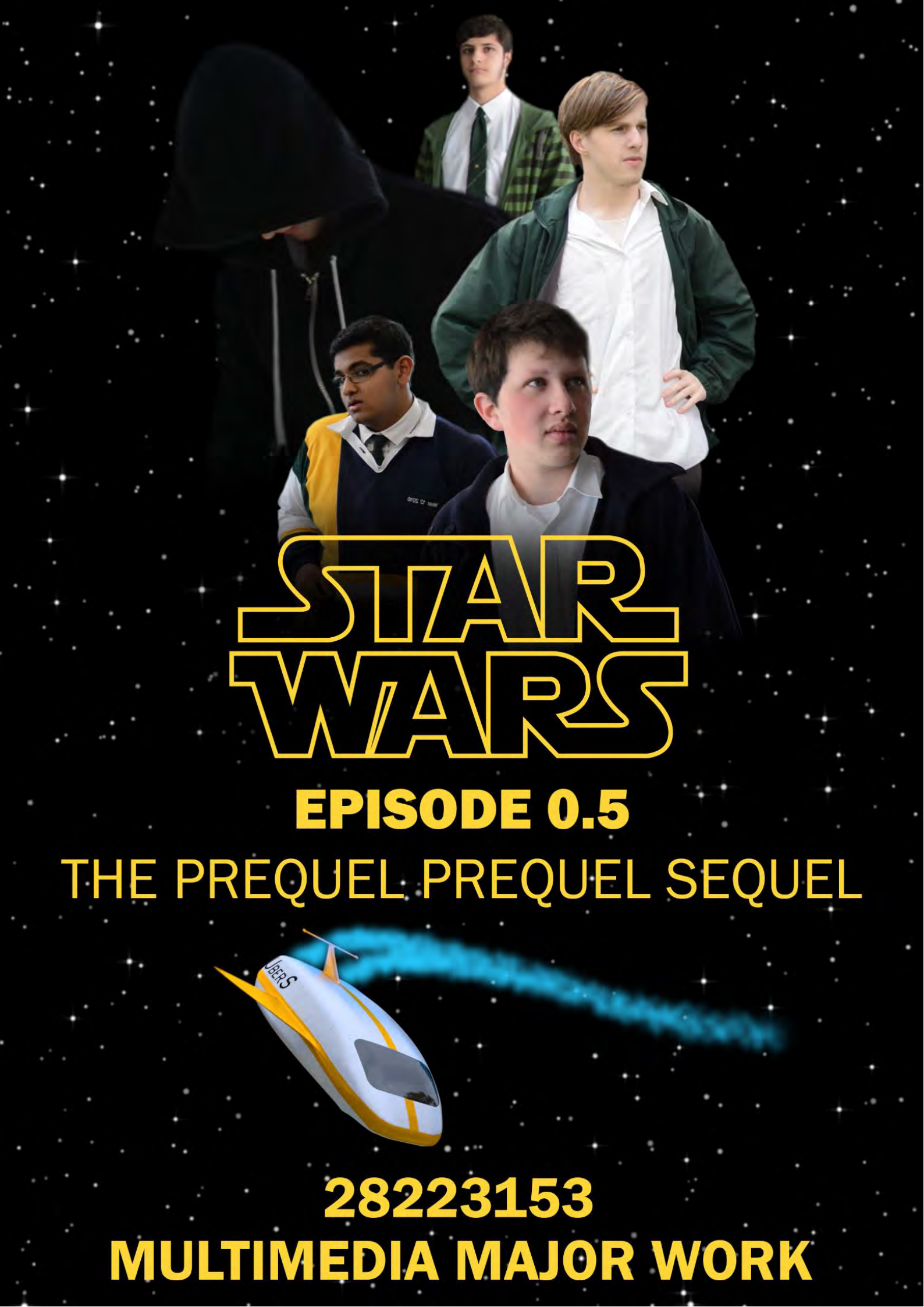

STAR WARS
EPISODE 0.5
THE PREQUEL PREQUEL SEQUEL
28223153
MULTIMEDIA MAJOR WORK

CONTENTS

STATEMENT OF INTENT

For my Major Work I intend to create a short film, presented on a website which I will create myself. The short film will be a parody of Star Wars and will include multiple effects such as a CG space ship, which I will create myself, and will be motion tracked and composited into the video. I will also have a 3D holographic display effect in the video. I will create the website myself using HTML, CSS and JavaScript.

REASONS & MOTIVATIONS

The main reason for creating this project is to get band 6 mark and an InTech Display nomination. I chose this project as it has a lot of different skills required, which will allow me to show that I have those skills, such as 3D Modelling, CG and website creation.

TARGET AUDIENCE

The target audience for my Major Work will be for ages 12 and up. Since the video will be a parody of Star Wars, it is also targeted towards people who have seen Star Wars.

SOFTWARE AND EQUIPMENT

To complete my Major Work, I will require various types of software including video editing software, compositing, 3D modelling, 3D rendering, camera tracking and web development software.

I will also need a lot of equipment for filming the video, editing the video and creating the website such as a camera, a microphone, a tripod, a laptop or tablet for reviewing footage without having to use a desktop computer and a desktop for editing and creating the video.

SKILLS REQUIRED

For such an ambitious project I will require many skills to accomplish it. The skills required for the video will include filming, directing, editing, compositing, 3D modelling, motion tracking, sound design, planning and organising. Creating the website will also require many skills such as designing, storyboarding, HTML, CSS and JavaScript.

TIME FRAME

The time frame for my project is from term 4 2015 to term 2 2016. The major-work is due week 4, term 3 2016, but from weeks 1-3 will be trial HSC tests so I plan to complete my major-work early. In order to complete the project within this time-frame I will need to properly manage my time, something which I'm not great at.

SWOT ANALYSIS

Strengths

The strengths of the project are that is requires a lot of skills, which will hopefully improve the mark of the project if I successfully complete it.

My strengths are that I have many of the skills required that I learned from previous multimedia projects. I am also fast at learning new skills which will help me to complete areas of the project I have never done before.

Weaknesses

My project doesn't have many weaknesses as long as I complete it successfully. One possible weakness is the story not being entertaining or fun.

My biggest weakness is time management. I need to properly manage my time to complete the project before it's due. Hopefully I will be able to do this.

Opportunities

This project has a lot of opportunities. If I complete it successfully I will hopefully get a band 6 mark for it and possibly an InTech Nomination. Other opportunities are to improve my skills and learn new skills.

Threats

Threats to the project include not completing it on time due to poor time management and other responsibilities getting in the way. Things that could get in the way are work for other subjects, and my job.

EVALUATION

I think the statement of intent for my major work is good. My plan for my major work involves many skills, such as modelling, texturing, animating, motion tracking, compositing and website creation, which will allow me to demonstrate that I have those skills and hopefully get me a band 6 mark. I am concerned that I will have enough time to complete my major work however, I will have to manage my time well in order to finish on time.

RESEARCH

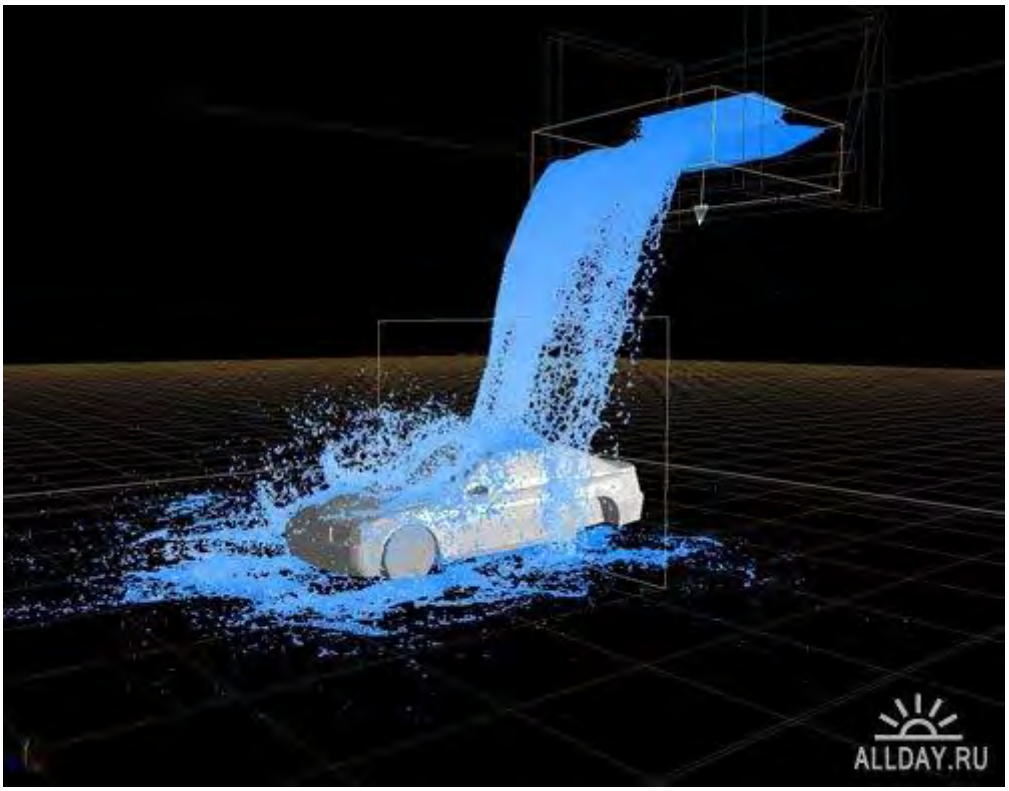

Research
Software
•3D Modelling
•Simulation
•Tracking
•Compositing
•Rendering
•Website creation
Compression
•Lossy
•Lossless
Resolution and Framerate
Modelling
•Polygonal
•Curve
•Sculpting
Hardware
•Computers
•Cameras
File Types
•Images
•Videos
•Audio
•Codecs
SFX
Presentation
•File
•DVD
•YouTube
•Website
Tutorials
Storyboard
Camera Shots
Camera Angles
Inspiration
Types of Films
Genres of Films

3D Modelling Software

http://link.ssis.edu.vn/@api/deki/files/1029/=blender.png
Blender 3D

Software	Pros	Cons
blender	- Free - Many free tutorials and resources - I am very familiar with it - Also does compositing, video editing, simulation and more - Cross-platform (Windows/Mac/Linux)	- Can be more complicated to learn - Sometimes crashes/freezes
AUTODESK® 3DS MAX®	- Industry standard - Lots of support - Powerful for modelling	- Expensive - I have no experience with it - Windows only
MAYA	- Industry standard - Lots of support - Support for rigging and animating - Better for character design - Cross platform (Windows/Mac/Linux)	- Expensive - I have very little experience with it

Simulation Software



http://4.bp.blogspot.com/_vIxWX6ygKJs/TDSB32La3pI/AAAAAAAAAA8/DF9jnZAC9sI/s1600/1193160313_bild_2a.jpg
Realflow

Software	Pros	Cons
blender	- Built in support for rigid body, soft body/cloth, particle and fluid simulation - I have experience doing simulation with it	- Difficult to get some simulations working - Particle collision requires an add-on - No particle mesher built in
AUTODESK® 3DS MAX®	- Particle simulation - NVidia PhysX rigid body dynamics simulation - Built in particle mesher	- No built in soft body/cloth or fluid simulation (requires add-ons)
REALFLOW	- Industry standard - Powerful fluid, rigid body and soft body/cloth simulation - Cross platform (Windows/Mac/Linux)	- Expensive - I have no experience with it

Camera Tracking Software

http://www.itsartmag.com/features/boujoutrack/1.jpg

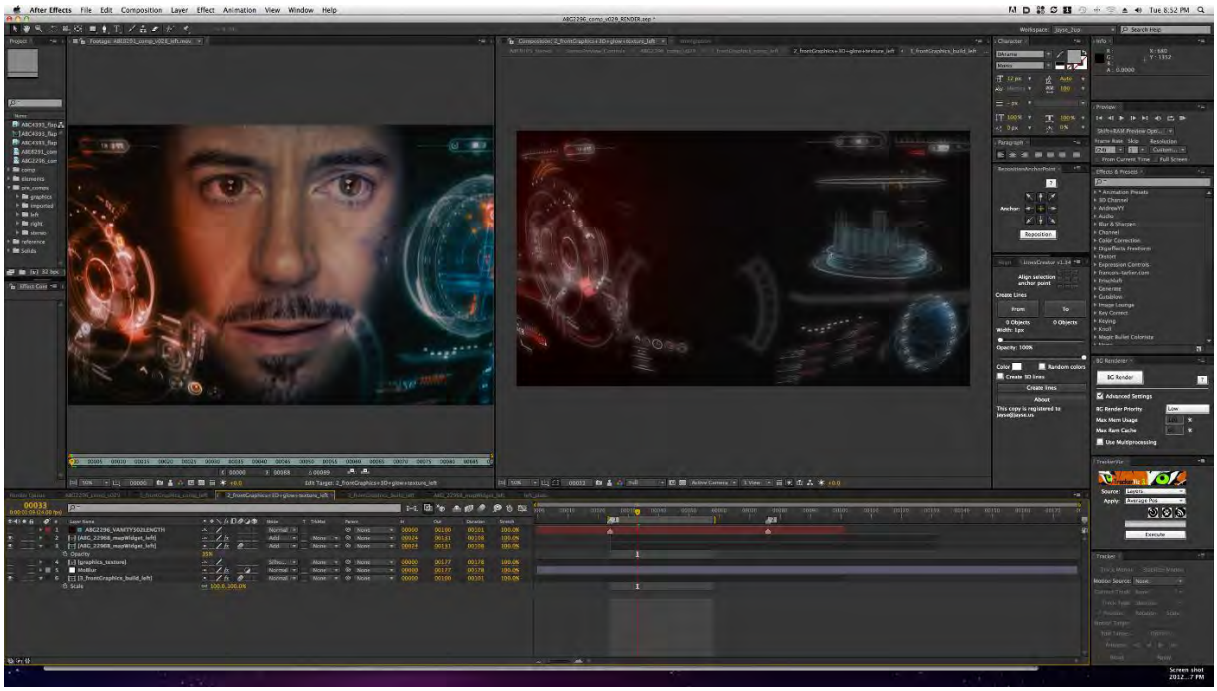
Boujou

Software	Pros	Cons
blender	- I have experience with camera tracking in it - Easy to work with in blender	- Can be tricky to get the tracking right
Ae	- Quick and easy to use - Works well with Cinema 4D	- Expensive - Sometimes it just doesn't work - No (official) support for blender
boujou.	- Industry standard - Better results	- Expensive - No (official) support for blender

ONGOING EVALUATION

I have started to think of ideas for my major work such as effects and the general plotline but so far I have mainly focussed on research, which is going well. I plan to do a lot more in depth research on how to do effects that I have ideas for.

