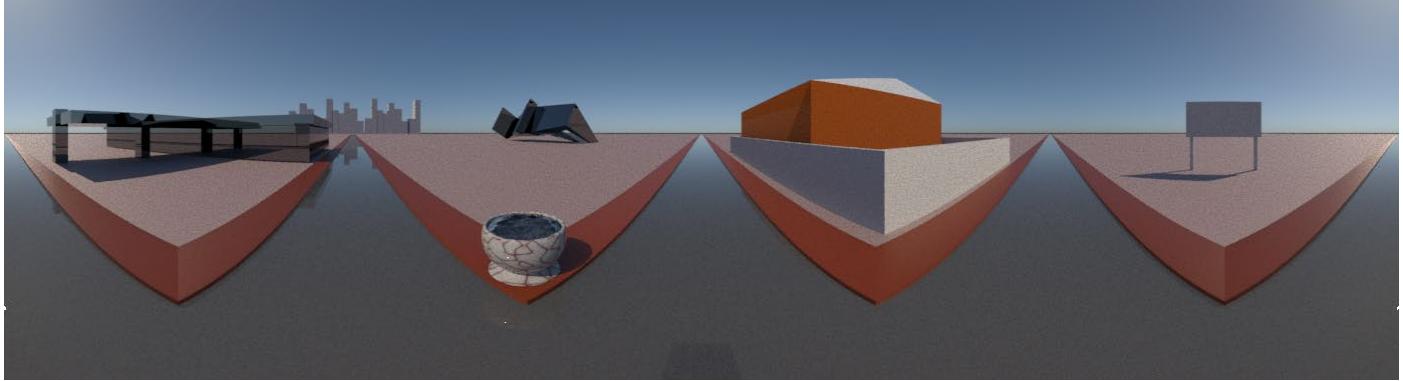


Figure 50: A render from the blockout stage

### Texturing and adding details

Adding textures and details to the 3D models is extremely time consuming and finicky. This is particularly true when best practices have not been followed during the modelling stage. This is something brought about due to the application of the RAD approach and the fast development speed. The first step required is to create a UV map of the object. This gets each face and maps it to a position in the UV coordinate space. The next step can vary from this point onwards due to the huge number of ways UVs can be used however, it will always result in a series of images that affect the model (where its effects depends on the location of the mapped faces in the UV plane). The effects of the images include colours/textures, transparency, reflectivity, index of refraction, apparent surface detail (bump and normal maps) and geometry (height maps). Two examples of using UV mapping to texture objects are shown below.

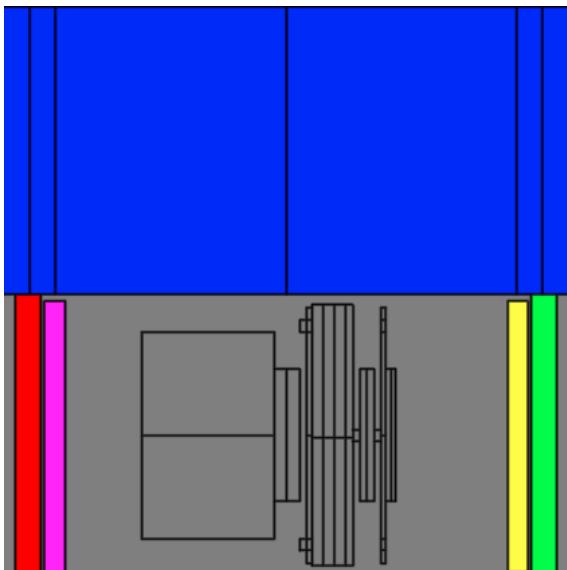


Figure 51: A test texture on billboard UVs

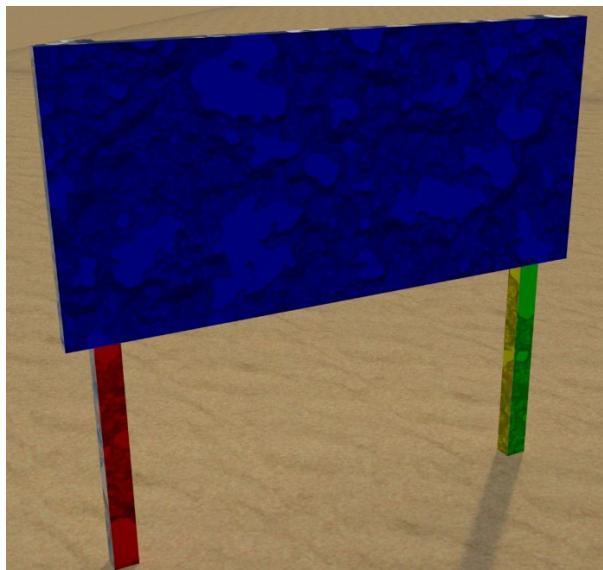


Figure 52: Rendered result of test textures on billboard

See the videos *ground* and *billboard* for a time-lapse, step-by-step example of UV mapping and texturing.

## Lighting and Environment

The lighting is generally controlled by a material I've used in Maya called "aiPhysicalSky". This gives the user control over various elements of the lighting as well as adding a sky hemisphere. This is fantastic however, everything below the  $y = 0$  line is black so perspective can lead to odd black lines on the horizon, visible in the final image (See *Appendix B: Figure 73: Render I*).

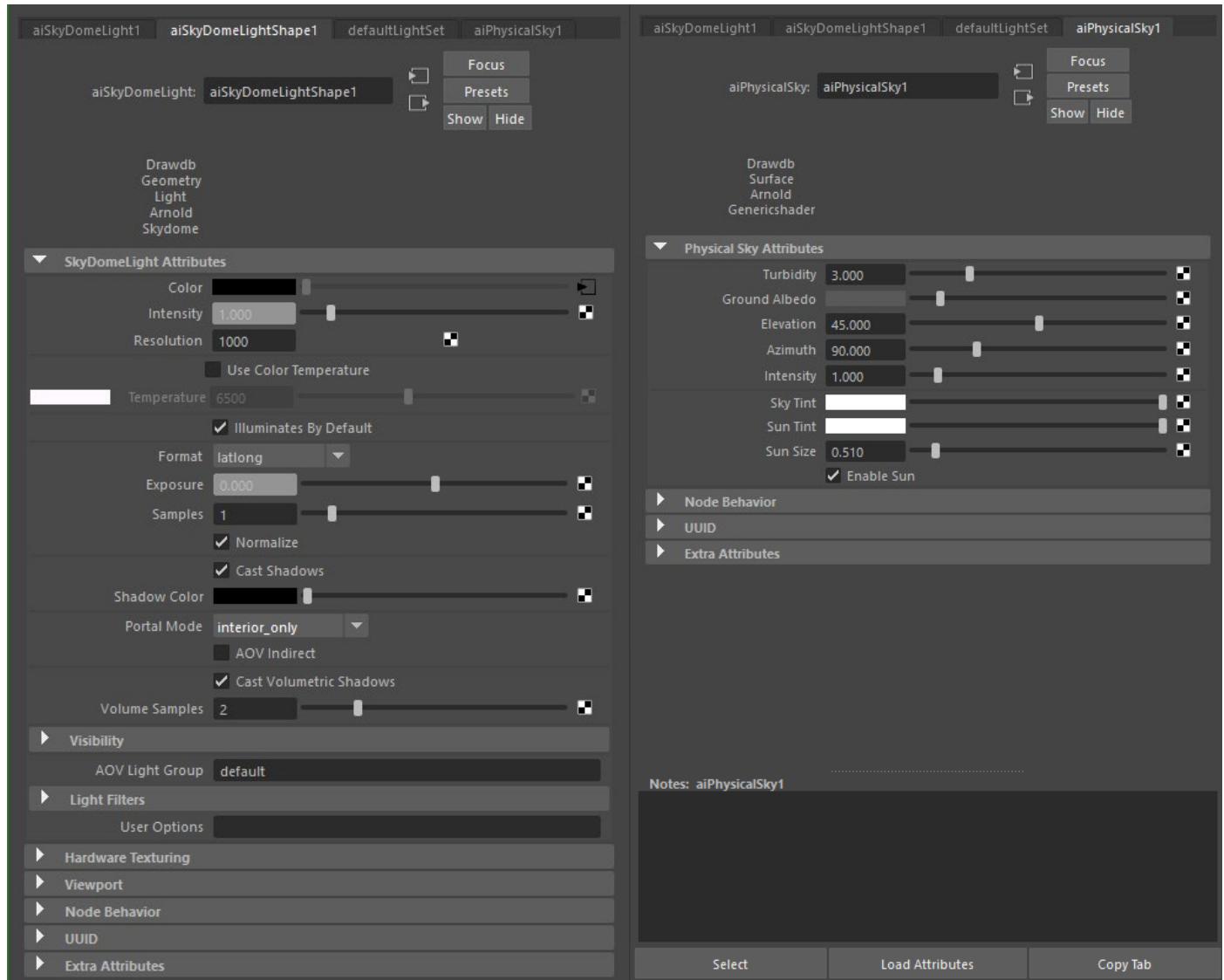


Figure 53: Screencap of some of the skydome light options

## Ongoing Evaluation and Appeal to Experts

During an interview with the teachers they said they wanted the city to be burning in the distance, I thought it would be relatively simple to add a red light and smoke to create the illusion of distant fire but the red light idea didn't work at all. To try to figure it out I reached out to the people at Animal Logic (a professional animation studio, they animated the Lego Movie, Legend of the Guardians Owls of Gahul and much more) through their work experience Facebook group I joined when I did work experience there in 016. The question I posed and their responses are below.



Ryan Van Dyk

July 8 at 7:58 PM

...

Hey Krista Jordan do any of your cg magicians know how to make it look like there's a fire in the distance using maya and arnold? I've included some pictures for reference.

Or how to make it look like sunset, or how to do the clouds better... but mostly just making it look like a fire in the distance.

Thanks 😊

Edit: Each of the photos now has a description

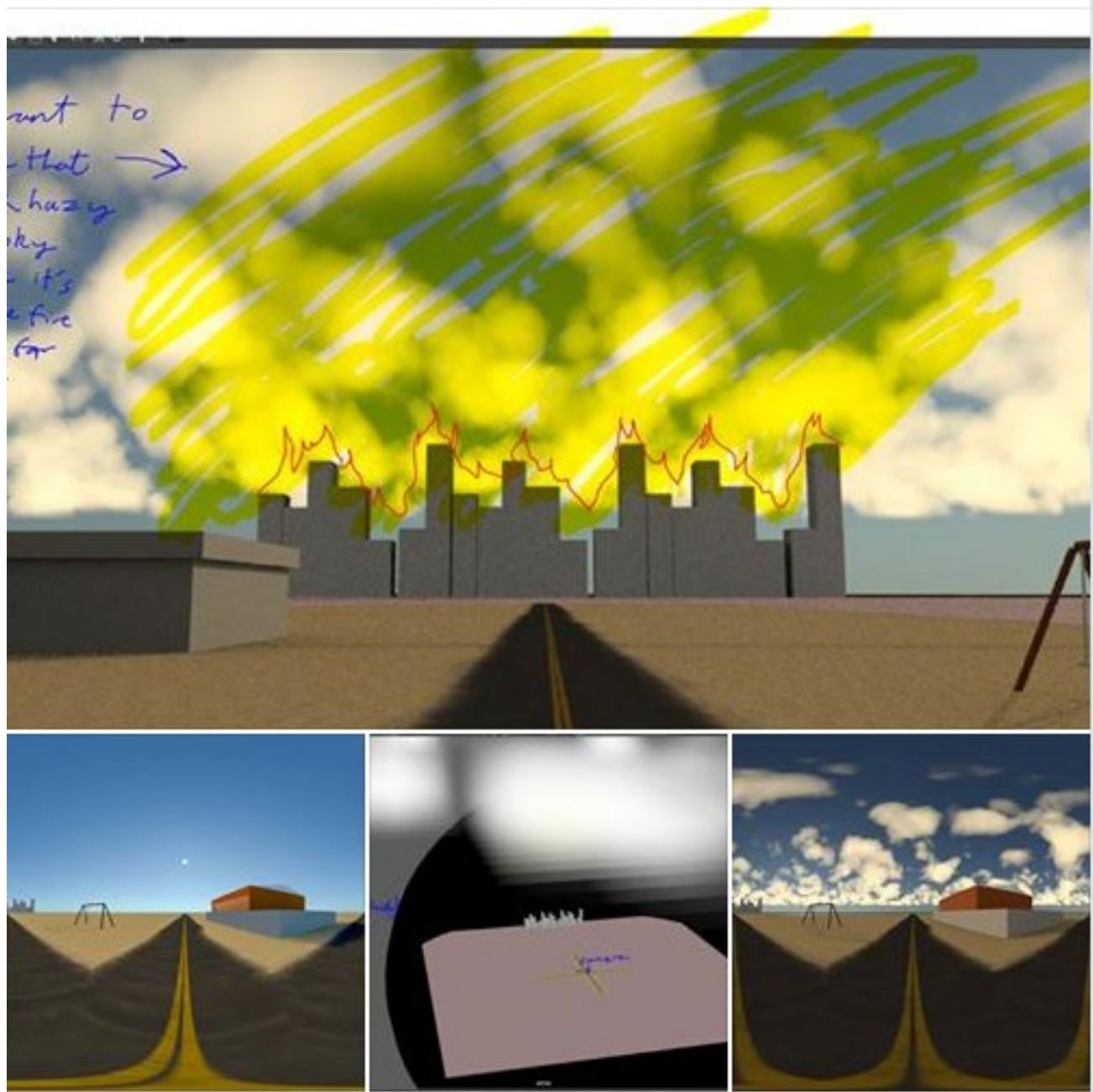


Figure 54: Question and images sent to Animal Logic

**Krista Jordan** Hi there! An awesome reply to your question Ryan, from Miles Green, FX Department Supervisor....

' - usually for fire in the distance on a film we would pass this task over to compositing, and they would place a number of practical shoot or fire elements in nuke. These elements are likely shot on black so they can be easily layered and the flames extracted from the background i.e:

<https://www.shutterstock.com/.../clip-226516-detailed...> (although We may often pay for very high resolution footage)

Only if there is a hero element ( that a stock element may not work for ) would we simulate the flames in fx:

here are some beginner tutorials for fire and clouds I'd look at if using houdini, sorry we stopped using Maya a few years back so not best to advise on those softwares

Fire:

<https://www.sidefx.com/.../learn-how-to-create-realistic.../>

<https://www.sidefx.com/tutorials/game-tools-fire-presets/>

<https://www.youtube.com/watch?v=56uRUH0njrA>

Clouds:

<https://www.sidefx.com/tutorials/cloud-fx/>

**Krista Jordan** Some more helpful tips from Sotiris Bakosis...

'some bush fire reference might be useful, I tried googling "distant bush fire aerial view" which comes up with some good references

this ones a good reference to show how you don't really see much fire especially during the day

<https://i0.wp.com/.../Forcett-Bushfire-Photo-by-Ian...>

maybe compositing something like that behind the buildings and then adding some cg columns of smoke coming off the buildings in the foreground?'



The conclusion I drew from these responses were that, one, I should do the effects like fiery skies and smoke after the render in something like photoshop. And two, remember to look at reference images, which I had forgotten to do. So I will be looking at doing both of the above to achieve the fiery skies the teachers desire.

Figure 55: Responses from Miles Green and Sotiris Bakosis

## Rendering

Rendering is the most computer intensive part of the process and actually puts the computer out-of-commission until it's finished. Rendering is what makes the scene go from being a preview to a photo. In this case, raytracing is used which is effectively the camera shooting out little laser beams, seeing where they land and then determining what colour the pixel should be, as complexity is added to a scene (bumps, reflections, subsurface scattering, etc.) the render time gets astronomically larger.

See the film *school* modelling, texturing and rendering (the rendering is the more photographic looking picture that frequently appears at the top left of the screen)/

See Appendix B for examples of rendered images.

## Working in Unity and Additional Testing

### Unity Import

This part is relatively simple but also vital. As stated prior rendering is a lot of work and it's something that puts an entire high-performance computer out for a good hour plus and uses a LOT of power while doing so, as such, the rendering is kept to the computer in order to minimise the impact on phones. To get the rendered image into the working Unity scene it must first be imported, then have its properties changed so Unity recognises it as a photosphere. Once Unity finishes processing the image a new material has to be created and set to be the skybox material. Finally the image is applied to the skybox material and it appears in the scene.

### Functionality Required

- **User Interface/Dynamic**
  1. Pop-up information panels that appear/disappear when a button is pressed
- **Audio**
  2. Ambient sound of wind in desert
  3. Occasional other sounds called by slightly randomised timer code (like birds or rustling)
- **Environmental/Passive**
  4. Video background for animated clouds and swingset

### Adding correctly located elements to the scene in Unity

- **Aim:**
  - To determine the best way to work within Unity so that objects placed appear in the correct place as the environment is an image/video and therefore anything in front of it needs to be placed very carefully to create the illusion that it exists in the same 3D space as the objects in the background.
- **Method**
  - Experiment with different methods including:
    - By eye
    - By modifying while having the app running
    - By using a reference
- **Results**
  - Placement by eye was a failure, this included from above and when looking from the same place the camera was located
  - Trying to place objects while having the app running didn't work because once the app stops running it resets everything that changed
  - Importing the entire environment as a 3D model and lining it up to the background, from the user's perspective, worked fantastically as it gave accurate reference points.

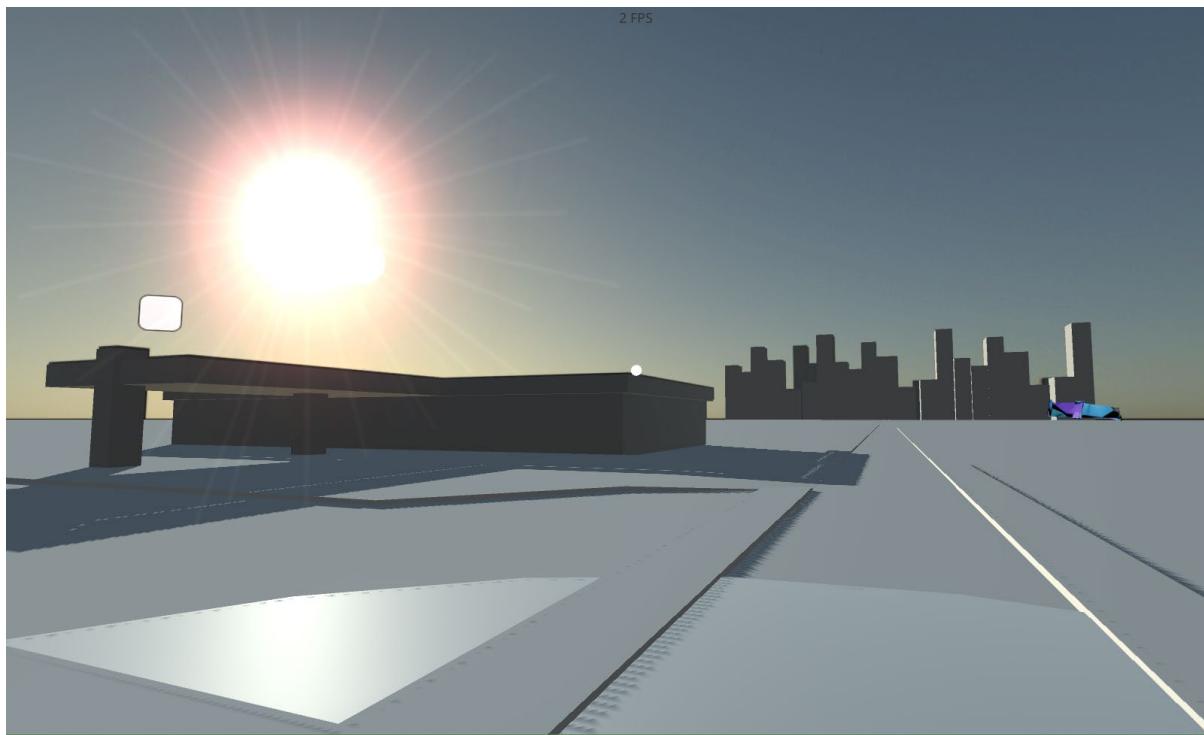


Figure 56: In-game screencap of Unity template scene

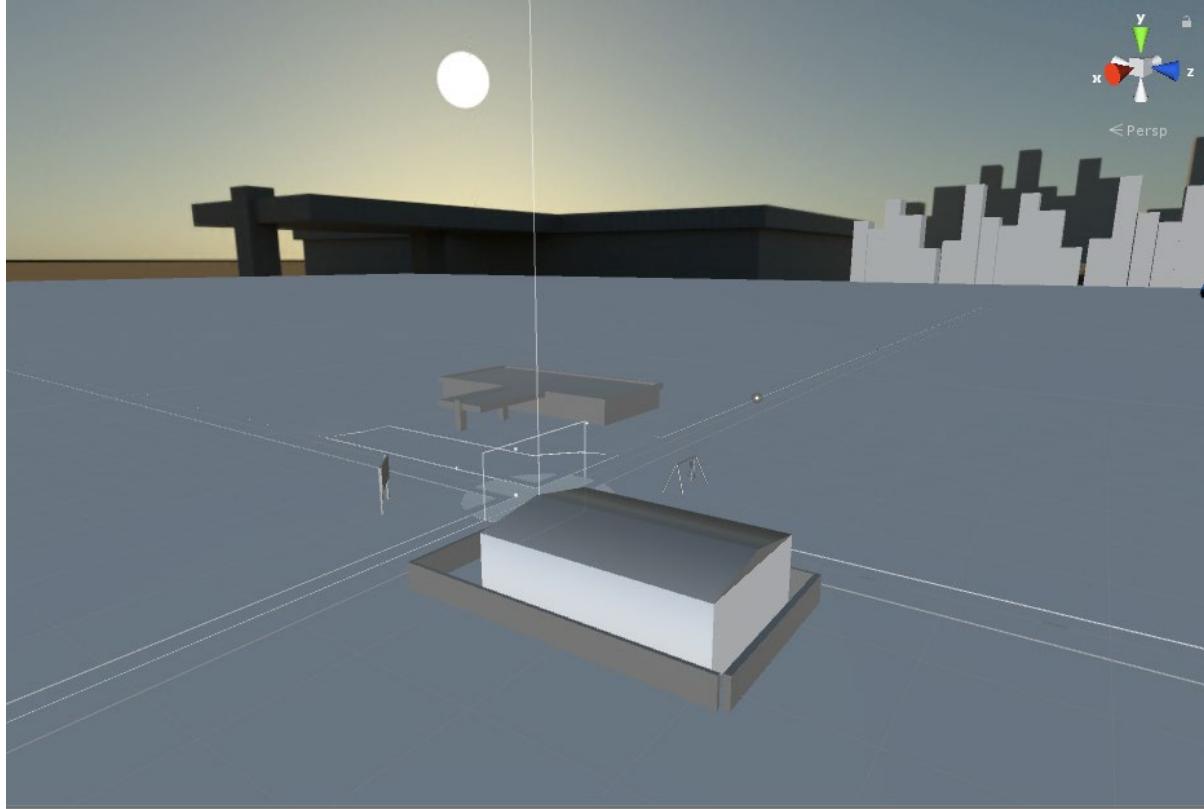


Figure 57: In-editor screencap of Unity template scene

- **Conclusion**

- Use the reference environment while building the product. It will be removed when versions of the product are built. This will ensure all additions to the scene from Unity are correctly placed and scaled.

- **Application of conclusion**

- UI elements and moving parts can and will now be added in their correct locations directly within the Unity workspace.
- A directional light was added within Unity and aligned to the same angle as the sun in the background image so that any assets placed in Unity will have accurate and correct shadows.

## *Adding a functional Google Cardboard software development kit (SDK) to Unity*

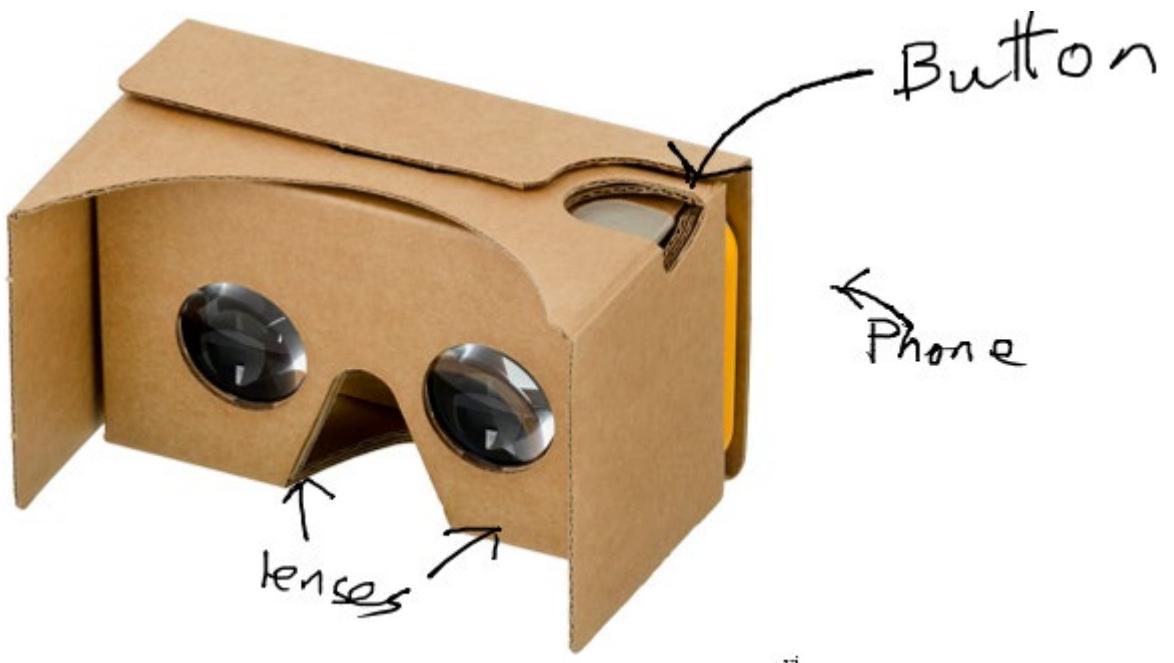
- **Aim:**
  - To allow development of mobile apps aimed for the Google Carboard IOS and Andriod platforms within Unity
- **Method**
  - Google
  - Follow online instructions
  - Become frustrated due to outdated instructions
  - Find an almost up-to-date video on Youtube
  - Set up Android and IOS build settings
  - Add Carboard Viewer assets to the scene
  - Install a java SDK (JDK)
  - Add experimental function from tutorial to ensure the development environment works
  - Run
- **Result**
  - Functional Google Cardboard development environment achieved
- **Conclusion**
  - The building environment now has the required functionality to begin further development
- **Application of conclusion**
  - Begin developing the base interactive features of the game