Compositing Software

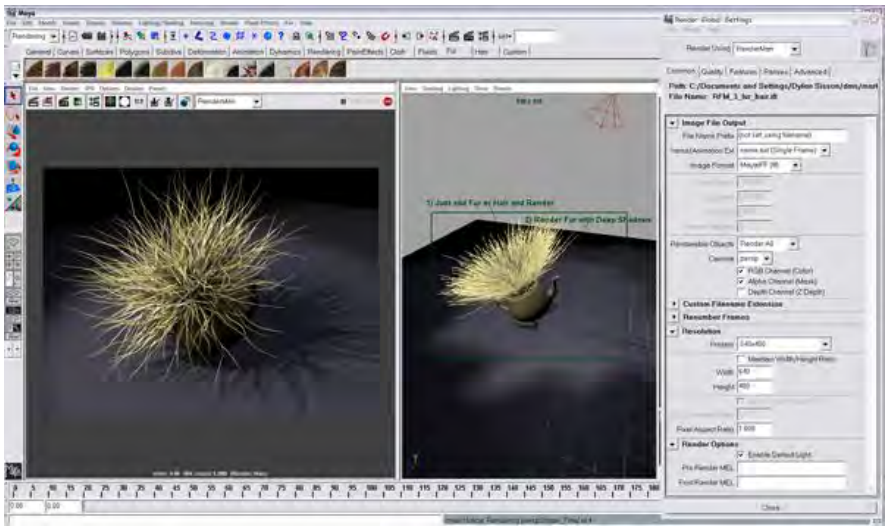


http://www.indietips.com/wp-content/uploads/2013/02/After-Effects-Iron-Man-Avengers.jpg

After Effects

Software	Pros	Cons
blender	- I am familiar with compositing in blender - Easy to work with in blender	- Can take a lot longer to do some effects that would be quick in other programs
Ae After Effects	- Much faster to do things than with blender - Lots of tutorials and support	- Costs money
Nuke	- Used a lot in the industry - Free for non-commercial uses	- Costs money

Rendering Software



http://www.hpcwire.com/wp-content/uploads/2011/08/renderman.jpg
Maya rendering with RenderMan

Software	Pros	Cons
blender™ Internal	- Faster than most other rendering engines - Integrated well into Blender - I am have some experience with it - Free and open source	- Difficult to get good results - Only uses CPU
blender™ Cycles	- Faster than most other unbiased rendering engines - Integrated well into Blender - Can use GPU acceleration - I am familiar with it - Free and open source	- Slower than Blender Internal and other biased rendering engines
V-Ray	- High quality results - Industry standard - Integrates with Blender	- Costs money
RENDERMAN	- Industry standard, used by Pixar - High quality results - Free for non-commercial use	- Support for blender is very experimental

File Types

Images

File type	Pros	Cons
PNG	- Lossless compression - Smaller than other lossless formats	- Larger than lossy and newer lossless formats
JPEG	- Small file size - Relatively high quality	- Lossy - No alpha channel support
TIFF	- Lossless - Supports layers	- Very large file size
OpenEXR	- Half precision floating point - Used for HDR (High Dynamic Range) images - Lossy and lossless compression	- Large file size
HDR/RGBE	- Uses 8 bits per channels + 8 bits for an exponent value to store much brighter or darker values	- Large file size
BMP	- Lossless - Supported by almost everything	- No support for alpha channel - Very large file size
WebP	- Lossy and lossless compression - Animatable - Small file size	- Not widely supported

https://i.stack.imgur.com/J1EEX.png
Comparison of BMP and GIF with file size

Containers

A container file is the file that stores video and audio (and other data such as subtitles and chapter markers) of a video. Since a video file is usually both video and audio data, which are encoded in separate codecs, these two data streams need to be combined into one (called muxing). The container format specifies how this is done and how it is stored and also the supported codecs and features.

Video (Containers)

File Type	Pros	Cons
AVI	- Many supported codecs	- Doesn't support subtitles - Not supported by all programs
MP4	- Supported by most programs - Supports most codecs	- Doesn't support some codecs, like lossless codecs
MKV	- Supports virtually any codecs - Open-source/royalty free	- Not supported by all programs
MOV	- Supports most codecs - Supports intermediary codecs (such as pro-res)	- Requires QuickTime
WebM	- Open-source/royalty free - Supported by almost all web-browsers	- Not supported by many multimedia applications

Audio (Containers)

File Type	Pros	Cons
MP3	- Supported by almost everything	- Only supports MP3 codec
MP4 (M4A)	- Supported by most programs - Supports lots of audio codecs - Supports lossless audio codecs	
FLAC	- Supports lossless FLAC encoding	- Only supports FLAC codec

Codecs

A codec is software which encodes and decodes media. Codecs are mainly for video and audio. They specify how data is saved and loaded to and from digital storage. They usually use compression to reduce the file size of the data.

Video

Codec	**Pros**	**Cons**
H.264 (MPEG-4 AVC)	- Extremely common, wide support - Good quality - Adjustable bit-rate (can choose between better quality or smaller file)	
H.265 (HEVC)	- Extremely good quality - Adjustable bit-rate	- Not widely supported yet
VP9	- Extremely good quality - Adjustable bit-rate	- Not widely supported - Very slow to encode
Pro-Res	- Intermediate format, for transferring files during production without losing much quality	- Requires QuickTime or OSX
MPEG	- Lots of support	- Low quality - Old

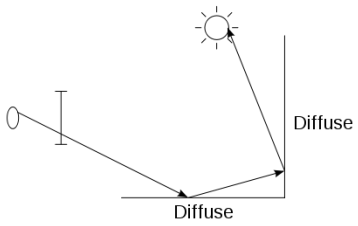
Audio

Codec	**Pros**	**Cons**
AAC	- High quality encoding - Supported by most programs	
MP3	- Good quality encoding - Supported by almost all programs	- Not as good as AAC
FLAC	- Lossless compression - Extremely high quality	- Not supported by many programs
WAV	- Supported by almost all programs	- Extremely large file size - Lack of compression options

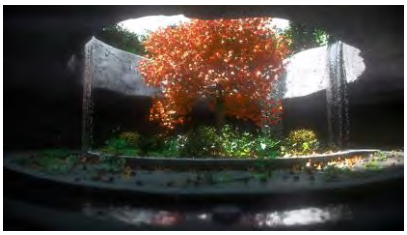
Rendering

Unbiased

Unbiased rendering engines aim to simulate the way the light would travel around a scene to get the most physically accurate result that it possibly can. The way they do this is usually with ray-tracing.



https://en.wikipedia.org/wiki/File:PathOfRays.svg
An example of how light can bounce off surfaces (diffuse lighting)

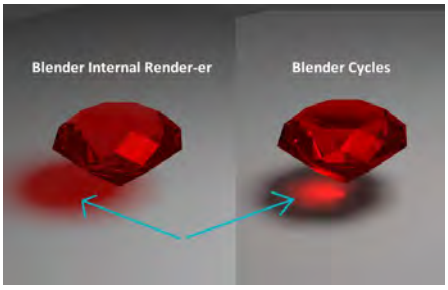


https://a248.e.akamai.net/f/574/7105/8d/www.extremetech.com/wp-content/uploads/2013/07/Tree_A06.03B.jpg
An example of global illumination. Parts of the scene are lit by light bouncing off

In real life, light bounces off objects and lights up things that aren't being directly hit by light. This is called **global illumination**. The light from surrounding objects that are being lit, bounces off them and into the shadows, lighting them up too.

Biased

Biased rendering engines attempt to produce faster results by not being as physically accurate in the final result. Biased rendering engines can usually be tweaked to achieve good results that looks accurate, but unbiased rendering engines make this much simpler but more computationally expensive.

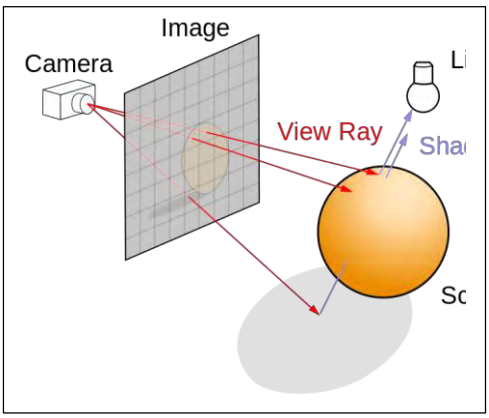


http://blenderartists.org/forum/attachment.php?attachmentid=274714&d=1386323152
Blender Internal (biased), the caustic (where the light should travel through the ruby and light up the ground) is not

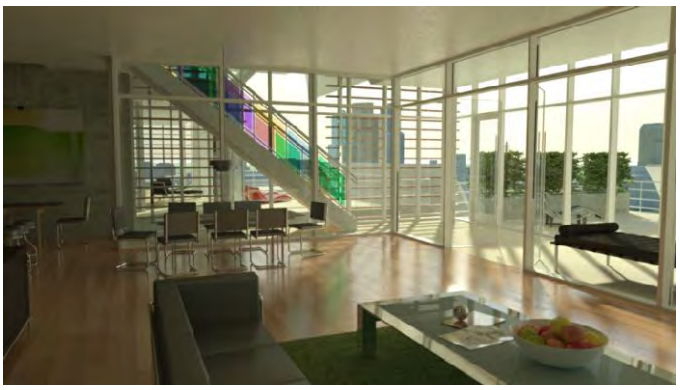
Ray Tracing

Ray tracing is a form of unbiased rendering. The concept of ray tracing is simple, calculate how light travels through the scene to get to each pixel on the image, then use that to calculate the colour of each pixel. This is actually a very intense process for a computer to do, it involves lots of calculations which takes time but the results are usually much better than other rendering techniques.

This is done by following a line (a ray) from the camera in the scene and calculate the direction it goes by bouncing off objects, reflecting off surface and refracting through objects. While the ray is being followed (traced), the light is calculated from what the ray has bounced off. This is done for every pixel in the image, calculating what each pixel 'sees'.



However because the ray from one pixel and the ray from an adjacent pixel might be very different, e.g. one ray might end up hitting a light but the other may not, this needs to be done multiple times for each pixel. So each pixel actually has many different rays, all starting at slightly different points inside the pixel, and then being averaged together to get the final colour for the pixel. This is called sampling, or the amount of samples for each pixel.



http://www.3dfocus.co.uk/wp-content/uploads/2011/03/ray-tracing-d.jpg
A scene rendered with ray-tracing. The light realistically travels around the scene illuminating the objects, notice the coloured glass being reflected on the floor.

Because this is takes a very long time to do, there are many different optimisations for ray tracing, mostly design to reduce the amount of redundant rays (rays that don't hit any light and don't contribute to the final image at all). Some of these include:

- Bi-direction ray tracing – Two rays are traced, from both the camera and the light source, and are joined so that they all hit light sources and contribute to the image.
- Dynamic Sampling – The amount of noise in the image is calculated, and instead of just setting the amount of samples for the whole image by the user, the amount of samples is set so that the final image is below a certain amount of noise.

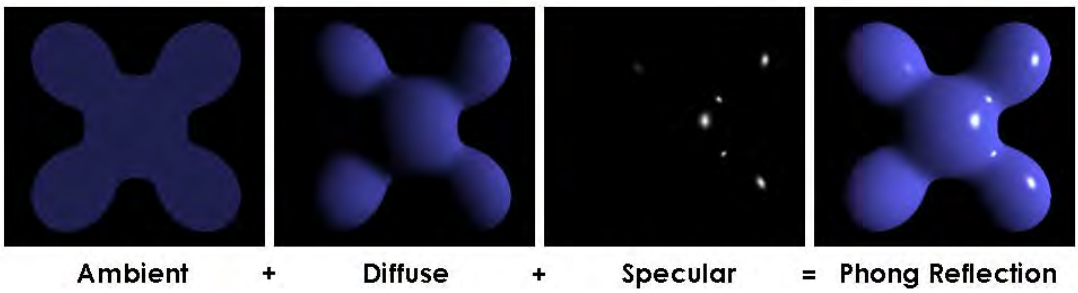
Scanline

Scanline rendering works by instead of following light through the scene, objects a projected onto the 2D image, and then for each pixel on the object on the screen, the colour for that pixel is calculated by a **shader**. This is called **shading**. This results in less accurate images but is far faster for a computer to do.

http://help.autodesk.com/cloudhelp/2015/ENU/3DSMax/images/GUID-2A5E4F74-D3E7-4D28-8700-18193AFED1C0.png
A scene rendered using scanline rendering. Shadows are faked instead of simulated, and generally the lighting across the scene looks flat due to lack of global illumination.

Because each pixel's colour is calculated individually, this means that the lighting in the scene must be 'faked' instead of simulated. Because each pixel, when being shaded, has not information on any other pixel of the image, effects such as lighting must be faked using the **Phong reflection model** and **Phong shading**. The Phong reflection model breaks down the lighting effects into 3 main parts:

- Ambient lighting – lighting that is applied evenly to the whole object, this is usually flat and is there to simulate global illumination by having object not be completely dark when not directly lit.
- Diffuse lighting – direct lighting on the object. This is calculated by taking into account the angle of the surface compared to the angle of where the light is coming from.
- Specular lighting – this gives the surface 'shininess', by having bright highlights on particular parts of the object where the light would reflect directly into the camera.



https://en.wikipedia.org/wiki/File:Phong_components_version_4.png
The Phong reflection model.

Due to this technique's speed and relative accuracy, it is often used in video games. In video games many other effects are also included into their scanline rendering engines. Some video games have ray traced lighting, but due to the slowness of it, it is **baked**, which means the lighting is pre-calculated and just applied into the scene. This means that it can only be used on state (not moving) objects.

ONGOING EVALUATION

So far I have research a lot of software and technical information which will help me to plan the effects and skills of my major work. So far I have plans for the general outline of the plot and also ideas for effects that I have. I need to continue my research also testing so that I am confident that I can achieve these effects that I am planning.

Examples

Unbiased rendering engines	Biased rendering engines
Arnold - used in Thor, Captain America, The Avengers, Pacific Rim and Gravity	**Blender Internal Renderer** - Blender's original biased rendering engine
LuxRender - Open-source rendering engine, supports almost all 3D Modelling programs	**3DS Max Scanline Renderer** - 3DS Max's default rendering engine
Cycles - Blender's unbiased rendering engine	
Octane Render - First publically available renderer that used GPU acceleration	
RenderMan - Pixar's rendering engine, used for all of their animated films, uses biased and unbiased rendering	
VRay - Supports both biased and unbiased rendering	

Compression

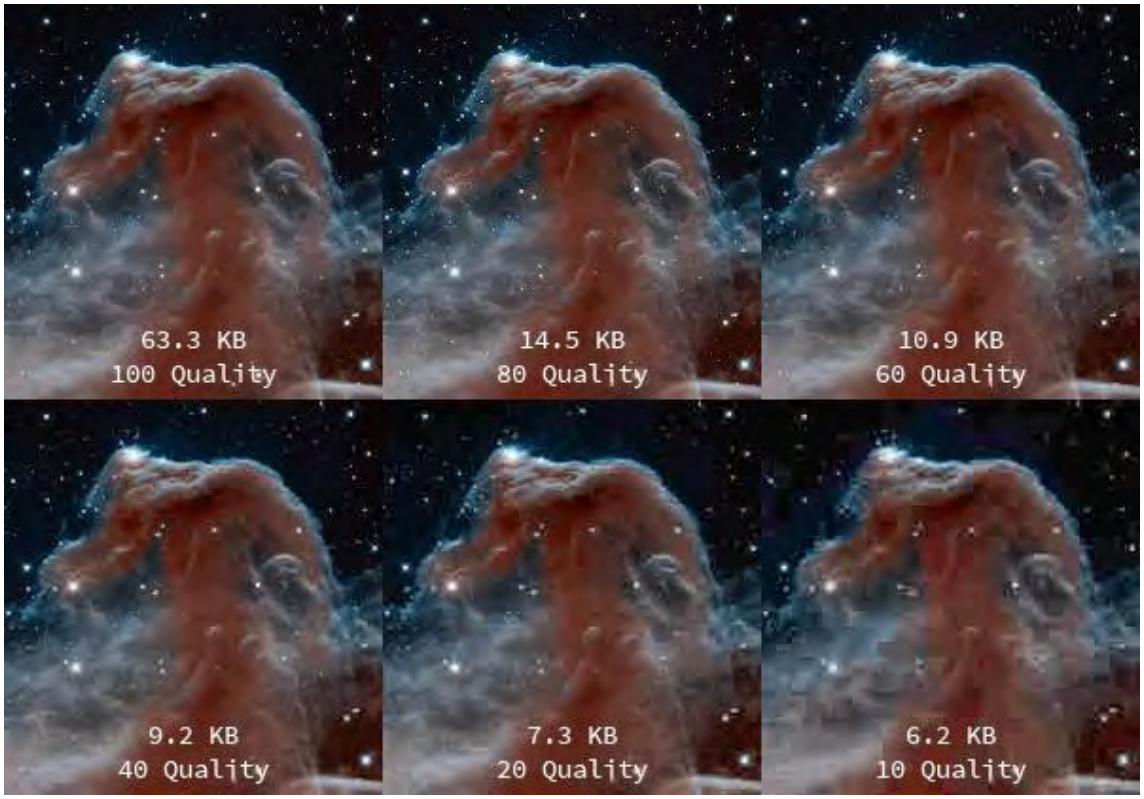
Lossless

Lossless compression reduces file sizes without losing any of the original data. It can be used to compress almost any data, including text, images and audio. It usually results in a larger file sizes that lossy compression but none of the original data is lost meaning there is no decrease in quality.

ONGOING EVALUATION

I have started to work on the storyboard for my major work and am beginning to plan when to the effects that I want to have, such as a holographic 3D phone effect and also a space ship that I will model and mix with live action footage. I have also started to plan the technical parts of my major work such as the file types and software that I will use.

Lossy



http://www.gimp.org/tutorials/GIMP_Quickies/JPG-Compression-Sample.png

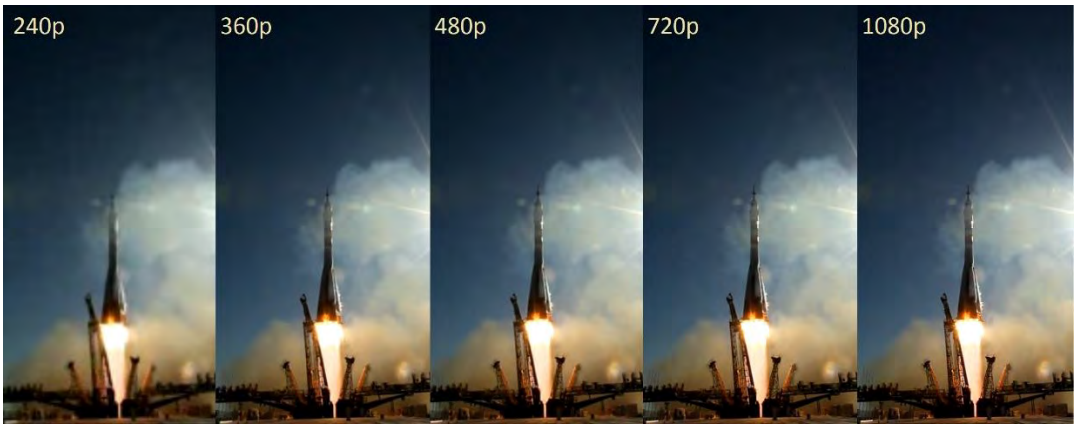
Example of lossy JPEG compression, notice the blocky-ness on the lower quality images

Lossy compression sacrifices some of the original data to reduce the file size even more that lossless compression. Since not all of the original data is kept intact it can only be used for specific file types such as images, audio and video. It can't be used on text or binary files since they require all data to be intact.

The data that is sacrificed is usually data which is 'redundant'. This means that the data doesn't contribute a significant amount to the information. Various techniques are used to determine what data is redundant and how to compress it. JPEG compresses images by finding patterns of small details which aren't as noticeable and compressing them to reduce the file size, but the compressed data is changed from the original data.

Resolution

Resolution is the amount of **pixels** in an image. A pixel is a single point in an image that has a colour. Lots of pixels together with the right colours make an image. The more pixels (higher resolution), the more detail can be included in the image. An image 100 pixels wide and 50 pixels tall has a resolution of 100x50.



https://upload.wikimedia.org/wikipedia/en/3/34/YouTube-resolution-comparison.jpg
Comparison of different resolutions.

Aspect Ratio

Aspect ratio is the ratio of the width of the image to the height of the image. For example, an image that is 100x50, has an aspect ratio of 100:50, simplified to 2:1.

In some cases, the pixels in an image are not square, they may be rectangular. This is called the **pixel aspect ratio**. This is often used to support wide-screen (16:9) resolution but keeping the 4:3 resolution. So an image that is 720x576, which is a ratio of 5:4, but the final image may have an aspect ratio of 4:3, or 16:9, depending on the pixel aspect ratio.

Common Aspect Ratios

Aspect Ratio	**Use**
16:9	Wide-screen TV, Some Movies, Most Computer Screens
16:10	Some Computer Screens
4:3	Standard Definition TV
21:9	“Ultra-wide” Computer Screens, Some movies
2.39:1 (Anamorphic)	Most modern movies

Common Resolutions

Common Name	Resolution	Aspect Ratio	Use
480p	854x480	16:9	Online Video, Some TVs
HD, 720p	1280x720	16:9	TVs, Online Video, Blu-ray
Full-HD, 1080p	1920x1080	16:9	Most TVs, Most Online Video, Blu-ray
NTSC, 480i	720x480	4:3, 16:9	Standard Definition TV in America, NTSC DVDs
PAL, 576i	720x576	4:3, 16:9	Standard Definition TV in most countries, PAL DVDs
DCI 2K	2048x1080	1.90:1	

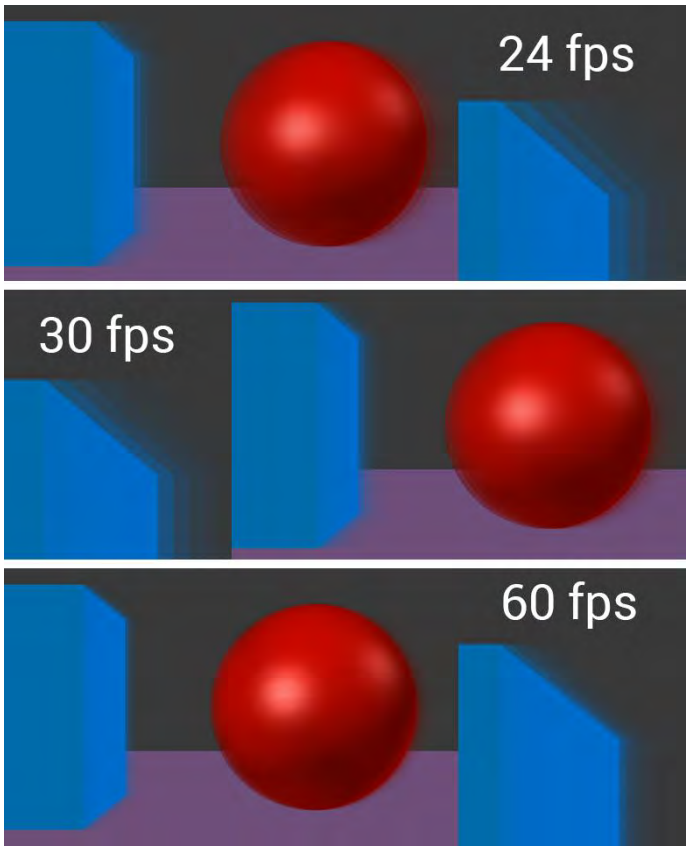
Framerate

Videos are actually just a lot of images, quickly shown one after another. The frame rate of the video is how many images (frames) are shown per second, it is measured in **frames per second (fps)** or **Hz**.

The more images there are, the more information about the movement in the video that your eyes can see. Most people can't tell the difference between video and still images after about 23 frames per second (fps) but this doesn't mean that you only need 23 frames per second. With higher frame rates there is more information about the movement in the video which makes the movement more fluid and smooth instead of jittery or stutter-y. Different video standards, such as movies or TV, use different frame rates.

Framerate also has an effect on post-processing and special effects. Odd framerates such as 23.976 and 29.97 are difficult to use in many CG software such as motion tracking software and 3D animating software.

Framerate (fps)	Use	Effect
23.976	Movies, NTSC Video (the video system used in America for TV), Some Online Video	Gives the feel of a movie or TV show, not always very smooth but usually this isn't noticed as people are used to this frame rate.
24	Most Movies, Most Online Video	
25	PAL (video system used in most countries for TV)	
29.97	NTSC, Some video games, Some Online Video	
30	Most video games, Some Online Video	
48	High frame rate movies (2x 24), used in The Hobbit	Makes the video very smooth and fluid. Good for lots of action since the smoother framerate makes movement more fluid.
50	High frame rate PAL (2x 25 fps)	
59.94	High frame rate NTSC (2x 29.97 fps)	
60	Most Video Games, Some Online Video	

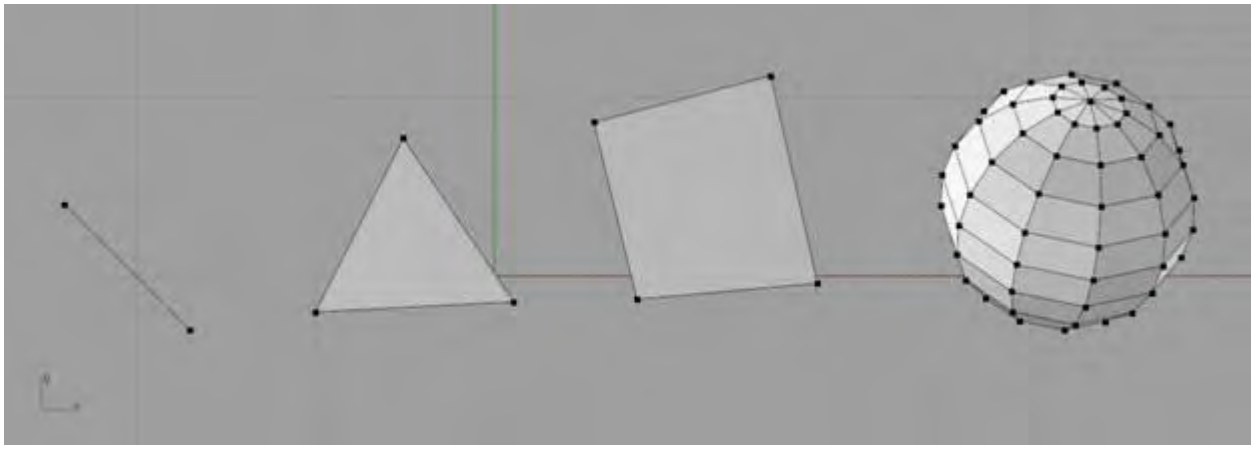


This image compares the frames in a video at 24fps, 30fps, and 60fps.
You can see that in the 24 fps video, the difference in the frames is quite noticeable. This means that your brain has a harder time interpreting the still images as movement.

The effect is less in the 30 fps video, but in the 60 fps video you can barely tell the difference between each frame which means that your brain notice the individual frames less and instead only notices the movement in the video, resulting in a smooth looking, more fluid video.

Modelling Types

Polygonal



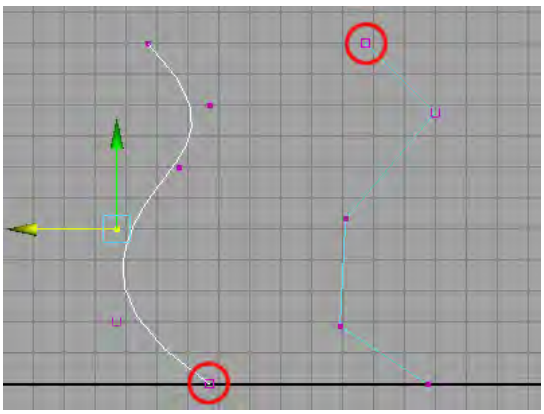
http://www.tsplines.com/UserManual_files/image058.jpg
Polygonal models

Polygonal modelling is modelling with polygons in 3D space. Usually it involves manually manipulating the vertices of a model such as translating (moving), scaling, rotating, extruding and deleting.

Advantages	**Disadvantages**
- Lots of tools to modify such as loop cuts, subdivision, boolean, cutting and displacement - Easy to create by manipulating each vertex individually - Easy to texture by applying a UV map to the mesh	- Limited detail, each polygon is flat so curved surfaces are actually just lots of polygons -

https://s3.amazonaws.com/blenderguru.com/uploads/2014/03/Wireframe_big1.jpg
A BMW modelled using polygonal modelling rendered with a wireframe

Curve



http://0.tqn.com/d/3d/1/S/0/0/-/-/CurveAnatomy.jpg

Curve modelling uses curves to form models. Curves have control points, called handles, which are moved in 3D space and affect the shape of the curve. The shape of the curve is calculated from the control points usually using Bezier curves.

Advantages	**Disadvantages**
- Models creates are infinitely scalable because everything is mathematically based - Useful for creating characters which mostly consist of smooth surfaces	- Harder to create solid models with sharp edges - Harder to work with because results can sometimes be unpredictable with weird angles - Hard to create models with lots of small details

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ONGOING EVALUATION

So far I have done a lot of research on software, file types, codecs, rendering types, compression, video and modelling types. This information will be very useful to know when deciding on how to do my major work. The variety or different software I have researched has helped me to decide what software to use for different tasks and the research into file types, codecs and compression has helped me to decide on what files to use in order to get the best quality and file size for my major work.