## *Ambience setup*

- **Aim:**
  - Add some effects that help add life to the scene
- **Method**
  - Brainstorm appropriate visual effects
- **Results**
  - The scene is set in a desert so features could include:
    - Sand blowing
    - Wind whistling
    - Occasional bird calls
    - A flare from the sun to add intensity (see fig. 56 above)
- **Conclusion**
  - Find out how to add sound
  - Try using the “dust storm” asset in Unity’s ‘Standard Assets’
  - Apply a flare effect to sun in Unity
- **Applications of Conclusion**
  - Research how to add sound as initial attempt failed
  - The dust storm looked really nice but it could place a large load on the phone which could be cause for concern
  - Initially I used a 50mm lens flare effect but it was unrealistic so I swapped to a standard sun flare. The sun flare adds incredible life and ambience to the scene, it really emphasis the desolate desert feel with an unrelenting sun beating down on the environment and user.

## *Adding user interface (UI) to the Google VR environment (GVR) in Unity*

- **Aim:**
  - To find out how to add a 360° UI to the GVR in Unity
- **Method**
  - Google and trial and error
- **Results**
  - In the Unity workspace there is a set of UI *gameobjects*. It turns out that these *gameobjects* must exist on something called a canvas which by default works with something called “*screenspace*”. This is optimal for multiple screen sizes where the UI is projected onto a 2D plane. However *screenspace* does not work with items placed in 3D space, as such I had to change the canvas to *worldspace* and then add UI elements, such as text, as children of it.
- **Conclusion**
  - It is possible to add a 360° UI that will work in VR to Unity
- **Application of conclusion**
  - Learn how to create interactive UI elements



vi

Figure 6: Annotated Cardboard

## *Adding an appear on click function to UI items*

- **Aim:**
  - To learn how to make text and other UI items appear when the user clicks a button
- **Method**
  - Learn from YouTube tutorials, forums and official Unity documentation
- **Results**
  - None of the information found online helped, at all. In the end, after multiple hours of experimental coding and frustration the solution was a UI item called toggle, which I stumbled upon by chance. After about half an hour of guess and check I had it set up and working.

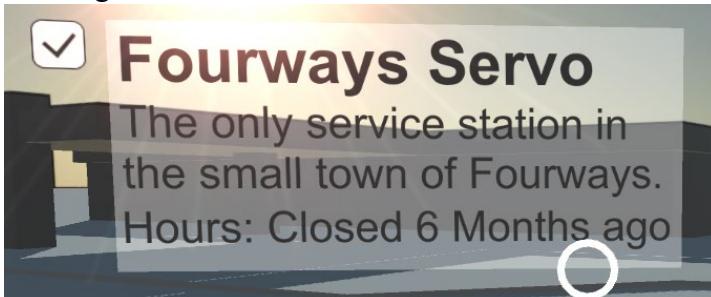


Figure 58: In-game snip of toggle button on

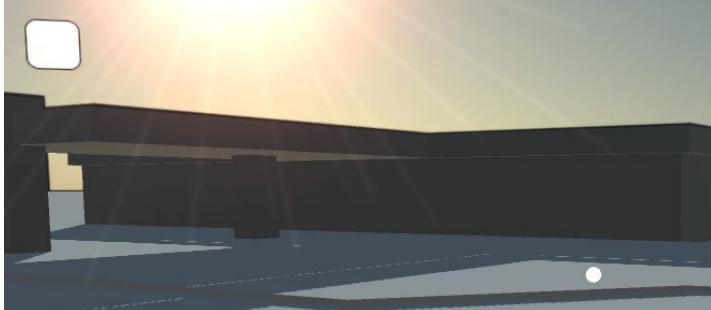


Figure 59: In-game snip of toggle button off

- **Conclusion**
  - Individual toggle buttons can hide, show or call reversible functions (toggle them) which allows for easy-access, implementation and reuse.
- **Application of conclusion**
  - Place toggle buttons that reveal information about specific elements within the scene, such as the school, in locations that make their purpose clear (as can be seen in figures 58 and 59).

## Audio setup

- **Aim:**
  - Implement a complimentary audio environment to the scene and learn how to use audio in Unity
- **Method**
  - Brainstorm appropriate sound effects
  - Google free sound samples
- **Results**
  - Decided a windy sound would be good to communicate desolation and vulnerability
  - Audio in Unity was harder than expected. It didn't work when I placed the audio player and listener onto the camera. I'll do some more research to figure it out.
  - Eventually changed the mixer being used from GVR audio to Master Audio and now it works
- **Conclusion**
  - Audio is working and the howl of the wind adds so much life to the scene
- **Application of conclusion**
  - Apply more sounds where appropriate, this includes directional audio
- **Further development**
  - I became aware that it is difficult to make unity play multiple audio files at once, so I used adobe premiere to mix 5 different audio files together, as well as randomising the directions they came from to improve ambience.

## Building to mobile device from Unity

This is a step that is made difficult for various reasons, none of them issues I foresaw or expected. The first issue was Unity not working with the latest Android SDK so I had to look online for a significant amount of time before finding that the solution was using an older SDK. This then broke something else, the Java development kit (JDK), because the Andriod SDK was no longer compatible with the latest JDK so I had to find and use an older version of that as well. Even worse is that from a windows computer I can't put the app onto an Apple iPhone, I need a Mac to do that. Luckily my Dad has a Mac so all I had to do was figure out how to build on windows, get the files, perform a second build on the Mac and then I would finally have it on my iPhone. Fortunately, a friend had an old Android phone I was able to borrow to perform prototype testing and ensure the app worked, which it did.

## Evaluation of build 1

- The sound works
- The models seem appropriate
- It ran smoothly
- The text was a bit hard to read
- The stationary buttons were better than the moving one
- The edges on the road are odd

For background used in build 1 see Appendix B:  
Figure 79: Scene Render 7



The response from the client was:

- Ms Munro: *The controls were easy to follow. The text was unreadable. A scarier atmosphere would be good, and add more story to the scene. Make the options more scary and dilapidated. The audio was appropriate.*

## Polishing

This is the section where I took the base models, the placeholders, the flat materials and polished them to add realism, life and immersion to the scene. This process includes:

- Building entirely new and more detailed 3D models for components like the school (Including the damages where appropriate)
- Texturing finished 3D models (This is like painting a house after its been built)

The polishing process will require learning how to create, edit and use UV maps. UV maps are used in 3D creation to apply bump and normal maps, texture maps, transparency maps and more (e.g. reflectivity).

Creating UV maps requires assigning the vertexes of the faces on the 3D models to a location in the UV coordinate plane.

Editing a UV map is relatively simple, but still time intensive, as it is the same as editing a picture in photoshop.

Applying the UV maps to achieve the desired effect is complex but it's also the best option as attempting to add all the minor details in 3D is too time consuming and is a blatantly unrealistic. It should become easier as I learn how to do it properly.

## The Ground

- **Goals:**

- Improve the ground to make it look more realistic
- Use only one 3D model
- Use UV maps to texture the ground add detail like bumps in the sand and road

- **Method**

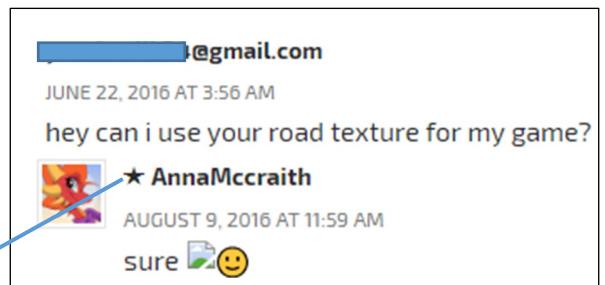
- Delete old road
- Use a tile strategy to account for detail limits imposed when trying to add textures to something gigantic
- Find texture for road
- Find texture for sand
- Make a new material for the road tile
- Apply the material to the road tile
- Draw textures directly onto the 3D model in Mudbox
- Export texture map
- Apply textures to material in Maya
- Duplicate the road material and rename it crossroads
- Create another flat plane model to be the centre crossroads tile
- Make a copy of the road texture
- Modify texture in photoshop to make it a crossroads
- Apply texture to crossroad material
- Place the centre crossroads tile in the middle and arrange the other tiles around it until there are 3 roads in each cardinal direction from the crossroads
- Create a new flat plane
- Apply the old ground material to the flat plane
- Change the colour of the ground material to match the colour of the sand

- **Results**

- Seamless sand texture from hhh316 on Deviantart:  
<https://www.deviantart.com/hhh316/art/Seamless-Beach-Sand-Texture-271683282>



*Figure 60: Seamless sand texture*

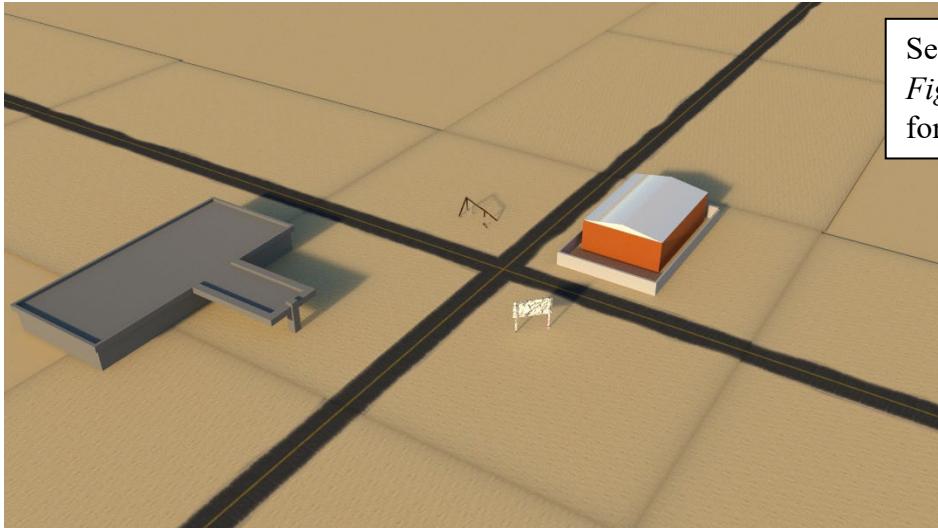


- Road texture from Anna McCraith:



*Figure 61: Road texture*

- See film “road”



*Figure 62: Overview render of roads*

- **Conclusion**

- The ground looks amazing and so much better than it used to, and the seams are easier to fix in photoshop post-render than in Maya by adjusting textures
- The new ground adds so much life to the scene and makes it feel so much more professional and finished

- **Application of conclusion**

- Apply UVs elsewhere faster and more effectively.