Types of Film

Style/Genre	Description	Example
Animation	Created frame by frame, instead of using a camera, using techniques such as 3D modelling and animation or drawing each frame individually.	 http://www.caminandes.com/wp-content/uploads/2013/09/caminandes_episode_2.jpg Caminandes
Found footage	Usually shot on a phone camera or stylised to looks like a phone camera. The film pretends that the footage was 'found' usually after an event and is edited together to tell a story.	 https://filmplanetasylum.files.wordpress.com/2010/10/cloverouch.jpg Cloverfield
Action	Uses lots of intense, fast paced scenes usually with lots of explosions and action.	 http://img2.wikia.nocookie.net/__cb20140113040310/marveldatabase/images/8/8d/Avengers_(Earth-199999)_001.jpg The Avengers
Drama	Tells a dramatic story usually about people to form an emotional connection of the viewer to the characters.	 http://www.titanicuniverse.com/wp-content/uploads/2009/10/titanic-movie.jpg Titanic
Horror	Designed to be scary to the audience. Usually uses dark scenes, low camera angles and lots of suspense or creepy settings and characters to scare the audience.	 http://i.telegraph.co.uk/multimedia/archive/02381/Shining-Nicholson_2381314b.jpg The Shining

Camera Shots and Angles

Camera shots and angles are important to know when making a film. I researched different shots and angle that I would be using to make my film. It is important to know when to use different shots and what effect they give.

Shot	Description	Example
Wide Shot	Shows the entire subject and their environment - used to show where the subject is in a scene.	
Long Shot	Shows the entire subject e.g. from head to feet.	
Medium Shot	Shows the target, but not entirely e.g. head to legs.	
Close Up Shot	Shows a close view of the subject, usually just head and shoulders - Used to show emotion and details.	
Over the Shoulder	A shot from over someone's shoulder - Used to show a conversation or confrontation.	
Eye Level	From the same height as the subject's eyes - Used for normal shots	
Low	From beneath the subject angled upwards - Used to make the subject look powerful or intimidating	
High	From above the subject angled downwards - Used to make the subject look small or weak	

Presentation

Type	Advantages	Disadvantages	Example
File	- Simple to use - Will work on most devices	- Unprofessional - Looks bad	 Multimedia Major Work.MOV
DVD	- Looks professional	- Low resolution - Can be unreliable	 https://i.ytimg.com/vi/-ManW0rc12Q/maxresdefault.jpg
YouTube	- Available almost anywhere - Easy to use - Reaches a wide audience - Free	- Can be more professional	 https://www.youtube.com/watch?v=YfHh4BNPyK4
Website	- Look very professional - Works on most devices	- May be hard to find for some audiences - Takes lots of effort to make - Costs money to host online (if you want to host it online)	 https://www.shortoftheweek.com/

Websites

HTML

HTML (Hyper Text Mark-up Language) is the language that define the structure and content of a web page. It consists of 'tags', which each have a name, attributes and optionally child tags. Each tag is defined as:

```
<name attribute1="value 1" attribute2="value 2">
    [contents]
</name>
```

If a tag doesn't have any children, the closing tag (`</name>`) can be left out.

There are many different tags defined in HTML, such as tags for bold text, italics and separate 'sections' of the page.

CSS

CSS (Cascading Style Sheets) is the language used to style HTML. It allows you to add different styles and effects and modify the layout of the page and individual HTML tags. The language consists of different 'declaration blocks' which start with the name of the tag, or an id or class for a tag or tags, which describe properties with values:

```
name-of-tag {
    property1: value1;
    property2: value2;
}
```

Just like HTML, CSS has many pre-defined properties which have different effects on tags.

JavaScript

JavaScript is a programming language made to interface with HTML and CSS on a web page. It adds interactivity to a web page, such as performing an action when a button is clicked. JavaScript, like many programming languages, is a complex language with many different features. It is far more complicated than HTML and CSS but also is far more powerful.

CPU

http://www.globalspec.com/ImageRepository/LearnMore/201311/chips8b74c2a3d3b543d58e6a4540e6469e25.png
An Intel CPU

The CPU is the main part of a computer. It performs all the calculations and runs the entire system.

A faster CPU will increase the performance of almost all multimedia software such as video editing programs for applying effects to and encoding video, drawing programs for rendering vector graphics which usually can't be rendered on a GPU, image editing programs for applying effects to images, and 3D modelling programs for performing calculations such as modifiers and effects to the 3D models.

GPU (Graphics Card)

http://robertoblake.com/blog/wp-content/uploads/2014/01/GTX780.jpg
NVidia GTX 780

The graphics card is usually used to render the elements on the screen. Modern graphics cards can also be used as 'compute devices' which are often much better than CPUs at performing many small, similar calculations, such as rendering each pixel in an image.

Some multimedia software can take advantage of having a faster GPU such as 3D modelling for displaying higher quality models while creating them, 3D rendering programs for ray-tracing, a technique that gives high quality images and is much faster on a GPU than a CPU, and some video editing software which can use the GPU to apply effects and render video.

RAM (Memory)

http://notebooks.com/wp-content/uploads/2013/10/shutterstock_133277192.jpg
RAM

RAM is used to store temporary data that is being operated on. Almost everything requires RAM, and multimedia programs such as 3D modelling software and video editing software requires lots of ram. The more ram you have, and the faster it is, the better.

HDD (Hard Drive) / SSD (Solid State Drive)

HDDs and SSDs store data permanently. Multimedia requires lots of storage space as the files used are very large.

HDDs are mechanical, spinning disks that store data magnetically. They are usually reasonably fast, and provide lots of space for storage. SSDs have no moving parts and store data using flash memory.

SSDs usually don't have the same amount of storage for the same price but are extremely fast, which is important for multimedia applications to load video files faster (so you don't have to wait for the video to load while editing it).

Cameras

Exposure

Exposure is the brightness of the image. It depends on many factors such as the **shutter speed**, **ISO**, and **aperture**. If an image is too dark it is under-exposed, and if it is too bright it is over-exposed.

http://www.myphotoshopsite.com/tutorials/level_3/images/exposure_sample.jpg
Example of different exposure levels.

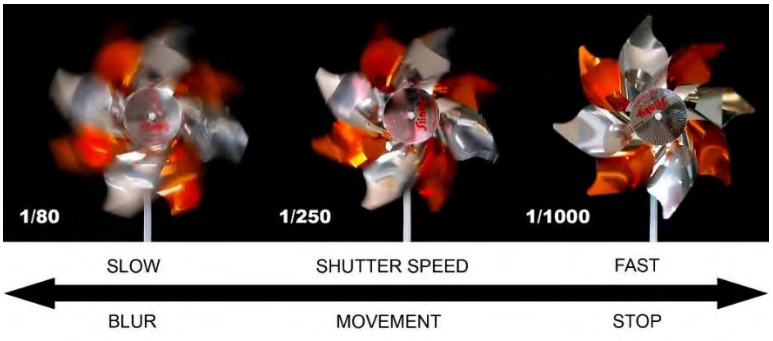
Focal Distance

Focal distance, more commonly referred to as zoom, as how wide or small the camera's **field of view (FOV)** is. FOV is the angle that the camera sees. A wide FOV means that the camera can see a large amount of the image, while a small FOV means that it is focused on a small part of the image. Focal length is measure in mm, which is the distance between the lens and the camera's image sensor.

http://cdn-7.nikon-cdn.com/Images/Learn-Explore/Photography-Techniques/2009/Focal-Length/Media/red-barn-sequence.jpg
Comparison of different focal lengths.

Shutter Speed

Shutter Speed is the amount of time that the shutter is left open to capture light. A slower shutter speed leaves the shutter open for longer which results in more light being let into the camera. This results in a brighter, more exposed, image however in the camera moves while the shutter is open then the resulting image will be blurred, because what the camera sees moved.



http://azphotojournal.com/wp-content/uploads/2013/10/SHUTTER_SPEED_SAMPLE_GRAPHIC.jpg
An example of how shutter speed affects motion blur.

Shutter speed is measure in seconds, or fractions of seconds. So a shutter speed of 1/250, is one 250th of a second.

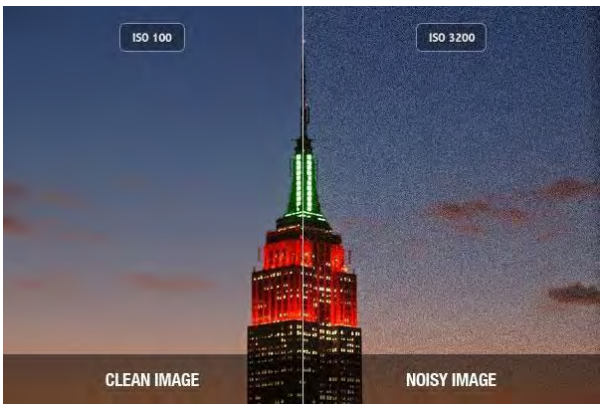
Aperture

Aperture is how wide the iris of the camera is. A wider aperture means that more light is let into the camera and results in a brighter image. However, a wider aperture will result in a smaller **depth of field (DOF)**. DOF is the range where objects in an image are in focus. A small depth of field means that only objects a specific distance away from the camera are in focus, while a large depth of field means that a larger range of distance is in focus.

http://www.nucleo.com.au/content/uploads/2015/07/Image-3.jpg
Comparison on aperture and how it affects depth of field. Notice how in the road in the f/1.4 image is blurred much more than in the f/16 image.

ISO

ISO is a camera sensor's sensitivity to light. ISO doesn't affect the amount of light; it simply changes the **gain** of the camera sensor. Gain is the amplitude of a signal (in this case, light). This means that the exposure of the image can be adjusted without changing shutter speed or aperture. This means it is useful if you want to keep the current motion blur or depth of field. However, because no more light is being used, amplifying the light also introduce noise. Normally this noise wouldn't be noticeable, but because the light is amplified this is visible in the image.



http://icdn9.digitaltrends.com/image/iso-625x1000.jpg
A comparison of a low ISO (left) compared to a high ISO (right).

SELECTION AND JUSTIFICATION

MATERIALS

Software

Blender

I will use Blender for as my **3D Modelling Software**, **Simulation Software**, **Camera Tracking Software**, **Compositing Software** and **Rendering Software** (Blender Cycles). I chose Blender because it is completely free with lots of free resources, tutorials and documentation. I also have 1-2 years of experience with it and am comfortable using it. It also does many different tasks, and using once piece of software for many different tasks means that everything will work together much better, so I don't have to constantly export from one program to another.

For 3D Modelling, Blender includes many tools such as sculpting tools, curve modelling tools and mesh modelling tools. Blender has a small learning curve compared to other programs, but once you get over it (like I have), modelling is extremely efficient as there are many keyboard shortcuts and tools, this makes Blender excellent for 3D Modelling.

For Simulation Blender includes rigid body, soft body, cloth, fluid, smoke (and fire) and Particle physics simulation. While it's not the most accurate or easy to use software for simulation, it produces decent results and is built directly into the program.

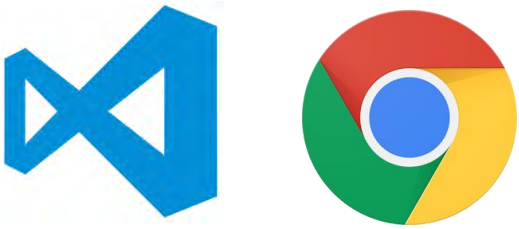
Blender includes Camera Tracking, which does take more time to get a good result than some other programs, but using it is very easy as you can automatically setup the 3D camera to move with the tracked camera and setup compositing with a single button.

Blender's includes an extremely powerful, node-based, compositor which includes many nodes for achieving many effects.

Blender Cycles is Blender's built-in, unbiased (ray-traced) rendering engine. It achieves very good results with little effort and is faster than many other rendering engines.

Adobe Premiere Pro

For my **Video Editing Software**, I will use Adobe Premiere Pro. I am familiar with it and it has many tutorials available for free.



Visual Studio Code / Google Chrome

As my **Website Development Software** I will use Visual Studio Code and Google Chrome. Both are available for free.

Visual Studio Code is a text editor with auto-complete and syntax highlighting for many different languages. It supports HTML, CSS and JavaScript. I will use it mainly for coding the website.

Google Chrome is a web browser that also includes developer tools such as a JavaScript console and HTML and CSS editing in real-time. I will mainly use it for previewing the website, debugging JavaScript code and for modifying the website in real-time to quickly test out changes and different styles.

File Types

PNG

For any images in my project I will use PNG as the **Image File Format**. PNG is supported by all of the software I will be using, and is widely supported on all web browsers and computers. It also provides decent file sizes and is a lossless format, which is important for maintaining high quality.

MP4

I will use MP4 as my **Video Container Format**. MP4 is supported by all of the software I will be using and all major web browsers. It also supports a wide range of video and audio codecs.

I considered using WebM, but it is only supported by some of the software I have chosen (most using plugins however), and it is not supported by all web browsers.

M4A

I will use M4A as my **Audio Container Format**. M4A is the same format as MP4, but without a video stream, so it has all the advantages that MP4 has.

Codecs

H.264 (MPEG-4 AVC)

I will use H.264 as by **Video Codec**. It is supported by all of the software I will be using and almost all major web browsers. It provides good quality with a decent file size. Compared to other video codecs that provide higher quality as a lower file size, such as H.264 and VP9, it is much faster to encode.

AAC

For any audio files I will use AAC as the **Audio Codec**. AAC provides high quality at a low file size and is widely supported by most software.

PROCESSES

Rendering

For rending I will be using Blender Cycles, which is an **unbiased, ray tracing** rendering engine. An unbiased rendering engine is important to achieve good looking results, and also photorealism when mixing 3D and filmed footage.

Resolution

The resolution for the final video will be **1080p**. This will mean that the video will hopefully be very high quality, however it means that it will take longer to render than lower resolutions, and will require a better camera. I will have to plan for enough time to render, but luckily the camera that I have available is high quality and shouldn't have any issues.

Framerate

The framerate for the final video will be **24 (23.976) fps**. This framerate is widely used for internet video and also movies and will look smooth enough, while not being too high so that rendering the video will take significantly longer (such as 60 fps).

I will mostly film in 24 fps except for filming slow-motion sequences, if there are any, which will be filmed in 60 fps and slowed down to 24 fps in editing, or possibly slower and using frame-interpolation.

TECHNOLOGIES

CPU

The CPU I will be using is an **i5 3570k** or possibly a **i7 6700**. The reason I chose the i5 is because I already own it, and it provide decent performance and I have used it in previous multimedia projects. I may buy the i7 if the i5 is not powerful enough.

GPU

The GPU I will be using is an **NVidia GTX 660** and possibly a **NVidia GTX 970**. I currently own the GTX 660 and it achieves good performance when rendering using Blender Cycles. I a buy the GTX 970 I will be able to use it as well as the GTX 660 for rendering in cycles, which will greatly improve the performance of rendering.

RAM

I currently have **8GB** of ram, and if necessary I will upgrade to **16GB**.

Motherboard

Currently I have a **Gigabyte GA-Z77-D3H** which supports my current i5. If I upgrade the to the i7 I will get the **Gigabyte-B150M-D3H** motherboard to support the i7.

Storage

I currently have a **480GB Kingston SSD** and a **1TB Western Digital Blue HDD**. The 480GB SSD should be enough to use a scratch disk and the 1TB HDD for storing footage and files. I will also backup my data to Google Drive.

Cameras

I will either use a **Nikon D3300** which my school has or I will use my friend's **Nikon D600**.

DEVELOPMENT OF IDEAS

Originally my idea was to create a choose-your-own adventure video which would be presented on a website. I decided to change it though, as I didn't think I would be able to complete it in time, and it would be a lot of extra effort when the audience will probably only go through it once, missing out on certain paths in the story. I kept the idea of presenting on a website, but decided to go with a normal linear video.

I wanted to show as many skills as possible in order to get the best mark. I chose to combine live action with 3D modelled and rendered footage, and came up with the effects of the holographic phone, and the space ship.

PLOT

The video starts with the main character, Jasper Skywalker, and his Son, Isaac Not-Vader, receiving a mysterious letter from a mysterious man. The letter contains proof that Sam, a friend of theirs, was the real killer of Alex Skywalker, Jasper Skywalker's Father. Jasper pulls out his R1-D1 holographic phone, and orders an UberS, the new space version of Uber. The holographic phone will be an effect done with CG. I will 3D model the screen, motion track the footage, and composite the CG hologram onto the footage.

After Jasper orders the UberS, the ship arrives, flying in from the sky. The ship will be 3D modelled and animated by me, and composited into the real footage using motion tracking. The two will then get into the ship, where they meet the driver, P.B. I plan to film the scene inside the ship with green screen, and composite it into the 3D modelled interior of the car.

When they reach their destination it is revealed that Sam is not the real killer of Alex. The mysterious man from the beginning appears and reveals his identity. He is actually Alex Skywalker, and was alive the whole time.

CONCEPT STORYBOARD

Sc 1-3 cont.

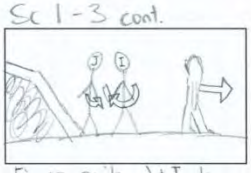


Figure exits, J+I turn to each other

Sc 1-4

"Who was that? ..." Jasper strokes chin.

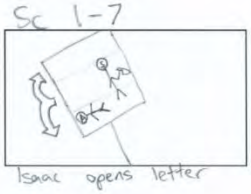
Sc 1-5

Isaac looks back at figure. "It looked like..."

Sc 1-6

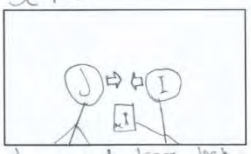
I looks back to envelope. "Never mind, What's this?"

Sc 1-7



Isaac opens letter

Sc 1-8

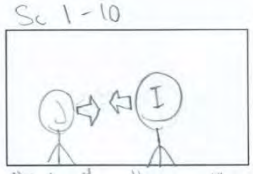


Jasper and Isaac look at each other. "Oh my god!..." *Dramatic sound*

Sc 1-9

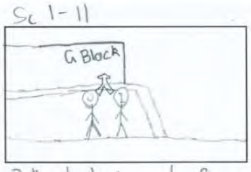
"We can't let him get away wi this!..."

Sc 1-10



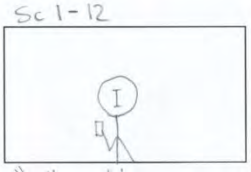
"But wait... how are we gonna get to him. He's all the way over in a block!"

Sc 1-11



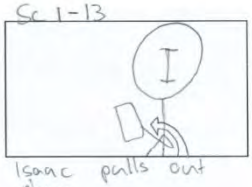
Both look up at G block.

Sc 1-12



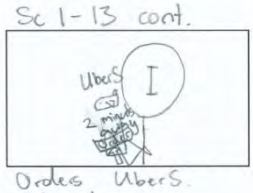
"Let's catch an UberS!..."

Sc 1-13



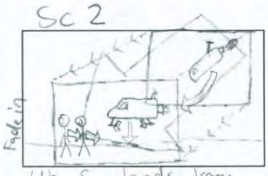
Isaac pulls out phone.

Sc 1-13 cont.



Orders UberS. Fade out.

Sc 2



Fade in

UberS lands. Isaac and Jasper approach. Camera tracks ship down.

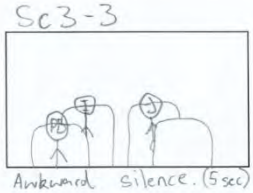
Sc 3-1

J & I get inside UberS, "... where are you going today?"

Sc 3-2

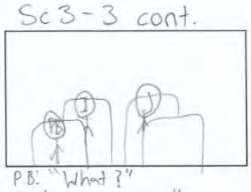
"To get revenge.." *Dramatic sound*

Sc 3-3



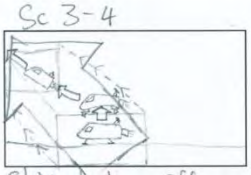
Awkward silence. (5 sec)

Sc 3-3 cont.



P.B: "What?"
I: "Ignore him..."

Sc 3-4



Ship takes off. Camera tracks ship. Fade out.

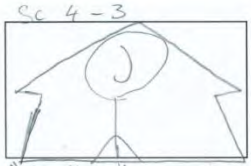
Sc 4-1 fade in

Jasper and Isaac walk up stairs to Sam's ship

Sc 4-2

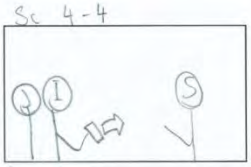
"J and I, Good to see you, need a ship?"

Sc 4-3



"Not this time... We're here for revenge" Camera zooms in slowly.

Sc 4-4



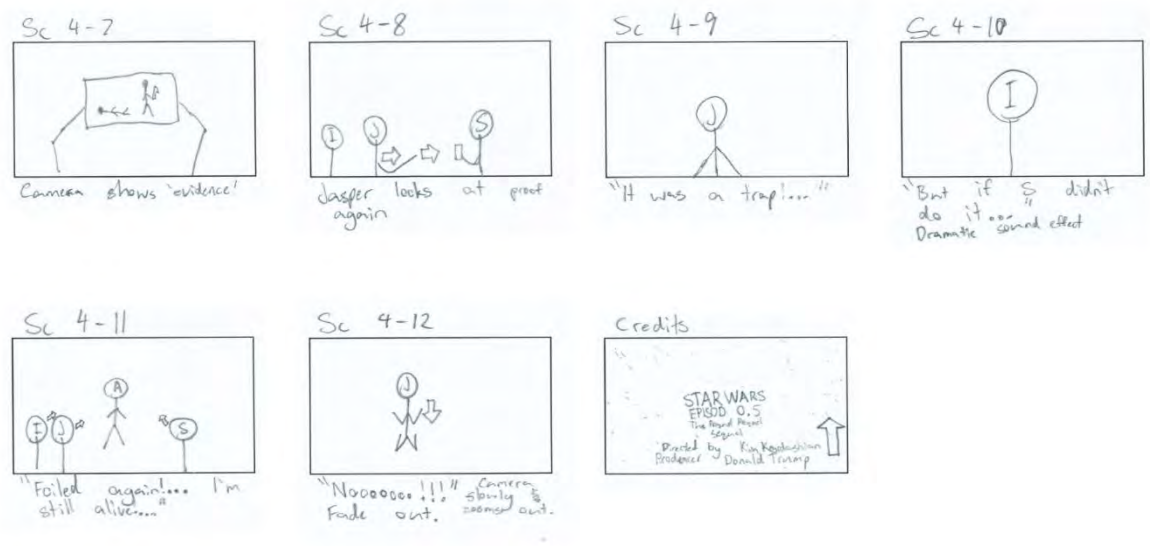
"What are you talking about? This?" "Then what's" Hands S envelope.

Sc 4-5

"This is fake"

Sc 4-6

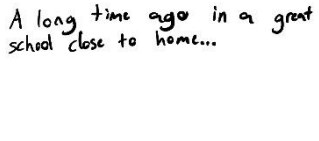
"Inconceivable!"



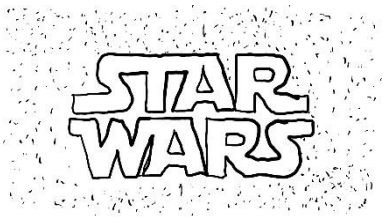
EVALUATION

The concept story board for my major work is fairly basic. Since I am not very good at drawing, I mostly used stick figures. Despite the low quality drawing, the story board should still be useful for planning different shots and angles and also the general outline of my major work's plot.

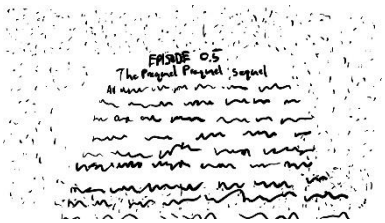
FINAL STORYBOARD



Opening text.



Title appears. Star Wars theme plays. Title moves back.



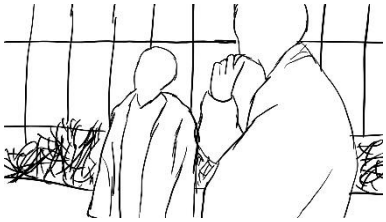
Opening text crawls.

Fade in on mysterious figure approaching Jasper and Isaac.

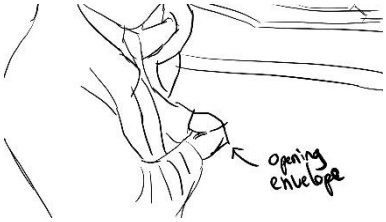
Handing letter to Isaac.

"Who was that..."

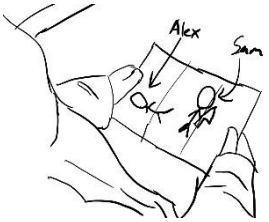
"They looked familiar…"



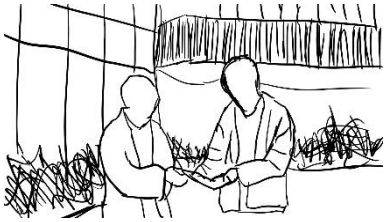
"It looked like…"



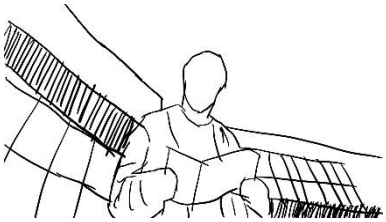
Isaac tears open envelope messily.



'Evidence' that Sam killed Alex.

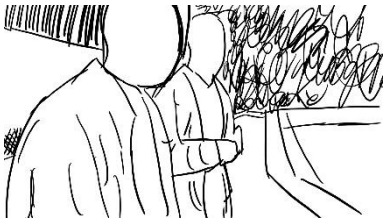


"Let me see that…"



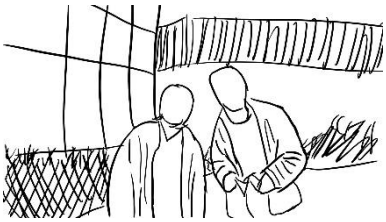
"Oh my god! Sam killed my father!"

"We can't let him get away with this…"



"But he's all the way over in G Block…"

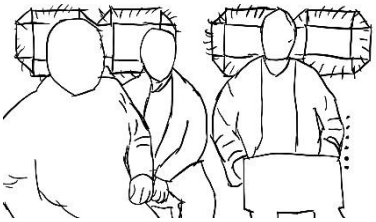
Establishing shot outside G Block.



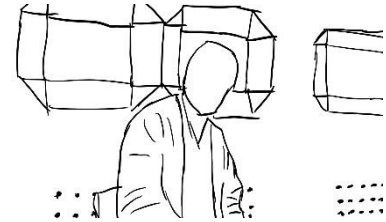
UberS product placement bit.

Isaac opens holographic phone and orders Uber S.

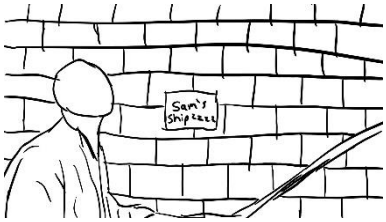
UberS ship flies in and lands as Jasper and Isaac walk towards it.



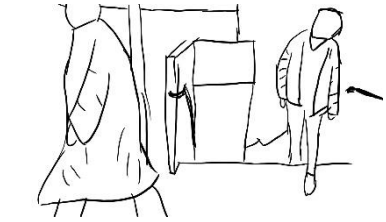
Jasper and Isaac enter ship. "Hello my name is PB, where do you want to go?"



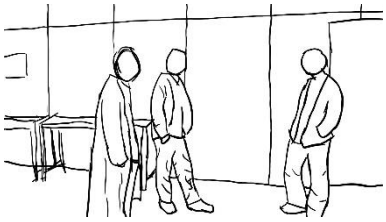
"To get revenge…"



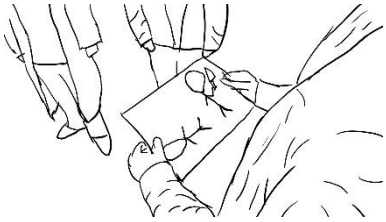
Jasper and Isaac walk up stairs to Sam's Shipzzz.



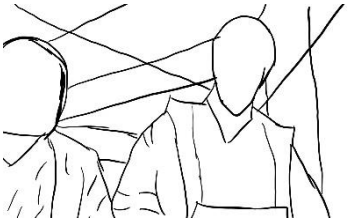
Jasper and Isaac enter Sam's Shipzzz.



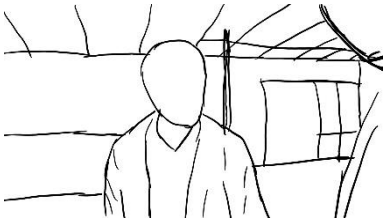
"Jasper and Isaac, good to see you…"



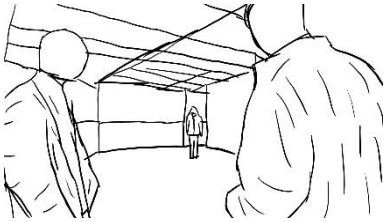
Sam looks at 'evidence'



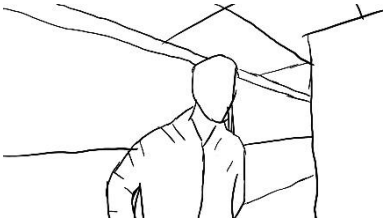
"It was a trap!..."



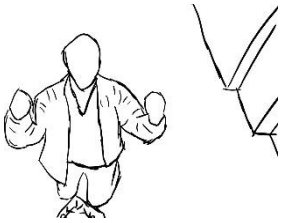
"But if Sam didn't kill Alex... Who did?"



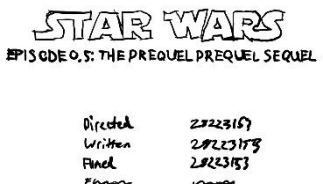
Mysterious figure approaches. All turn.