## The Billboard

- **Goals:**

- Make the billboard look damaged via UV mapping or changing the 3D model or both
- Make billboard look realistic
- Add a message or picture to the billboard that is indicative of dystopian society

- **Method**

- UV map the billboard
- Create a sketch for the image on the billboard
- Create bump, colour, transparency and normal maps to add damage and a message to the billboard

- **Results**

- Sketch of billboard plan:

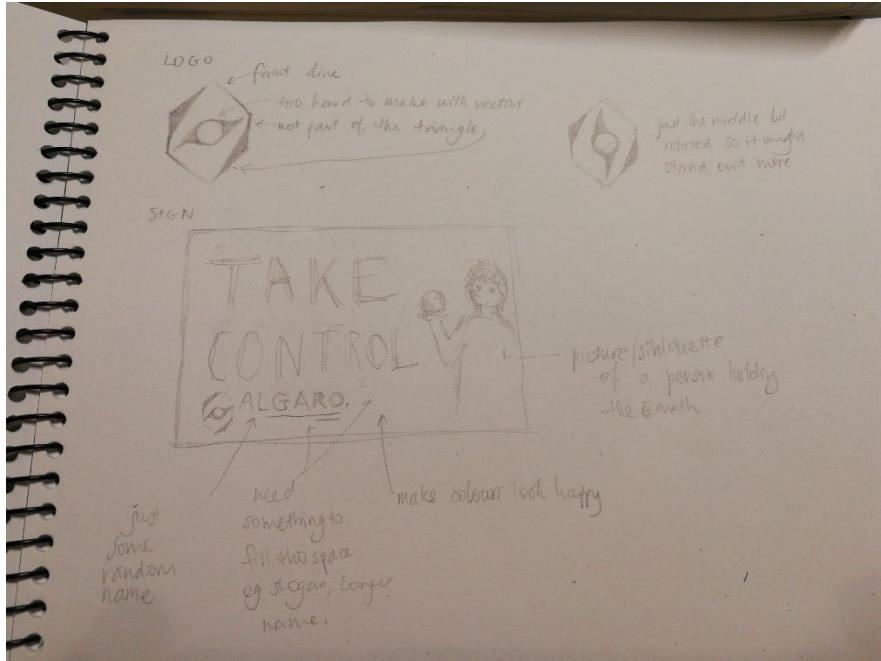


Figure 63: Billboard design sketch

- UV map test, note that the coloured areas are the faces visible to the player, all the black outlines with grey inside them are the other faces, which the player cannot see, so no effort will be wasted making them look appealing.
- The Algaro name and logo were also designed during this stage. The Algaro logo has been designed to look like an eye to better represent a “big brother” corporation that holds monopoly of the world’s resources.

- **Development of billboard textures**

- Development of the textures took place in photoshop for the majority of it and adobe illustrator for the Algaro logo. Illustrator is appropriate for the development of the logo as it will be used many times in the scene at different resolutions, which makes a vector image, produced by illustrator, optimal.

- **Billboard textures**

- See the film *Billboard* for a timelapse of the billboard’s texture development
- From top left to right the textures shown are the base colour, subsurface colour, subsurface weight and transmission. The base colour is like the paint on a canvas, it’s the colour on the surface, subsurface colour is like the surface of the canvas, and any light that makes it through the paint above will be affected by it. The subsurface weight is effectively how much of the paint on the canvas has been scraped off, allowing you to see the canvas, the whiter an

area is, the more paint has been scraped off. Transmission is how much light can pass through the object, where it is black, all the light passes through, making it invisible.



Figure 64: UV textures for billboard

- **Result**



Figure 65: Finished billboard render

## The Swingset

- **Goals:**
  - Add realism with textures
  - Animate it
  - Add a creaking sound in time with the animation
- **Method**
  - Use the cut tool to make holes in the frame
  - Add edges along shapes so that they don't glitch later
  - Thicken the frame so it has volume inside as well

- Bend and twist the frame a bit
- Lay bits of broken off frame in the ground
- Distort the broken off frame to look broken
- Remake the material
- UV map the frame
- Add bump to create an aged imperfect appearance

- **Results**

- See film *swing* for a step-by-step time-lapse of swing production

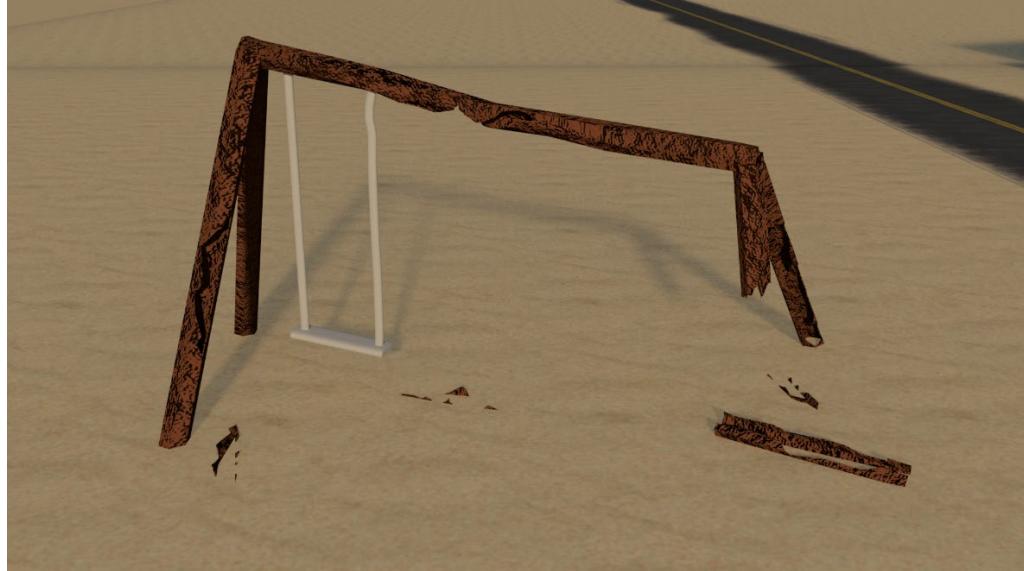


Figure 66: Finished swingset render

- **Conclusion**

- The revised model of the swing is very effective at communicating dystopia and dilapidation. If time remains the swing will be animated to add life to the scene and the seat will be coloured black.

## The Service Station

- **Goals:**

- Make a brand new service station model that is more recognisable
- Add realism
- Be visibly aged

- **Steps**

- Ensuring to work from the sketch created during testing, create the model for the new service station.
- Modify the model
- Create materials appropriate for the model
- UV map then texture the model
- Polish

- **Result**



Figure 67: Almost finished servo render

- **Evaluation**

- The service station looked too clean, and the glass on the roof was no longer letting light onto the sign, as the position of the sun was changed, so noise files were added in combination with specular and subsurface maps to simulate age and wear. The Algaro logo incorporated into the sign and the front of the store reinforce the monopoly of Algaro within the narrative.

## The School

- **Goals:**

- Move past the blockout stage of the school and develop a dilapidated, small town school with a spiked fence

- **Steps**

- Sketch



Figure 68: School sketch

- Model simple version
- Polish and turn into final version
- Add textures

- **Results**

- See film *school* to watch the majority of the school's development. Including modelling and texturing.



Figure 69: Finished school render

- **Evaluation**

- In the same way as the service station, the school originally looked too clean and fresh, to counteract this, a second, darker wood texture was applied using a noise map on the subsurface layer, which gives the wood that mottled look. The roofing was also corrugated to make it feel more country-town and low-budget-esque. The school now looks appropriately worn and provides suggests neglect, as was intended.

## The Text

### Process:

The text was written to provide information to the user and allow them to better use the product as a stimulus. There are six toggable text boxes which the user has full control over, each one provides information about the object it is located next to and helps drive the narrative

Initially the text was effectively unreadable due to its mysteriously low resolution. Following some in depth research I found I just had to increase the reference pixels per unit (RPU). I trailed different values of RPU At 1 (default) the text was unreadable, at 2 it was moderately crisp, at 3 it was very clear, beyond 10 there were increasing numbers of artefacts. I chose 3 RPU as optimal. I also had to rotate the text separately to the toggle button to maximise readability. I did try to find a curved UI option however, the only one I found was exclusive to Unity pro subscribers. After handling this I realised that the text was difficult to read on the background of the scene so I incorporated a semi-transparent panel that toggles with the text to make it easier to read. The text was still hard to read however, in testing it I found I had to go almost cross-eyed to read it, the solution to this was to move the text further from the camera making it easier to focus on. Because the environment is spherical the text, which extends away from the button, ends up angled away from the user when it is expanded, to counteract this the text and the panel behind it were rotated to be tangential to a reference circle centred at the camera's location.

After I added a premade particle emitter in Unity, "dust storm", I found that it was moving in front of the text and hindering visibility. After conducting some research I learnt how to use layers in Unity, the top layers are not affected by visual elements behind them, so I incorporated these to move the dust storm to a layer below the text

### Evaluation:

Legibility of the text was a major concern, as it provides vital information, including instructions, to the user. There were various complications but the text has now been improved to the point where it is readable.

## Image Cleanup and Post-production Edit

Using Photoshop I perform a cleanup of the image to remove artefacts and add elements I couldn't add in Maya to the background

The rendered image is not perfect and needs to be cleaned up in various ways due to my production methods and how the renderer processes the data it receives. The primary artefact that appears in the rendered image are unwanted lines through the ground due to the tiling method I employed for the ground



Figure 70: Line artefacts removal

Any features not included in the render that I want to include in the background are put in at this point. These being the old-growth redwood forest in the distance and the fire and smoke above the city.

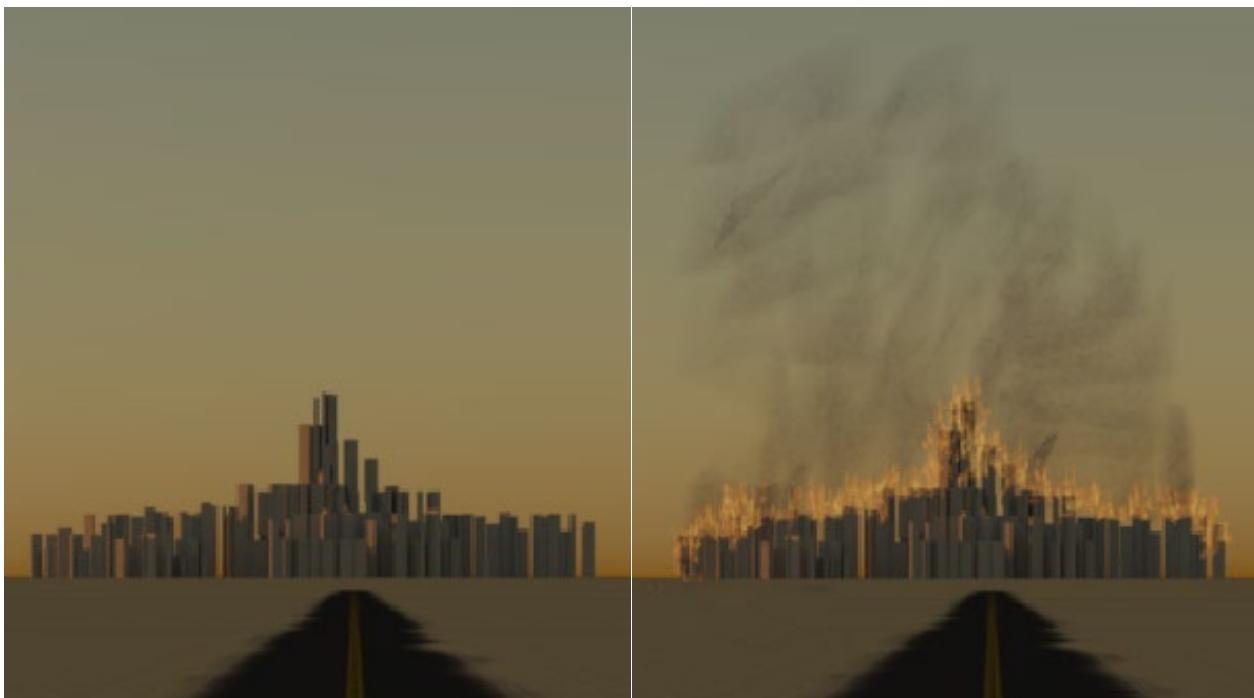


Figure 71: Fire and smoke addition



Figure 72: Forest Addition

# Project Evaluation

## Impact on the Individual

Individual feels more able to find inspiration from the product as a stimulus for their writing over other mediums because it is more immersive. The extra inspiration and immersion will allow the viewer to better understand the topic and hopefully allow them to perform better in it as a by-product. If it were to increase their marks it would most likely also increase their happiness.

## Impact on Society

The effect on society could be large, motivating individuals to become more engaged in the learning environment thus gaining more from it. It may also motivate others to explore ways VR can be used to assist and improve education. The negative effect of the product is minimal, requiring only cardboard, two small glass lenses and a smartphone (which the individual likely already owns) to run. The client said "*This product will be a great way to stimulate creative writing in our Year 11 Reading to Write dystopia program.*"

## Impact on the Environment

All Google Cardboard components can be easily recycled. The product may also potentially make the user more aware of their environment and the individuals in the world around them which would positively affect society and the environment, even if just slightly. The creation of this project was digitally based and was made largely using power from solar panels.

## Client Evaluation

The client tested the almost final version of the product and then provided their evaluation by filling out a feedback form and check sheet, made with google forms, that focused mostly on the criteria for success, before providing a final comment at the end.

Question	Response
How compatible/relevant is the product with/to the syllabus	Very
Is the product intuitive?	Very
Is the text readable?	Some of it
Is the product aesthetically convincing?	Yes, very
Is the audio appropriate?	Yes, very
Is the product usable within the time frame of a single class?	Yes, easily
Rate the 'Wow factor'	Wow!

**Q:** Any other comments or feedback?

**A:** This product will be a great way to stimulate creative writing in our Year 11 Reading to Write dystopia program. In one lesson, we will have students view the created world and then challenge them to write a narrative piece (or perhaps an informative/persuasive piece) inspired by the world. We may use scenarios such as 'The world has been destroyed. You are standing at a crossroads outside the city where you have lived your entire life. What do you do next?' etc. Or we may ask them to imagine what's happened to the world and write a news article. We're excited to use this in our classroom!

## Functional Evaluation

The product works exactly as intended, the pre-rendered background places the minimum possible strain on the device running it and all dynamic elements created in unity, including controls, the dust storm emitter and the toggle buttons work perfectly. The only potential change I would make is to the reticule so that it is less jittery when hovering over the toggle buttons, but it is not a particularly important or pressing issue.

## Aesthetic Evaluation

I am very happy with how the aesthetics turned out, they are the majority of my project and are all original items.

The swingset looks convincingly broken and rusted, adding to the somewhat mysterious and eerie atmosphere very nicely.

The logo for Algaro looks like an eye, which helps suggest a “big brother” style corporation. The colours selected for it went through various iterations but I like the way they turned out. The logo itself actually has four different versions in the scene, but each one is recognisably Algaro. The logo is definitely a success

The ground gave me a lot of trouble, it was the first item I tried to texture and I blundered around for hours trying to figure out how to add roads, hills, sand and other items to it. In the end I used a method very different from my initial attempts. The ground looks good though, the sand coming onto the side of the road with the little bumps in the sand on the sides very nicely suggests age, as well as loneliness, furthering the scenes eeriness and off-putting emptiness as might be found in an apocalyptic environment.

The horizon has been changed greatly from my initial ideas for it, but it turned out well.

The billboard turned out really nicely, but the images used in making it (mostly the person) could've been more appropriate or evocative, however it achieves its purpose and explicitly introduces Algaro.

The service station had two very distinct versions, and I spent a long time developing the old one before finally deciding that it would be better to create something closer to what I had originally sketched. I rebuilt the entirety of the service station and, despite losing everything I had done to the first one, I believe it was well worth it, the new service station is much more recognisable and also has the Algaro logo on it.

Overall I am very happy with the aesthetics, the dust storm and flare adds so much ambience to the scene and each of the items in the scene looks eerie, abandoned and dilapidated.

## Criteria for Success

Table 16: Criteria for success evaluation

Criteria	Importance (1-5)	Method to evaluate success	Standard I expect to achieve	Evaluation
<b>Functional</b>				
Relevant to the syllabus	★★★★★	Make sure PSE fits criteria set by interviewed teachers	The solution should help students achieve syllabus criteria	The app is relevant to the syllabus
Appropriate for school environments	★★★★★	Get the principal or deputy to check it off	Meet PG rating	The app meets the PG rating
PSE is useable within Class Time	★★★★★	Check that all features of the PSE be fully utilised within 50 minutes	Solution useable within one class	✓
Solution can be used by an entire class	★★★★	Attempt to get 30 people to use the PSE at once	I expect the solution to be useable by at least 30 people	✓
Minimal impact on phone resources	★★★★	Data calculation for computer vs phone and a measure of power used.	The phone should be affected significantly less than the computer	The phone can run the app in realtime without using much power and takes up ~1gb of space, compared to 30 on my computer
Works with school's existing resources	★★★★	Check the PSE is compatible with school's resources	The school should not have to purchase any additional resources	✓
Engaging and enjoyable	★★★★	Allow a group of teachers, year 11 and year 10 students to trial it and then interview them for their thoughts	I expect everyone to respond with a generalised "it was interesting" or "I enjoyed it"	Interviewees generally thought it was "cool"
Easy and intuitive to use	★★★	User check sheet	I expect all users will be able to use the solution without any difficulties	Interviewees had no troubles
<b>Aesthetic</b>				
Aesthetically pleasing	★★★★	Interviews, and general questions to those who see the solution	I expect it to be aesthetically pleasing	Interviewees liked it
Wow factor	★★★★	User check sheet	I expect users to be pleasantly surprised, at the very least	Interviewees were impressed
<b>Environmental</b>				
Minimal Impact	★★★★	Cradle to grave analysis	I expect an near-zero impact	No impact beyond power use

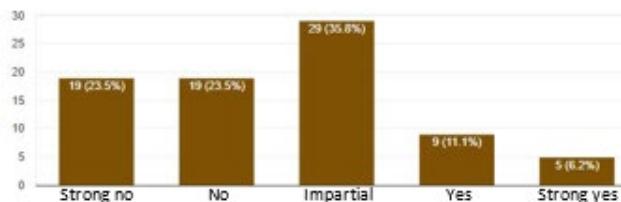
## Appendix

### Appendix A: Student Survey

Note: Some of the responses to the open questions had to be removed as they were inappropriate.

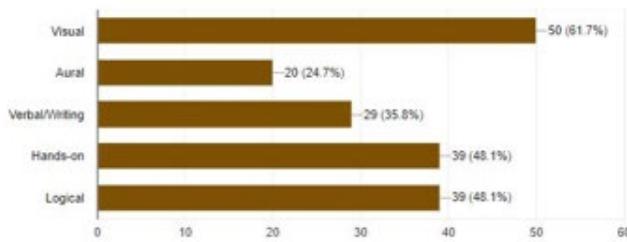
Do you find English Advanced, overall, engaging?

81 responses



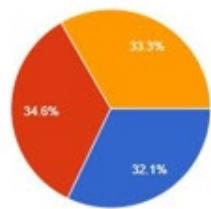
What type(s) of learning do you prefer?

81 responses



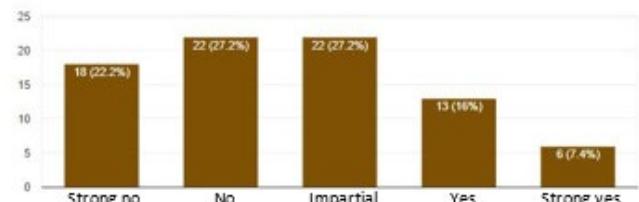
What are you best at in English?

81 responses



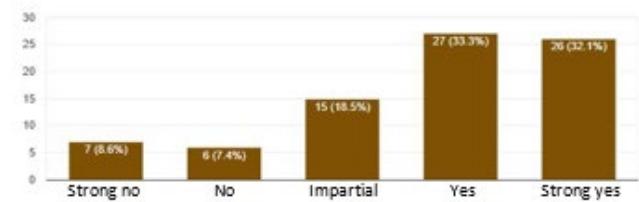
Do topic introductions spark your curiosity or interest? (Make you excited for the new topic)

81 responses



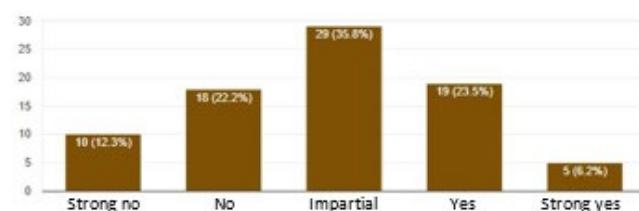
Would you appreciate a more engaging introduction?

81 responses



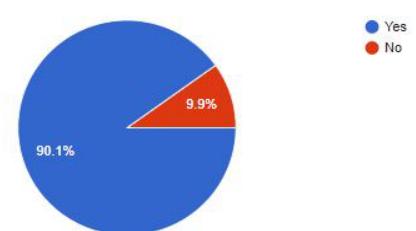
Do you notice any differences in how class is taught with each topic?

81 responses



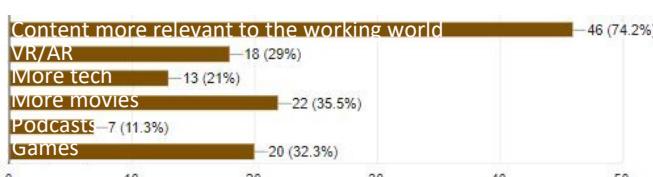
In your opinion, could English topics be more engaging?

81 responses



(Even if no) What may make it more engaging?

62 responses



(optional & appreciated) If yes, in a few sentences, how?

Let us do standard
A printout of the entire topic being given to the students - what you will cover, what parts of the rubric it will address, all the expected work for the term etc. and then straight into the topic and stop wasting time
Texts chosen for topics could be more interesting e.g. Motorcycle diaries relies on historical knowledge
I like when an English topic relates strongly to real life (like After the Bomb in Extension 1)
Have the teachers create something engaging themselves that will intrigue the class. Then explain the end goals of the topic (eg. narrative) and outline the steps that will get us to the end goal.
More interesting texts, more relevant topics with texts that directly relate to them
Drop abstract nature of area of study and replace it with something more concrete and grounded
Not joking currently our class is very socialist/ our way or the highway
Most of the societal and real-world context we get is purely factual evidence of what we need for the next assessment. It would be interesting to understand the effects on society in a more abstract and opinionated way, and possibly hold an informal debate on the relevance and ramifications of a topic (I'm just thinking about the consumerism and satire ones idk)
Often feels very exam oriented continually, so make it less of that at the start of a topic
Let the students decide how to write about something as long as they provide evidence. Also focus it on actual English rather than "conceptual understanding".
More practical please! I don't know anything about interpreting news and bias, perspective and analysis of factual/informative writing
There are so many interesting novels and types of texts out there however they always manage to choose the most depressing and in my opinion boring text which immediately makes it hard for any student to have any interest in the subject whatsoever so if the texts they choose were actually engaging and then the studies reflected on the actual meaning through what the author was saying instead of language techniques English could be a valuable subject. Plus everything is heavily based on strict restraints/constrictions, which if they were maybe loosened even slightly students would be able to be more creative and intellectual instead of just trying to please a marking criteria
I find English topics unnecessarily conceptual
The topics are always so convoluted. They need to make topics that are engaging to the audience and are helpful to our actual lives - the only English that gives you life skills is English studies and it's non-ATAR
Better books
Make it more real life and less figurative. Like a lot of the texts we study are really metaphorical and a lot of the time I have absolutely 0 clue what's going on in the text. Then teacher explains and I'm thinking to myself how the heck does the story show that?
Choosing better prescribed texts e.g. not MCD. The syllabus dictates that you kind of have pretty strict barriers to how far you can stray so there's not all that much that could be done??
Less repetition
I think many of the topics we are learning are unrelated to us and therefore we or I don't feel it has a use to me. I think there should be more focus on grammar and less focus on irrelevant topics such as Shakespeare. Knowing about Shakespearean poems and the values in Elizabethan society will never be of use to me. I would prefer to be learning about our language not old English that no longer makes sense

## Appendix B: Rendered Progression of Maya Scene

Version 1

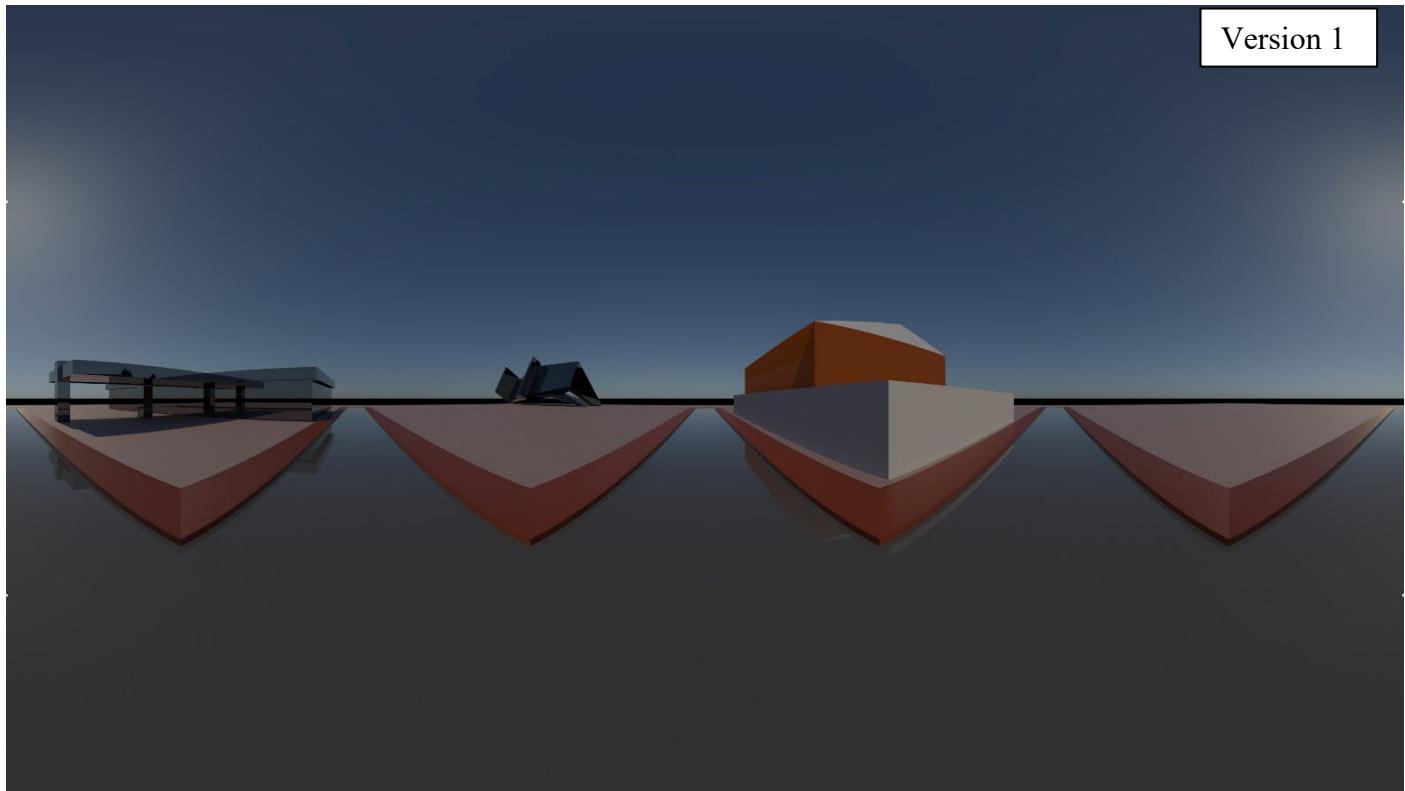


Figure 73: Scene Render 1

Version 2 – Distant city added,  
lighting adjusted, signpost  
added, terrain and road  
distance increased