Mysterious figure takes off hood revealing Alex. "Foiled again!..."

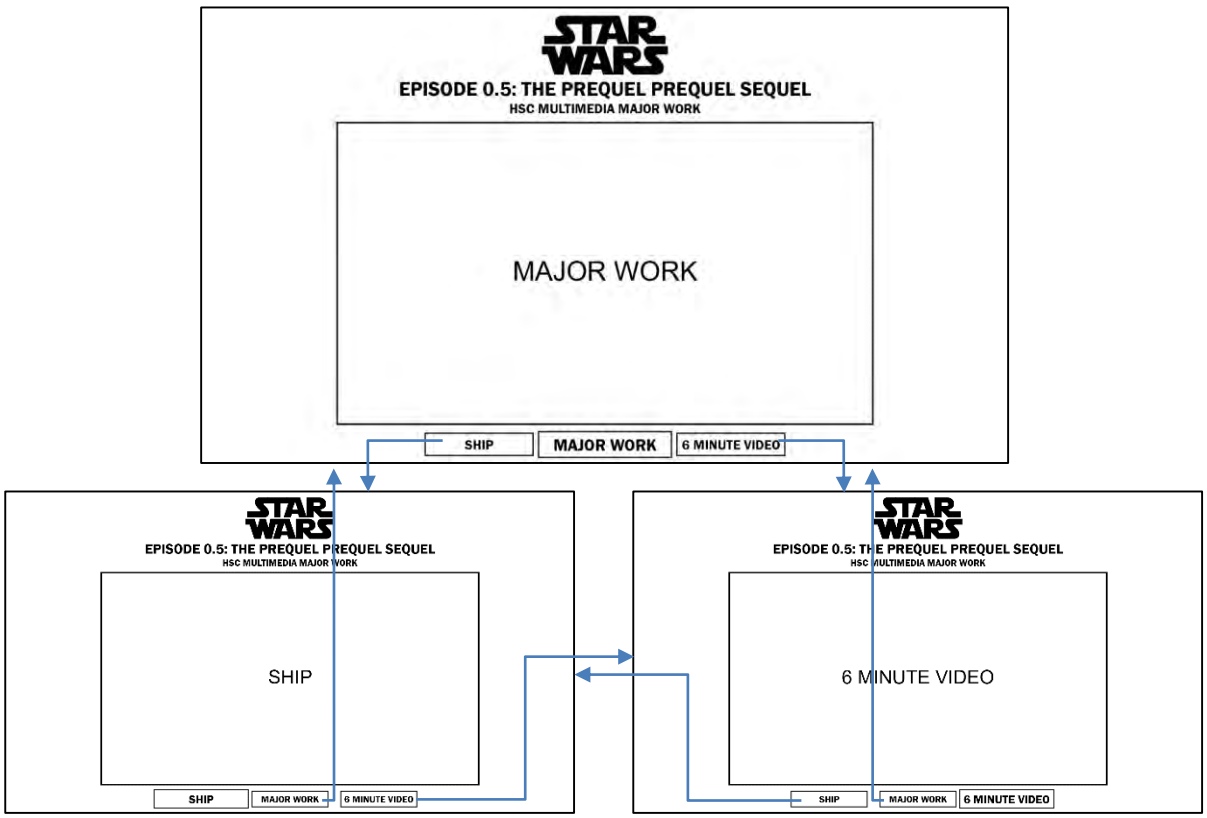


Jasper drops to knees. "Noooooooo!!!!!!!!"



Credits roll.

WEBSITE STORYBOARD

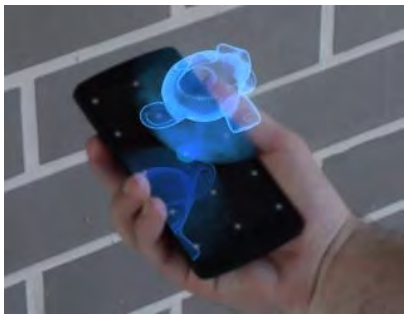


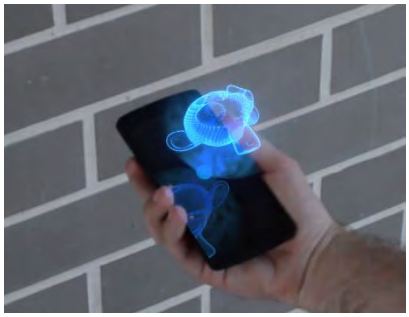
I designed the website for my major work to be simple and too look good. I wanted to have transitions between the three different pages so I made it as easy as possible to implement those transitions by having most of the page be the same between the different pages.

At first I was only going to have 1 page, with the video and then an interactive 3D view of the ship below, but then I realised that I could also put my six-minute video on the page, so I decided to make it 3 pages and for each page to fit within the browser window so there was no scrolling.

Holographic Display

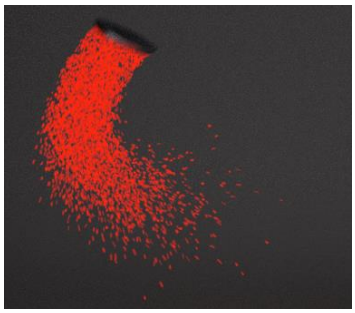
The initial testing for the motion tracking and adding objects that extrude from a screen was done with my tablet, which I displayed an image with markers on it to track. I then tracked it and added a simple cylinder just to test. I also added a plane to add reflections from the screen o the tablet. I had to render layers in Blender, each render layer included both layers (for the cylinder and the reflection plane), with each of them using the other layer as a mask. I also applied motion blur to make the 3D rendered objects fit better into the scene.



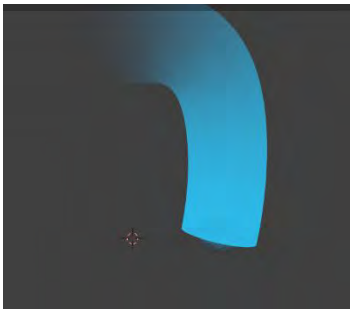


The second test for the holographic display was done with my phone. I used the same image for the markers but in black and white to the reduce the amount of light coming from the screen. I used Blender's built in monkey head model to test, and created a hologram material for it. I also added a cone with a volumetric material so it looked as if the hologram was being projected from the phone instead of just magically appearing. The effect looks really good but there are still a few problems, such as the fingers being in the way and the markers on the screen still being visible. In the final shot I will make sure that there won't be any fingers in the way, so they won't need to be masked out. I will need to mask out the tracking points though, so I tested that using Blender's masking tools and the inpaint node in the compositor, which worked well.

Engine Effects



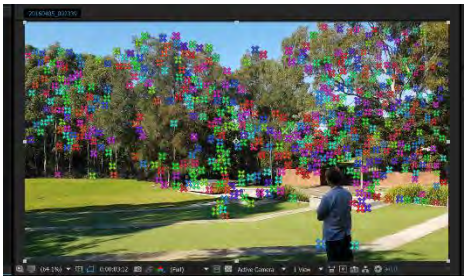
Initially I tried using particles for the engine trails. The advantage of particles is that they mostly work automatically, you don't have to adjust them each time you change the movement of the ship, but they don't look 'solid'.



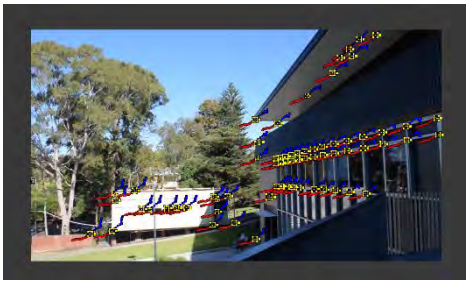
I then attempted to use a path, and then bevel the path with an object to make it tube-like. I animated the bevel amount so that the beginning of the tube would be the start of the ship, and the end would follow behind. I then applied a gradient texture combined with an emission shader.

This worked well but the ends were open, and when I set it to fill the ends, the gradient texture did weird things. Instead I applied the shader to the volume output, so that the tube was rendered as a volume instead of as a solid object. This fixed the problem with the ends and looks good.

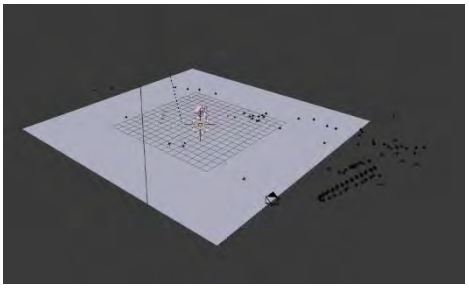
Camera Tracking



Initially a tried to track footage from a phone, which has OIS (Optical Image Stabilisation) which makes the footage appear smoother, but messes up motion tracking. I first tried to track it using After Effects, thinking it would be easier, however there was no way to export the motion tracked data to Blender.



I then tried to track the video in Blender, but due the the OIS, the footage was untrackable. Blender also has issues with footage that isn't a consistent framerate, as footage from phones usually is, so I reencded the footage in Adobe Media Encoder, but for some reason this dramatically decreased the quality of the footage, making it much harder to track.

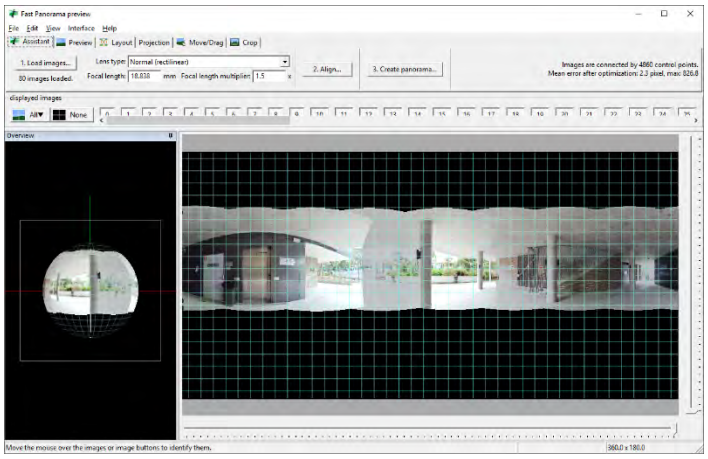


Finally I re-shot the footage on a proper DSLR, and tracked the footage in Blender without reencoding it which worked well. I added a suzanne model to test, with a simple plane underneath for catching shadows and reflecting light from the ground onto the model. I composited it similarly to how I composited the holographic display.

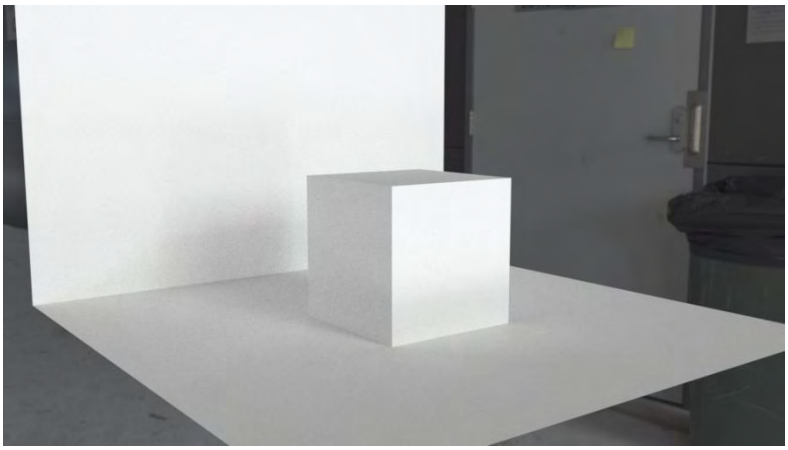
HDRi Lighting

In order to light my 3D models to fit in with the live action footage, I decided to try out creating HDRis (High Dynamic Range images). HDRis are images that can store values that are outside of the 0-255/0.0-1.0 range, this means that they can be used for more accurate environment lighting. For example, if an image includes the sun and also shadowy areas, the sun will be completely white and blow own, while the shadows will be completely black, because of the lack of dynamic range. Using and HDRi would fix this, as you could increase the brightness of the image and be able to see more detail in the shadows, or decrease the brightness and be able to see more detail on the sun.

To create HDRis, you need multiple photos, exactly the same but at different brightness levels. I took photos of about 20 different angles rotating the tripod, each with 5 different exposure settings, 1 EV (Exposure Value) apart. Since the camera didn't have exposure bracketing, I had to do this manually. I used a program called Hugin to combine these images into a HDR environment map.



I then used this image in blender to light a small scene I set up to test it. While the environment map wasn't perfect, it had many glitches where things didn't light up, It was good enough for lighting a scene, especially when the environment map wouldn't even be in the background, such as when the 3D is composited into live action footage.



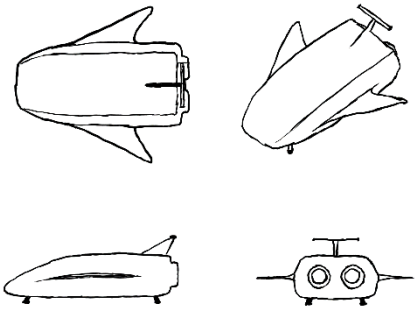
DESIGN MODIFICATION

Throughout my major work there were many modifications that had to be done for various reasons.

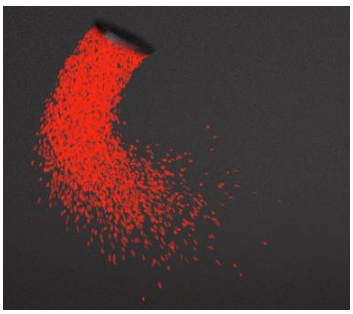
Statement of Intent

Originally I was planning on doing a different project for my major work. My original idea was to create a choose-your-own adventure interactive video. It was going to be similar to my current major work, presented on a website with effects such as CG composited into real footage. I decided to change the idea for my major work as it would have been far too much work for the amount of time that I had, and I would not have been able to complete it on time.

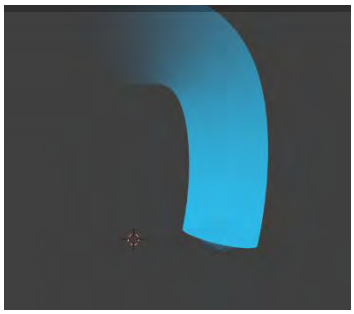
Ship



The design for my ship went through many stages to reach the final design, mostly to do with the textures and materials. Originally I planned for a more Star Wars themed ship, but I changed it. I also made many changes to the material, such as adding more realistic reflections using Fresnel nodes.



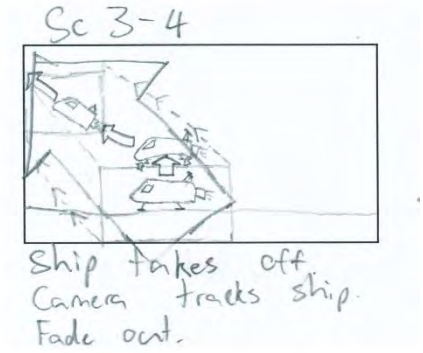
I also went through many revisions we designing the effect for the engine exhaust. I tried different techniques with varying success, such as using a path with volumetric rendering and using particles with motion blur. The final design was chosen as it was more practical while still looking good. My other ideas had problems such as taking too long to render or too long to set up and get working.