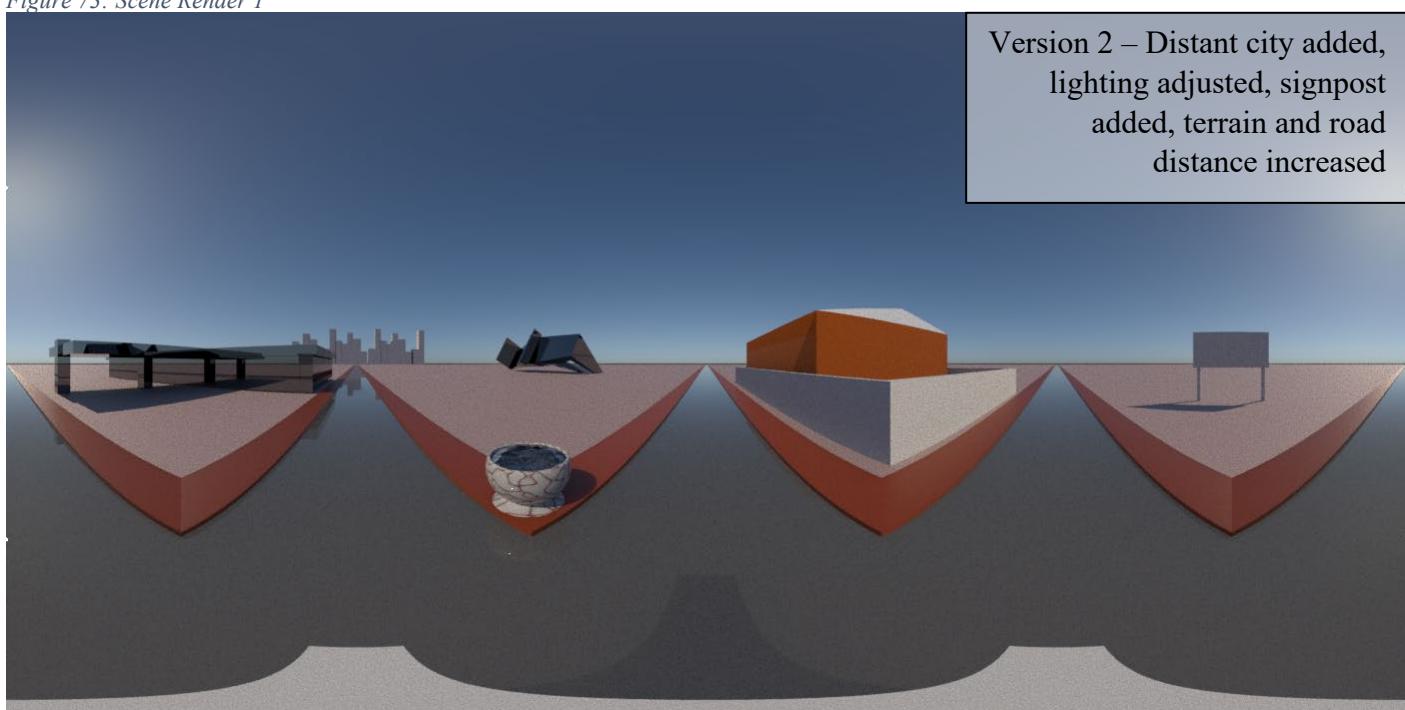


Figure 74: Scene Render 2

Version 3 – Sun moved, signpost textured, materials adjusted, swing set added, road lines added, petrol station moved and connecting road added

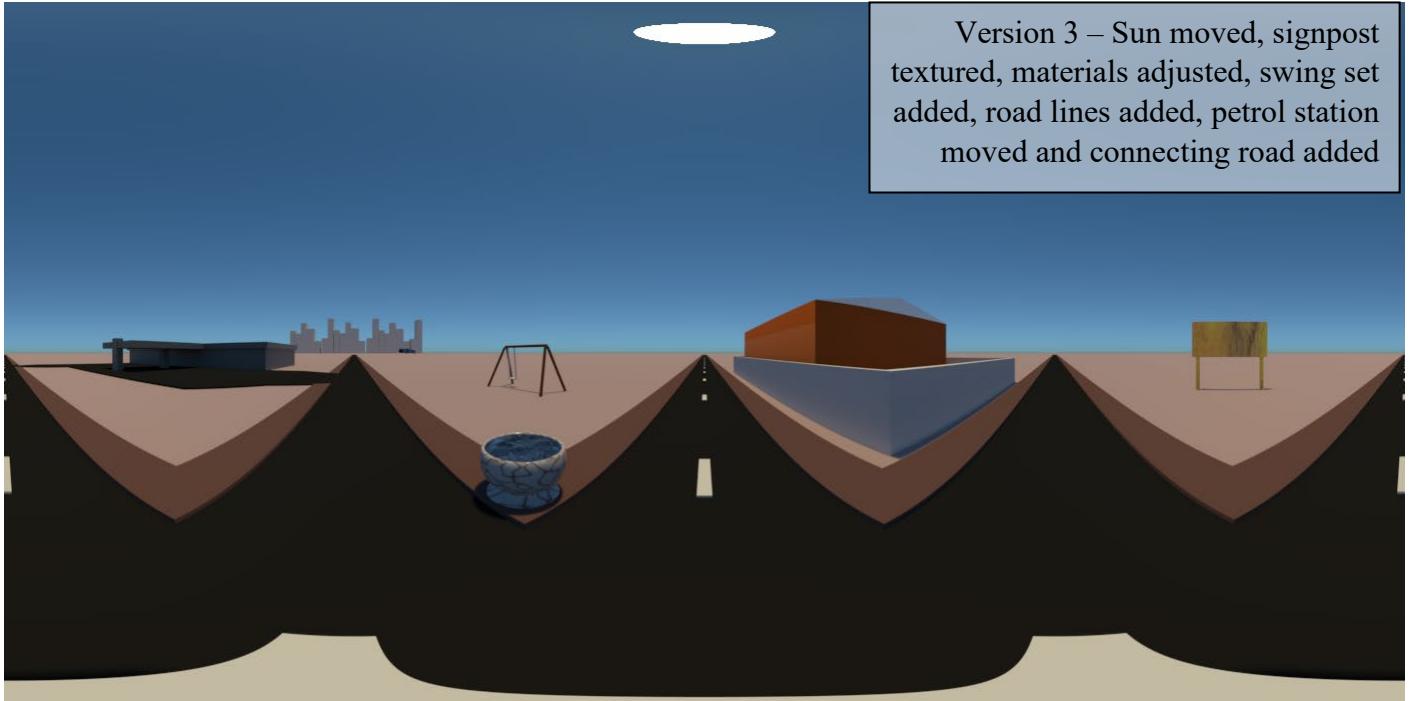


Figure 75: Scene Render 3

Version 4 – Sun moved, and light intensity and sky turbidity adjusted



Figure 76: Scene Render 4

Version 5 – Sun moved, sign texture removed, smoke added, camera position adjusted

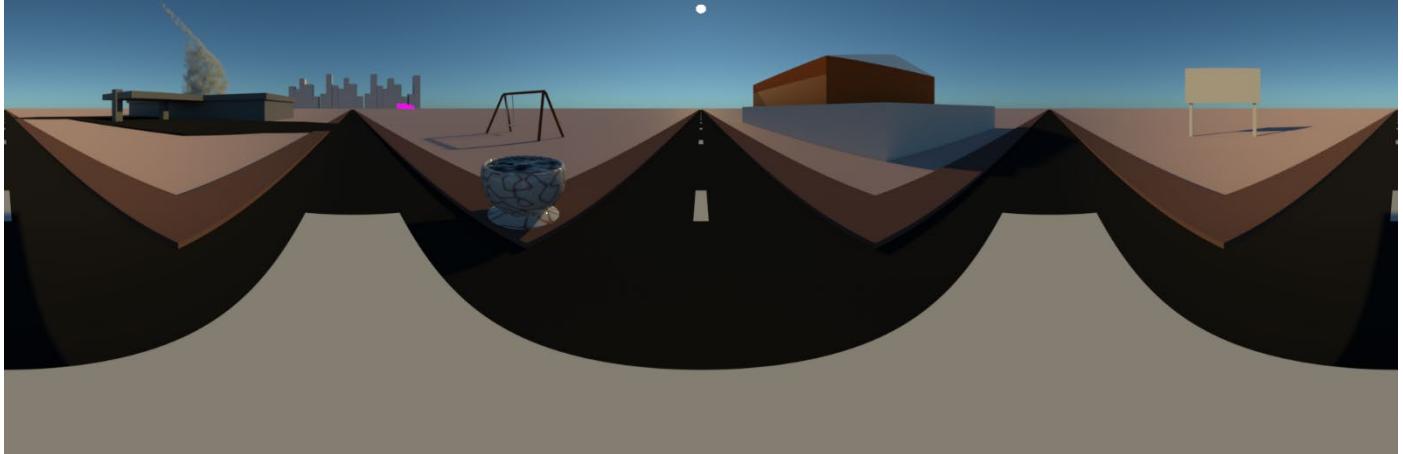


Figure 77: Scene Render 5

Version 6 – Smoke adjusted

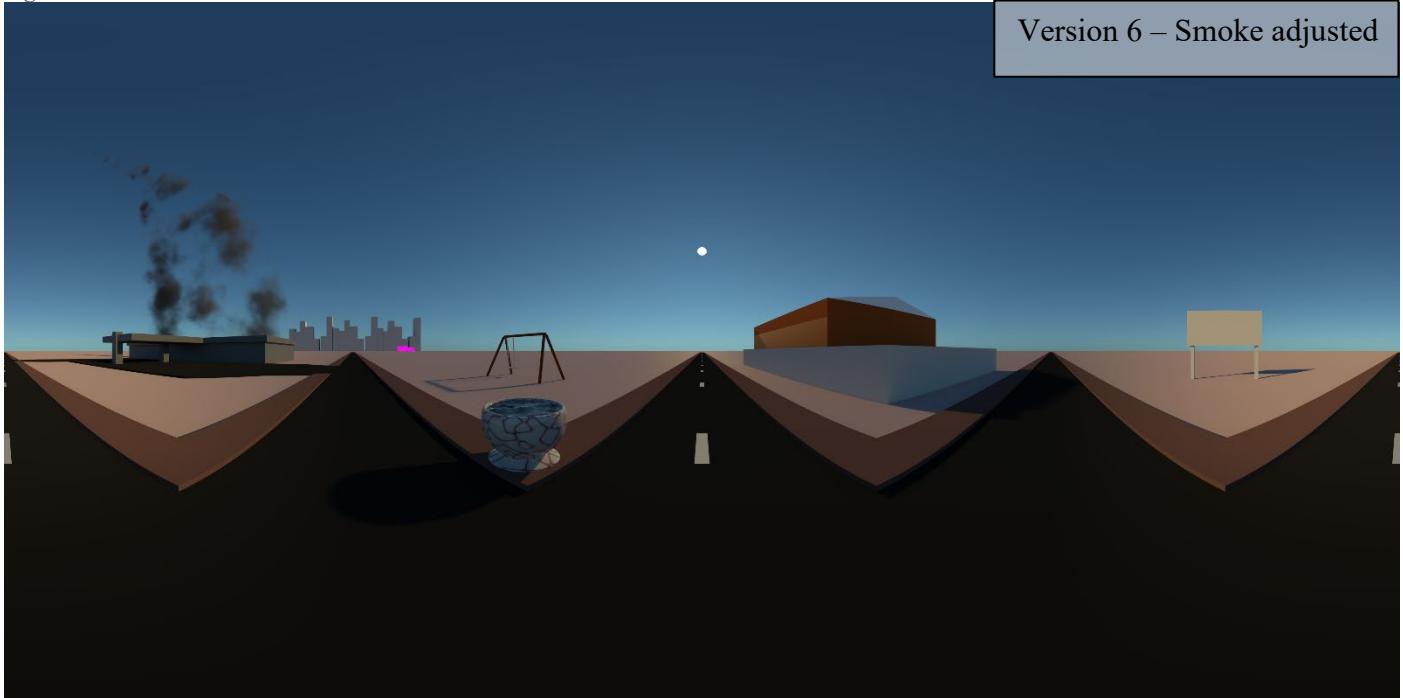


Figure 78: Scene Render 6

Version 7 – Smoke adjusted, pink building removed, more roadlines, lighting adjusted, camera position adjusted