G Block Sign

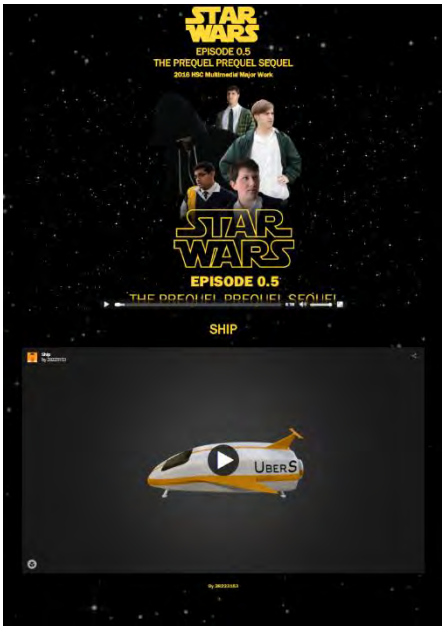
When doing my story board I didn't know if there was a sign already on G Block and when I was researching the location more I discovered that there wasn't, so I planned to add one as an effect. This effect was fairly simple, but it was an important part of the film to show where the characters were.

Filming



Originally I had planned to have a shot of the space ship taking off as well as landing, but because I forgot to film this shot I decided to cut it out. While filming I also didn't manage to get a few shots, so some shots and cuts from my storyboard didn't make it into the final video and I replaced them with shots from different angles or cut them completely. Most of these modifications were due to lack of time while filming, something that I could have planned better for.

Website



Originally I planned for the website to be simpler and only be one page. I changed this as I realised that I also need to include my six minute video, so I could have 3 pages, one for the ship, one for the video and one for the six minute video. I also used this opportunity to show more skills by adding transitions between pages.

Green Screen

Due to the limited time I had to film the ship interior scene, I didn't set up the green screen very well. In order to still use the footage, rather than shooting the scene again, I decided to rotoscope areas as well as using chroma keying. This made the footage useable, but still not very good unfortunately. I never planned to do rotoscoping for that scene, but luckily I planned for unexpected delays for my whole project and I was able to finish the scene in time.

TIME PLAN

Key	In Progress	Finished
Proposed		
Actual	-	#

Task	Term 4 2015											Holidays						Term 1 2016									Holidays		Term 2 2016										Holidays		Term 4 2016			
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	1	2	3	4	5	6	Exams		9	10	11	1	2	1	2	3	4	5	6	7	8	9	10	1	2	Trials			4
Development of Ideas																																												
Statement of Intent	-	-	-	-	-	-	#																																					
Script								-	-	#																																		
Storyboard										-	-	-	#																																
Testing Effects											-	-	-	-	-	-	#																												
Ship																																												
Modelling																		-	-	#																								
Materials and Texturing																				-	#																							
Rigging																						-	#																					
Filming																																												
Scene 1																																				#								
Scene 2																																				#								
Scene 3																																					#							
Scene 4																																				#								
Holographic Phone																																												
Motion Tracking																																				#								
Modelling																																												
Materials																																				-	#							
Animating																																				-	#							
Compositing																																					#							
Rendering																																					-	#							
Ship Landing																																												
HDRIs																																				-	#							
Motion Tracking																																				-	#							
Animating																																					-	#						
Particles																																						-	#					
Compositing																																						#						
Rendering																																						-	#					

Task	Term 4 2015											Holidays						Term 1 2016						Exams				Holidays		Term 2 2016										Holidays		Term 4 2016			
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	1	2	3	4	5	6			9	10	11	1	2	1	2	3	4	5	6	7	8	9	10	1	2	Trials			4
Ship Interior																																												
Modelling																															-	#												
Materials																																#												
Keying																																				-	-	-	#				
Compositing																																							#				
Rendering																																							-	#			
Editing																																												
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Scene 1																																	-	#										
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Scene 4																																				-	-	#						
Credits																																			-	#								
Master																																					-	-	#						
Sound																																												
Music																																						-	#					
Sound Effects																																								-	-	#			
Website																																												
Storyboard																																									#			
Creating Website																																									-	-	#	
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Writing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Finalising																																										-	-	#	
Printing																																											-	#

EVALUATION

The time plan for my major work looks good. Having a time plan helped me to manage my time for making my major work. The proposed time plan was realistic enough to get everything done, and gave me enough time to fix any problems that I had.

One big problem that I had was getting everything organised for filming. I planned to complete filming by term 1, week 6, 2016, but due to organising all of the people in my major work, and planning taking longer than expected, I only finished by term 2, week 5, 2016. I was able to work on and complete tasks that didn't require me to have filming complete, but tasks such as motion tracking and compositing were delayed. Luckily I was able to finish these tasks without too much delay and I had enough time to complete my major work.

FINANCE PLAN

For my major-work I had a budget of about $2000. I knew I would need a total of about $5000 to purchase all the equipment I would need, so instead I opted for equipment that I already owned, or could borrow, such as the rendering PC which was my old pc, and the Nikon D600, which I could borrow from my friend.

I was also unsure of how long I would need to use Adobe Creative Cloud for, I expected around 3 months. The student price is $15/month, so I planned for about 6 months, to make sure I had enough budget in case I used more than I expected.

Item	**Proposed Cost**	**Actual Cost**
Desktop PC for editing	$1909	$1535
Intel i7 6700 CPU	$457	$457
Asus GTX 970 STRIX Graphics Card	$509	$509
Gigabyte B150M-D3H Motherboard	$134	$134
Corsair 16GB 2133 MHz DDR4 RAM	$149	$149
Corsair CS650M Power Supply	$139	$139
Fractal Design Define Mini Case	$147	$147
Western Digital WD Blue 1TB HDD	$75	$0 (already owned)
SanDisk Extreme Pro 480GB SSD	$299	$0 (already owned)
Desktop PC for rendering	$1000	$0 (already owned)
Intel i5 3570K CPU	$200	$0
Gigabyte GTX 660 Graphics Card	$250	$0
Corsair 8GB 1600 MHz DDR3 RAM	$70	$0
Gigabyte GA-Z77-D3H Motherboard	$130	$0
Antec Three Hundred Case	$80	$0
Western Digital WD Green 1TB HDD	$70	$0
Nikon D600 Camera	$1600	$0 (borrowed)
Surface Pro 3 Tablet	$1150	$0 (already owned)
Blender	$0 (free)	$0 (free)
Adobe Creative Cloud 2015	$15/month (student) $90 for 6 months	$60 (4 months)
Printing folio	$72.65 (office works)	$72.65
Total	$5821.65	$1667.65

EVALUATION

I managed to keep the project within budget by borrowing instead of buying equipment such as cameras and using free software instead of expensive software. There were no unexpected expenses, and if there were I had extra budget left over which could be used to cover them.

RECORD OF PRODUCTION

FILMING

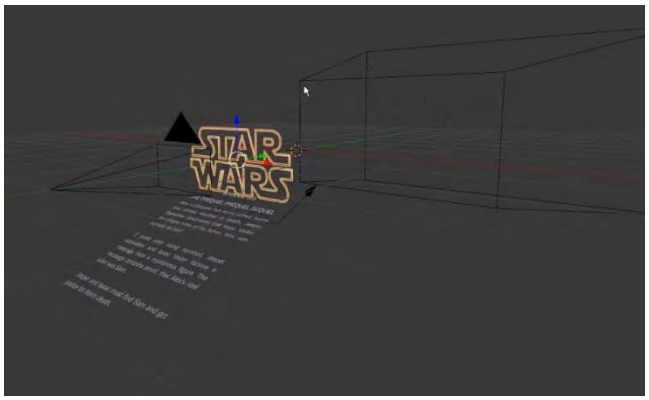
In order to film, I had to organise which shots needed to be filmed, and in which order to film them to be the most time efficient. I also had to plan when to shoot, which required organising with my “actors” to find out when they will be available. To do this I create a shot list, a spreadsheet with all the shots on my storyboard, and listed out the different things like who was in the shot, what costume they were wearing, and props needed and the camera angles for each shot. Once I had this done, I organised the shots into groups based on the actors needed and the camera angle.

Scene	Shot	Location	Description	Transition	Framing	Action	Sound	Dialogue	Actors	Props	Costume	VFX	Order	Planned Filming	Filmed
4	1	G Block	Entering Sam's Shipz	Fade In	Mid shot of sign, J and I walk past, camera follows	J and I walk past sign			Jasper, Isaac	Sam's Shipz Sign	J: Jacket, I: Robe		1A	2016-05-31	2016-06-01
4	2	G Block	Meeting Sam		Mid shot, eye level	J and I walk up to Sam		"J and I. Good to see you!"	Jasper, Isaac, Sam		J: Jacket, I: Robe, S: Shirt		1B	2016-05-31	2016-06-01
4	4	G Block	Showing Evidence		Mid shot of J, I and S	I hands evidence to S		"What are you talking about?"	Jasper, Isaac, Sam	Evidence	J: Jacket, I: Robe, S: Shirt		1B	2016-05-31	2016-06-01
4	8	G Block	J looks at evidence again		Mid shot of J, I and S	S hands J evidence			Jasper, Isaac, Sam	Evidence	J: Jacket, I: Robe, S: Shirt		1B	2016-05-31	2016-06-01
4	3	G Block	Confomting Sam		Mid shot, low angle, slowly zooming in			"We're here for revenge..."	Jasper		J: Jacket		1C	2016-05-31	2016-06-01
4	5	G Block			Mid shot of S, eye level	Sam looks at evidence		"This is fake"	Sam	Evidence	S: Shirt		1D	2016-05-31	2016-06-01
4	6	G Block			Close up of I			"Inconceivable!"	Isaac		I: Robe		1E	2016-05-31	2016-06-01
4	10	G Block			Close up of I	I looks into camera	Dramatic sound effect	"But is S didn't do it..."	Isaac		I: Robe		1E	2016-05-31	2016-06-01
4	7	G Block	Camera shows evidence		Close up of S holding evidence				Sam	Evidence	S: Shirt		1F	2016-05-31	2016-06-01
4	9	G Block			Close up of J	J looks into camera		"It was a trap!"	Jasper	Evidence	J: Jacket		1G	2016-05-31	2016-06-01
4	11	G Block	Alex revealed		Mid shot at Alex, over J, I and S's shoulders	J, I and S look at Alex. A enters from behind corner	Dramatic music	"Foiled again! ..."	Jasper, Isaac, Sam, Alex	Evidence	J: Jacket, I: Robe, S: Shirt, A: Hood		1H	2016-05-31	2016-06-01
4	12	G Block		Fade out to black	Wide shot of J, slowly zooming out	J drops to knees	Dramatic music	"NOOOOO!!!!"	Jasper	Evidence	J: Jacket		1I	2016-05-31	2016-06-01
1	1	Yr 7 area	J & I Hugging	Pan down + cross fade	Long shot	Hugging			Jasper, Isaac		J: Jacket, I: Robe		2A	2016-06-03	2016-06-03
1	3	Yr 7 area	Handing letter		Long shot	Figure hands letter to I			Jasper, Isaac, Alex	Letter (unopened)	J: Jacket, I: Robe, A: Hood		2A	2016-06-03	2016-06-03
1	2	Yr 7 area	Figure approaches		Mid shot, slight low angle	Figure approaches			Alex		A: Hood		2B	2016-06-03	2016-06-03
1	4	Yr 7 area	Who was that?		Close up	Jasper stroke shin		"Who was that?..."	Jasper		J: Jacket		2C	2016-06-03	2016-06-03
1	5	Yr 7 area	Isaac suspicious		Over I's shoulder, long shot at A	Alex walking away		"It looked like..."	Isaac, Alex		I: Robe, A: Hood		2D	2016-06-03	2016-06-03
1	6	Yr 7 area	Looking to envelope		Over I's shoulder, mid shot at J	J & I look at letter		"Never mind, what's this?"	Jasper, Isaac	Letter (unopened)	J: Jacket, I: Robe		2E	2016-06-03	2016-06-03
1	10	Yr 7 area	Talking		Over I's shoulder, mid shot at J			"How are we gonna get to him?"	Jasper, Isaac		J: Jacket, I: Robe		2E	2016-06-03	2016-06-03
1	7	Yr 7 area	Opening envelope		Cutaway, closeup on evidence	I opens envelope, sees evidence	Suspenful sound		Isaac	Letter (opened)	I: Robe		2F	2016-06-03	2016-06-03
1	8	Yr 7 area	Jasper sees evidence		Over J & I's shoulder, mid shot at evidence	J sees evidence, J & I look at each other	Dramatic sound	"Oh my godl..."	Jasper, Isaac	Letter (opened)	J: Jacket, I: Robe		2G	2016-06-03	2016-06-03
1	9	Yr 7 area	Talking		Over J's shoulder, mid shot at I			"We can't let him get away..."	Jasper, Isaac		J: Jacket, I: Robe		2H	2016-06-03	2016-06-03
1	11	Yr 7 area	Looking at G Block sign		J & I in foreground, long shot at G Block	Both look at G block			Jasper, Isaac	Letter (opened)	J: Jacket, I: Robe	G Block Sign (Motion tracking)	2I	2016-06-03	2016-06-03
1	12	Yr 7 area			Mid shot at I	Isaac pulls out holophone		"I know, let's catch at Uber S!"	Isaac	Holophone	I: Robe		2J	2016-06-03	2016-06-03
1	13	Yr 7 area	Ordering UberS		Over I's shoulder, mid shot at holophone	Isaac orders UberS			Isaac	Holophone	I: Robe	Holographic phone (Motion Tracking)	2K	2016-06-03	2016-06-03
2	1	Yr 7 area	Ship landing	Fade out to black	Long shot, following ship landing	J and I walking towards ship landing	Ship sound effects		Jasper, Isaac		J: Jacket, I: Robe	Ship (Motion Tracking, HDRI)	2L	2016-06-03	2016-06-03
3	4	Yr 7 area	Ship takes off	Fade out to black	Long shot, following ship taking off	Ship taking off	Ship sound effects					Ship (Motion Tracking, HDRI)	2L	2016-06-03	2016-06-03

When filming we tried to follow this order, however due to interruptions, such as people being in the areas we were filming, we had to change the order a bit. Unfortunately, due to the restricted time we had to film, we didn’t have enough time to get some shots, so they had to be cut from the final video.