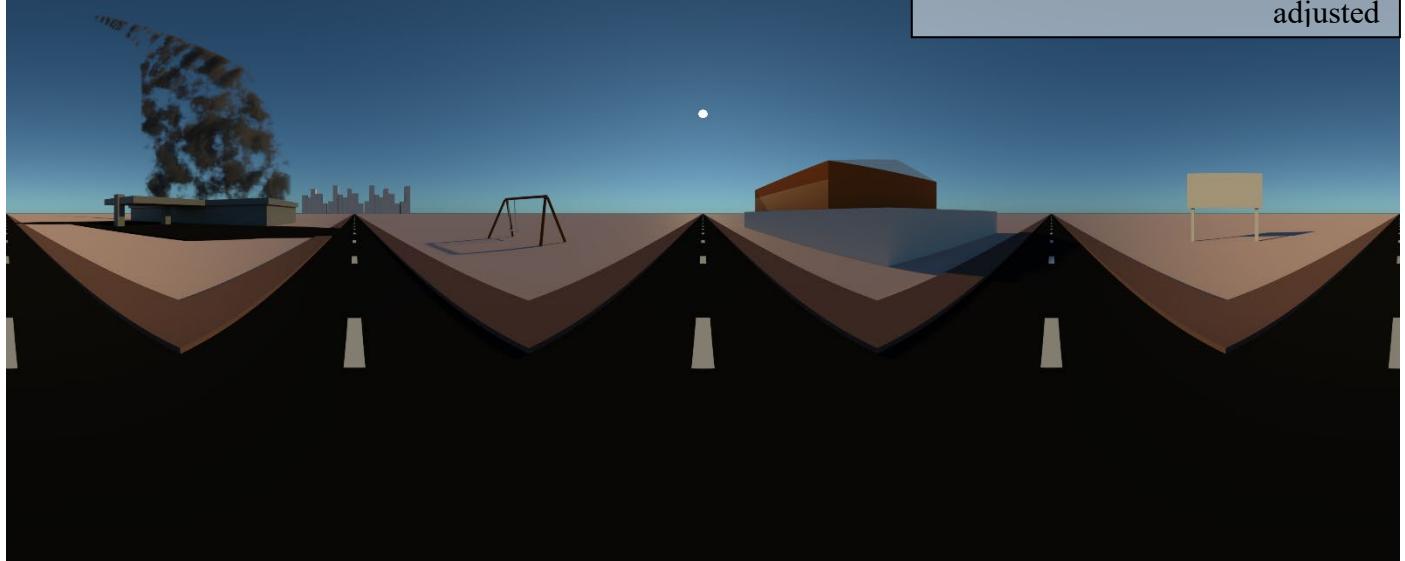


Figure 79: Scene Render 7

Version 8 – Ground completely deleted and replaced, smoke removed

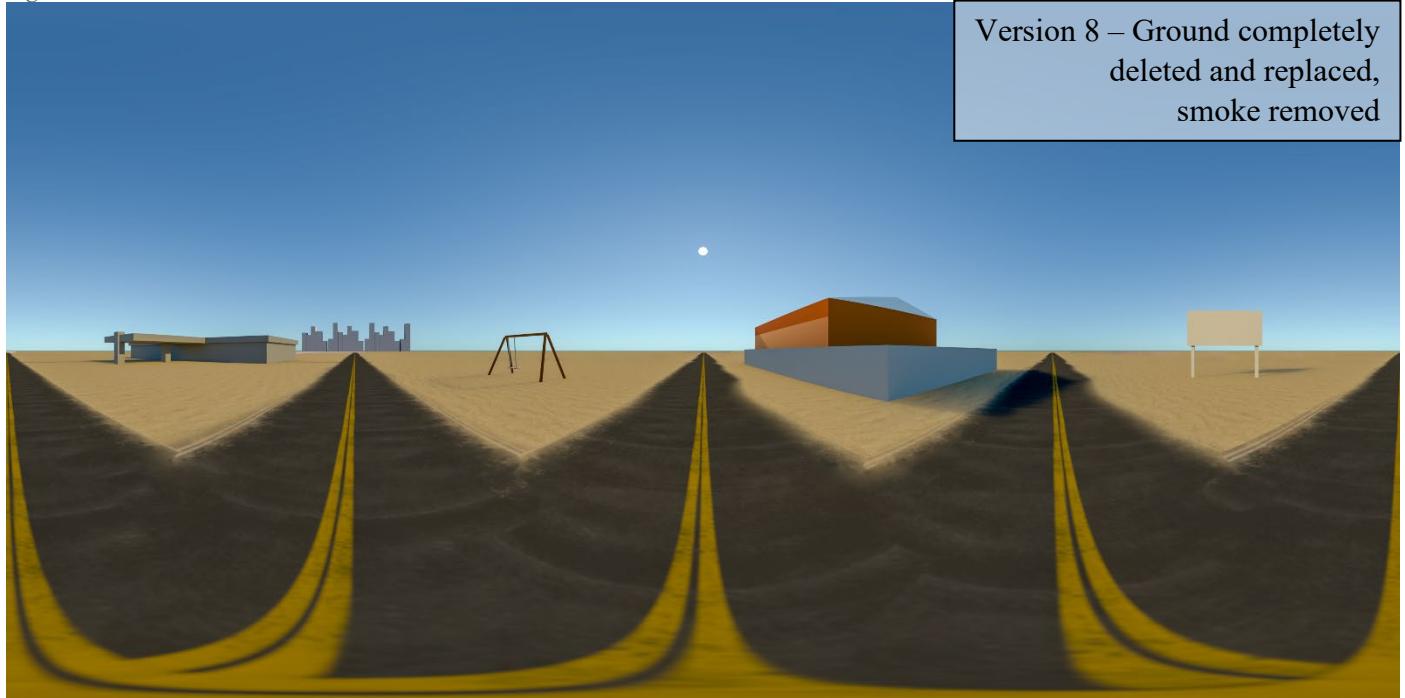
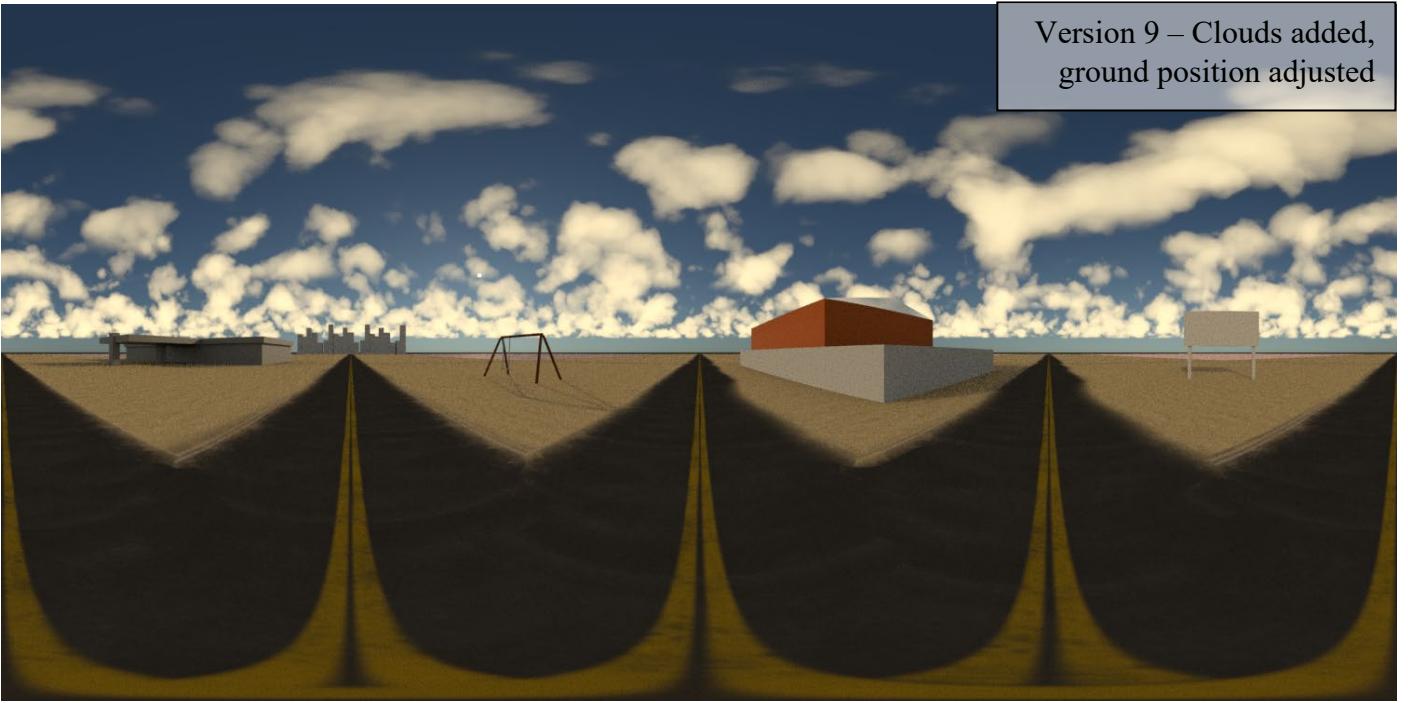
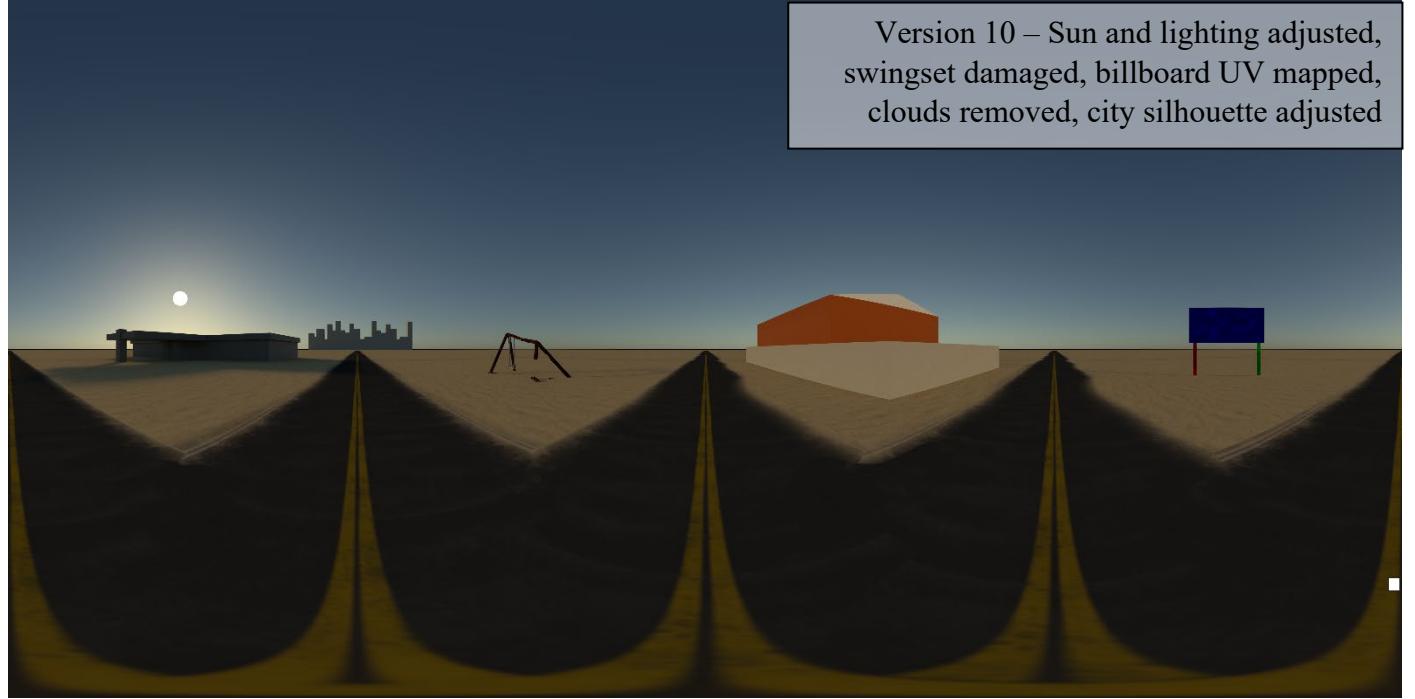


Figure 80: Scene Render 8



Version 9 – Clouds added,  
ground position adjusted

Figure 81: Scene Render 9



Version 10 – Sun and lighting adjusted,  
swingset damaged, billboard UV mapped,  
clouds removed, city silhouette adjusted

Figure 82: Scene Render 10

Version 11 – Billboard finalised, servo updated, sun and lighting adjusted.

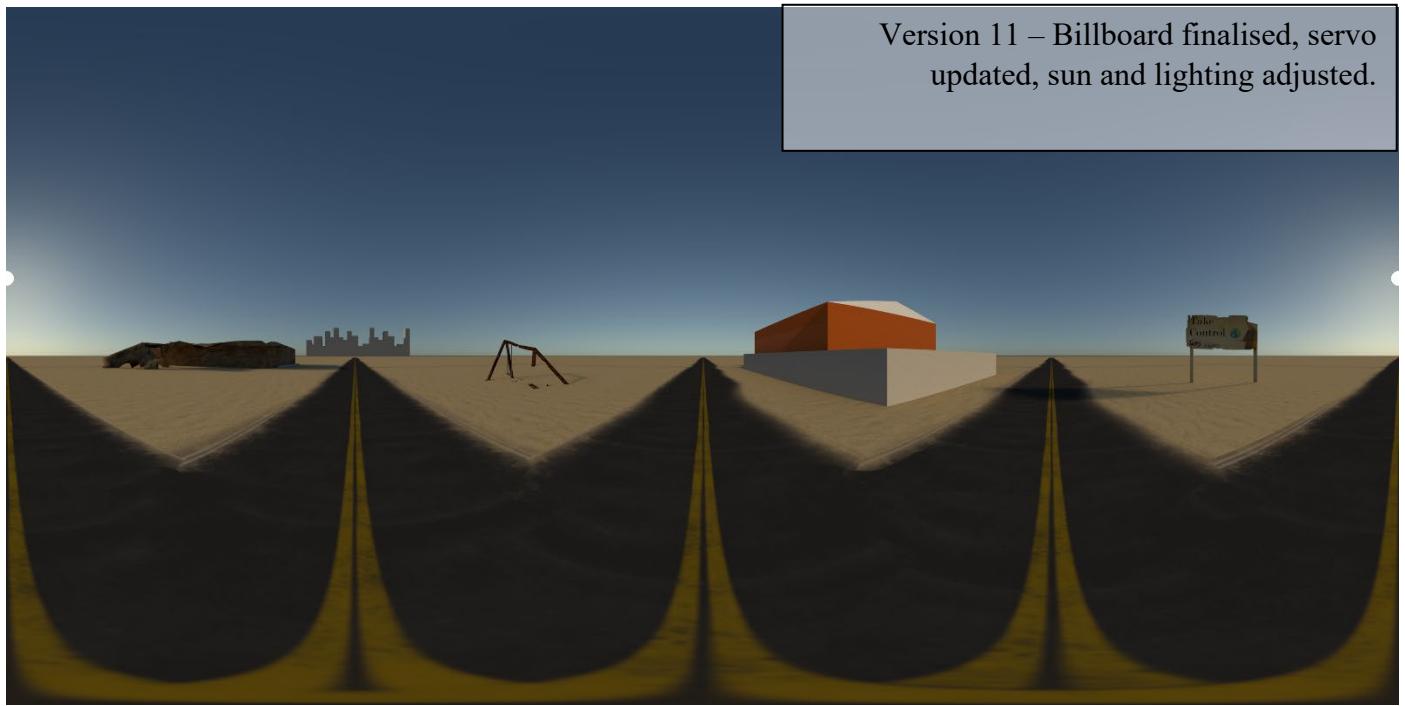


Figure 83: Scene Render 11

Version 12 – Servo and school completely replaced by final versions, sun and lighting adjusted.

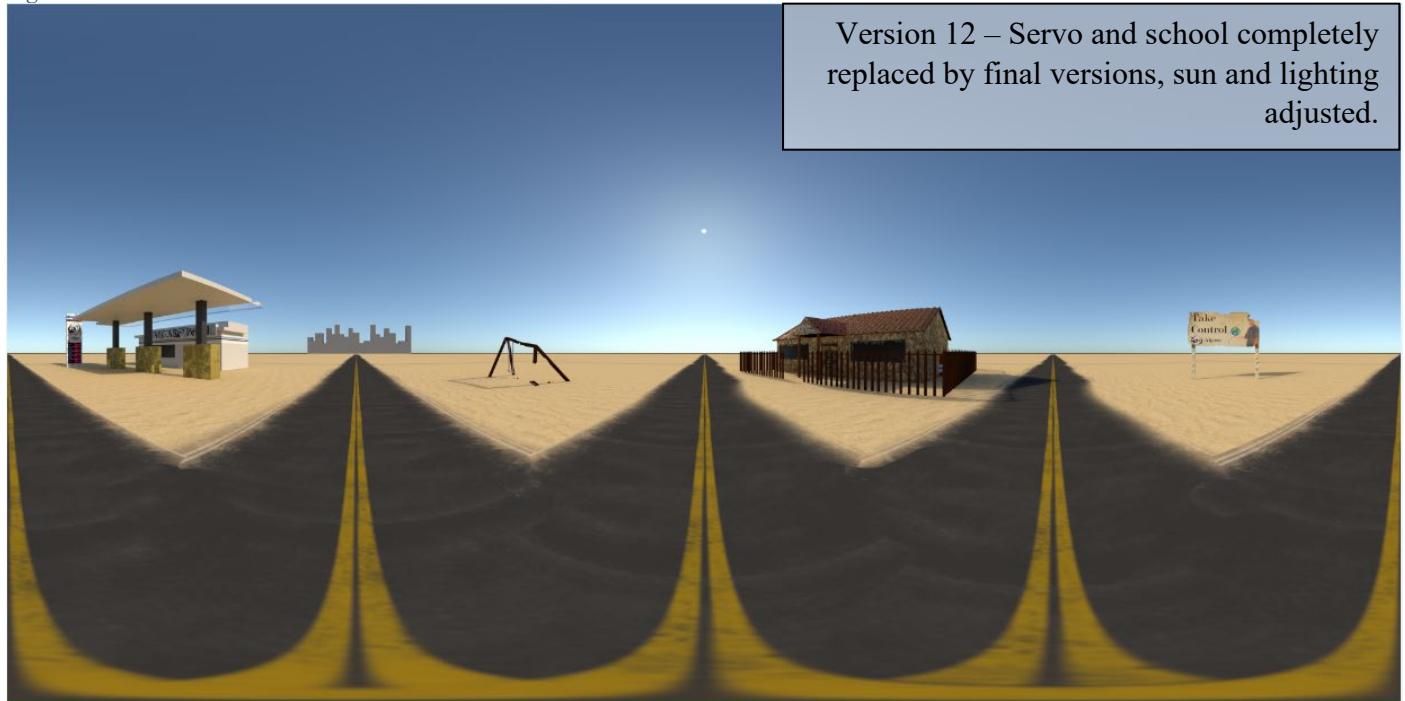


Figure 84: Scene Render 12

Version 13 – Sun and lighting adjusted.  
Wear added to servo.  
City skyline model changed

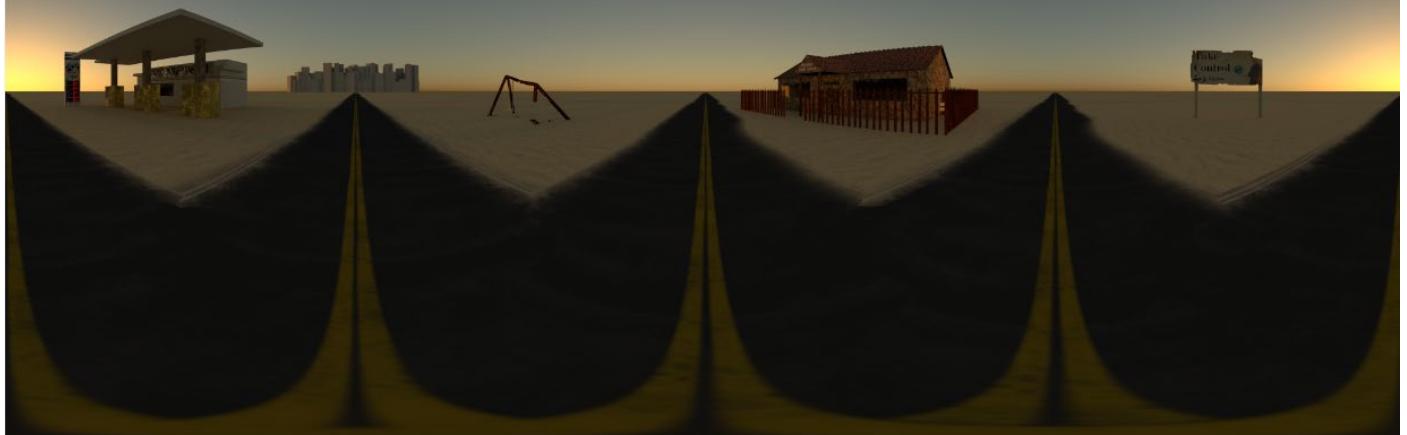


Figure 85: Scene Render 13

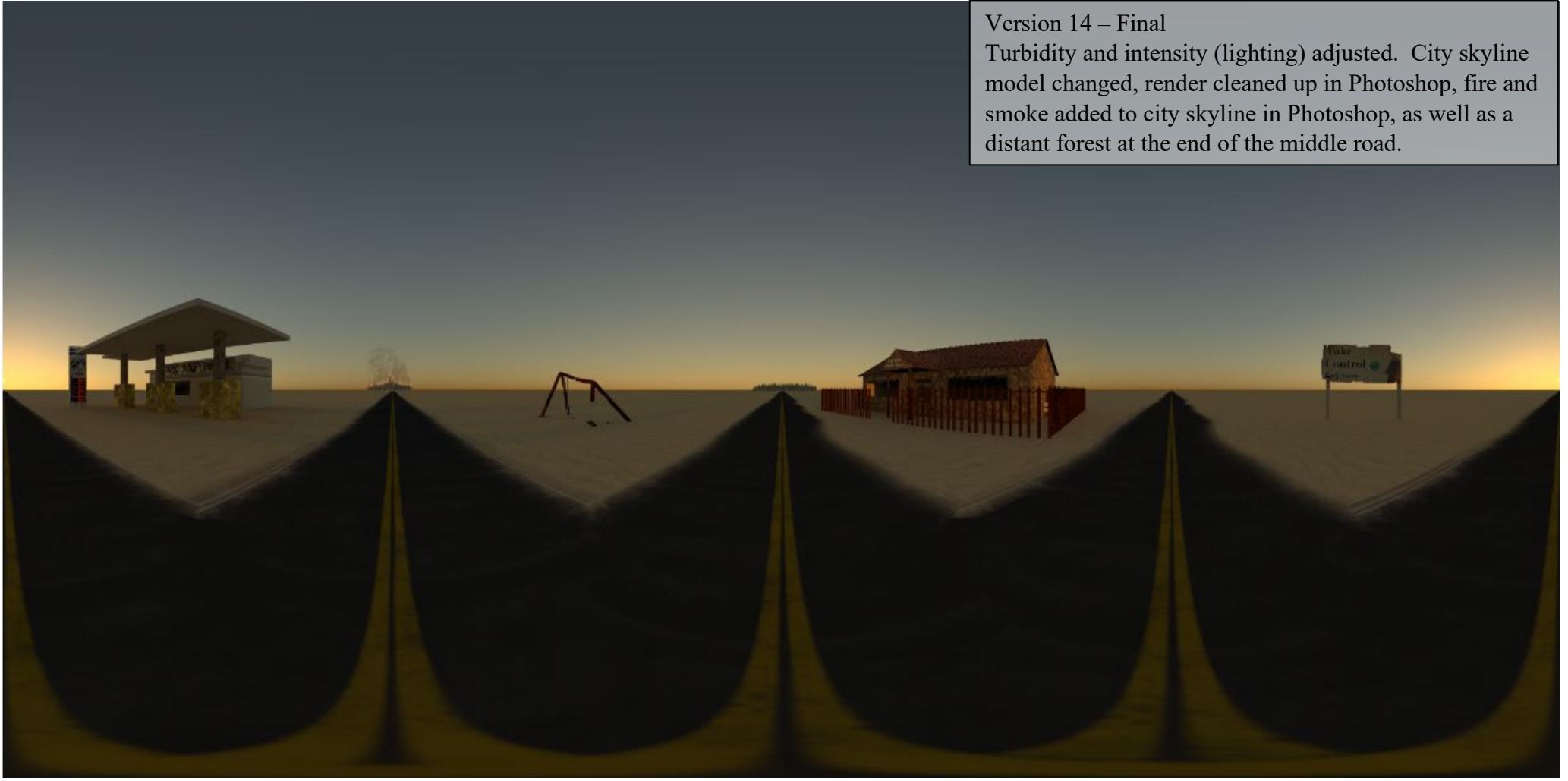


Figure 86: Scene render 14

Version 14 – Final

Turbidity and intensity (lighting) adjusted. City skyline model changed, render cleaned up in Photoshop, fire and smoke added to city skyline in Photoshop, as well as a distant forest at the end of the middle road.

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