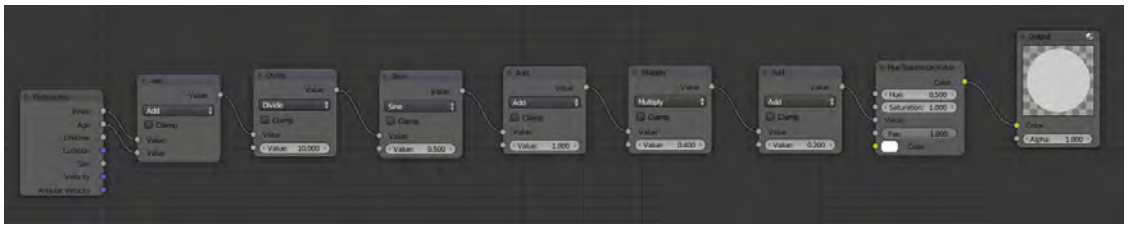
For filming I mostly use an apeture of f/11 and a shutter speed of 1/50” (which provides the most ‘natural’ looking motion blur when shooting at 24 fps). In order to get the correct exposure, I mostly relied on the ISO of the camera, which isn’t the best solution as it means if I need to raise the exposure, there will be more grain, but I can’t really adjust the shutter speed or apeture as they effect the motion blur and depth of field too.

OPENING

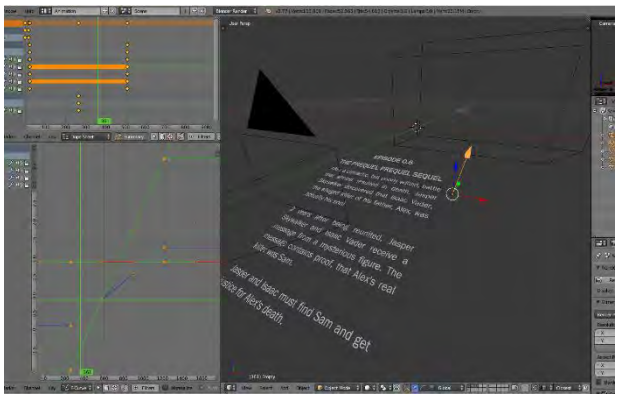


The plan for the opening was to emulate the intros of the Star Wars movies. I first tested creating a starry background in Blender, using a particle system. I added effects to the stars to 'twinkle' randomly, using the particle info node to get random values for each particle. This worked well and rendered reasonable fast (when using the Blender Internal Render instead of Cycles), however doing the text in Blender would be more difficult. So I attempted to do the intro in Premiere, using the starry background from blender. This didn't work as Premiere's titles were difficult to adjust, so I decided to just do the whole intro in blender.

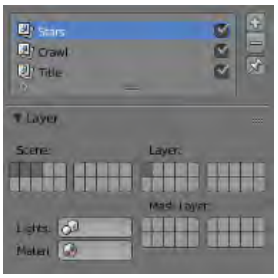
To create the 'twinkling' of the stars. I created a material in the node editor that gets a random value from the particle info node, and then combines it with the particle age and runs it through the sine function to get a pulsing material, where each particle pulses at different intervals.



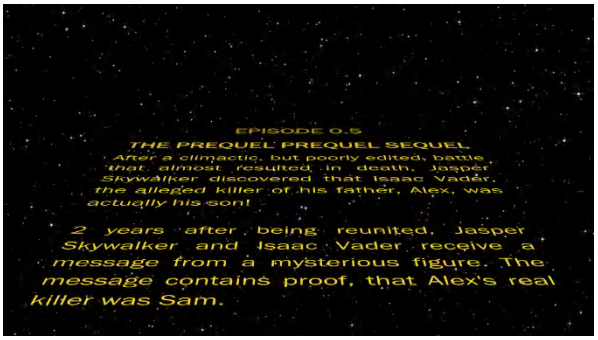
Adding the text and animating it was all fairly simple. I first added key frames for the position and scale of the "Star Wars" title, and then edited the animation curves to have it enter the frame quickly, slow down, then exit at a normal speed, until it scaled down to 0. For the crawling text, I had two text objects for the subtitle and the text, so I parented both to an empty, which I used to animate the position of.



For compositing, I wanted to add a glare effect to the stars to emphasise the twinkling effect and also the "Star Wars" title and text needed to fade out. To do this I had to separate each object into separate render layers when could then be composited together.



For the stars layer I added a guassian blur and glare effect, and then put it over a black background using the Alpha Over node. To make the crawling text fade out, I added a box mask, which I then blurred and then used to mask the crawling text layer so that the text faded out in the top third of the image. These two layers where then combined with the title to create the final image.



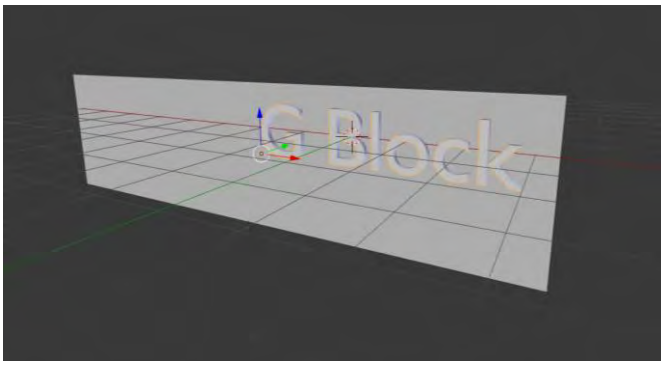
EVALUATION

With the opening my main goal was the emulate the Star Wars opening theme which I think I did really well. I think it would have been better to do it in a program such as After Effects instead of Blender however, but my knowledge of After Effects was probably not good enough. The timing of the scrolling text was also good, the text went by slow enough to be able to read all of it, but not too slowly that it would get boring.

Overall I think I did the opening scene well.

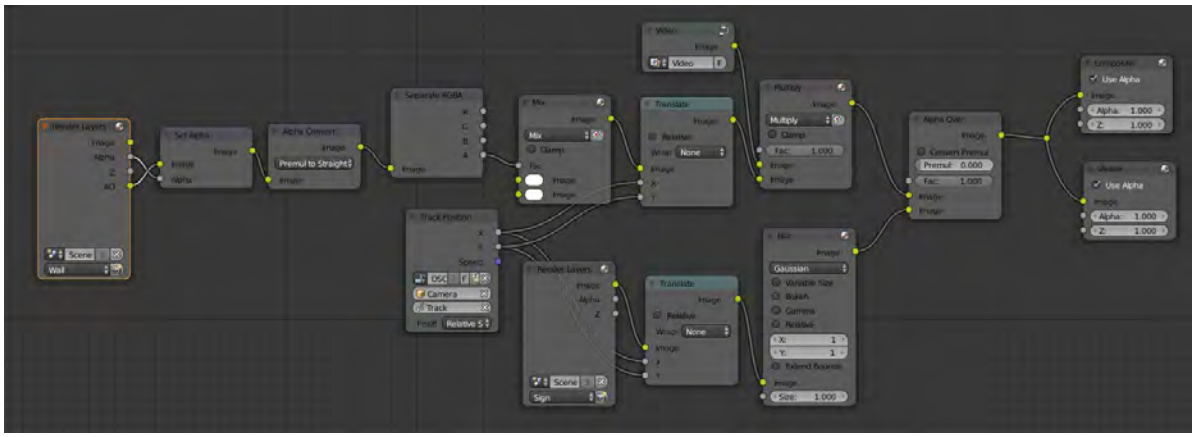
G BLOCK SIGN

To create the G Block sign I created a text object and then manually placed it into footage of G Block. I also added a plane for a shadow to be cast onto the wall.



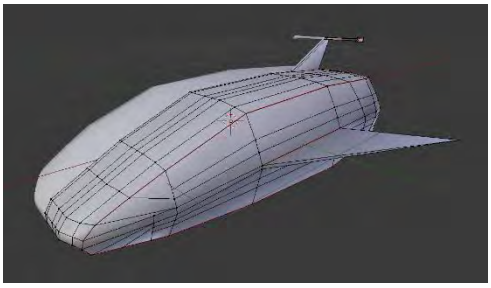
Since the footage was moving slightly, even though it was on a tripod, I added a few motion tracking points and then applied the motion from these points in the compositor.

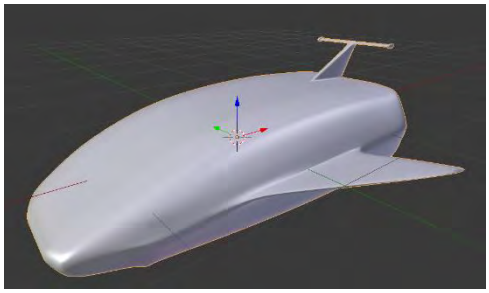
For compositing I used 2 render layers, one for the sign and one for the shadow. I multiplied the shadow layer with the footage and then put the sign on top.

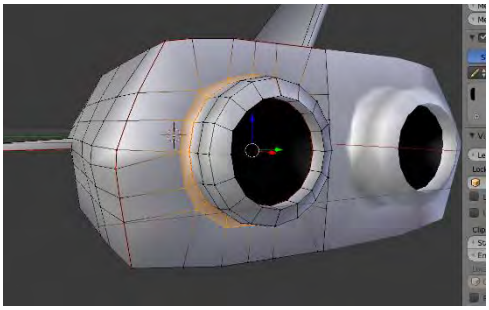


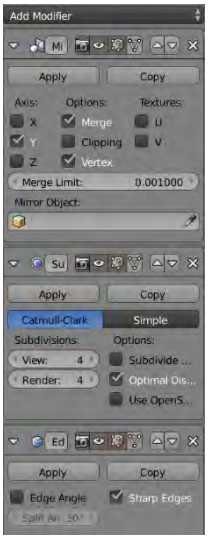
Modelling

For modelling the ship I used box modelling. I started with a rectangular prism, adding loop cuts and moving the verticles to get the generate shape of the dhip's body. I then extruded the wings and spoiler.









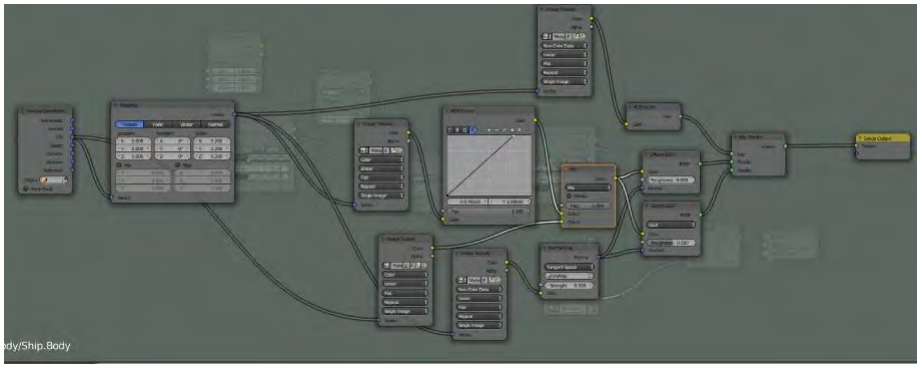
I then cut the mesh in half and added a mirror modifier so that I would only have to model one side of the ship and the other would be mirrored.

I added a subdivision modifier to smooth out the model. I also added creases to the mesh to make sharper edges and to keep the shape of the spoiler and wings. Finally I added an edge split modifier to keep the sharp edges shaded properly.

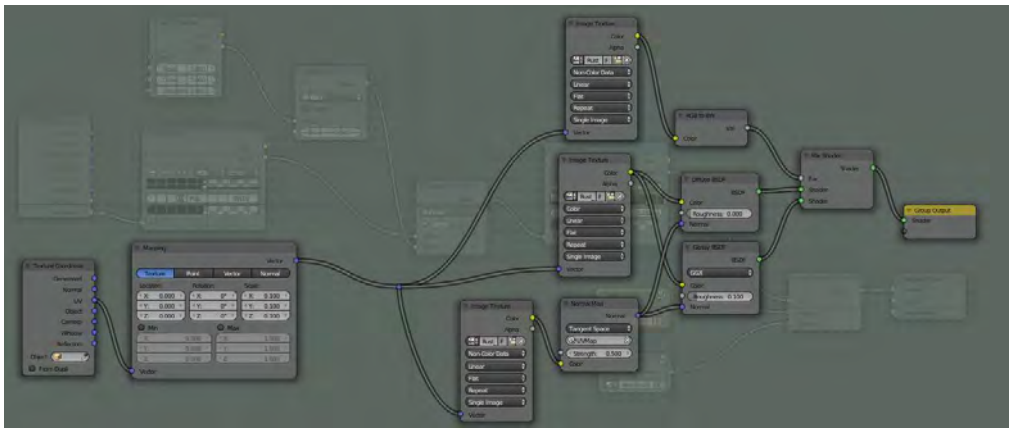
I modelled the engines on the back of the ship as a separate object and then later merged the objects and joined the meshes together using the bridge edge loops tool.

Materials and Texturing

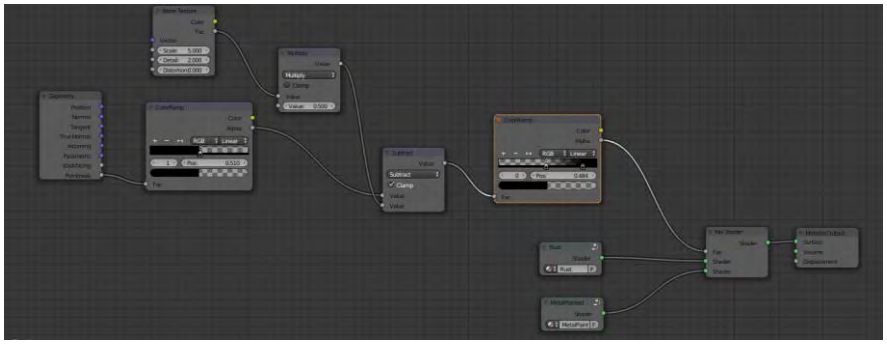
For texturing I wanted a rusty, old look to the ship. I started with a painted metal material, which was mainly a glossy and diffuse shader mixed together. I added a subtle metal texture and bump map and a paint texture to colour the metal as if it were painted.



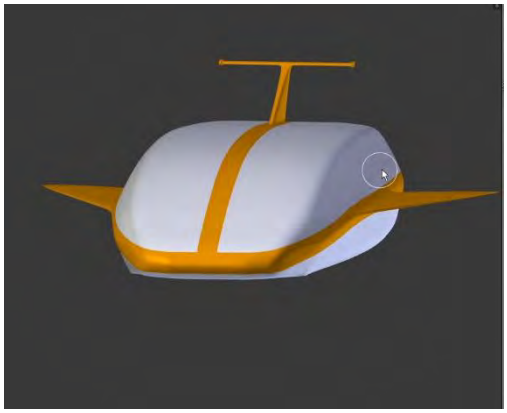
I then added a rusty metal material, which was simpler, but the same concept as the painted metal material. It only had one texture though, which is the rust texture.



These two materials were mixed together based on the ‘pointiness’ node. Which gives a number based on how ‘pointy’ the surface is, so on the edges of the ship, there would be rust. I also added a noise texture and mixed that into the factor to add a bit more randomness to the rust.



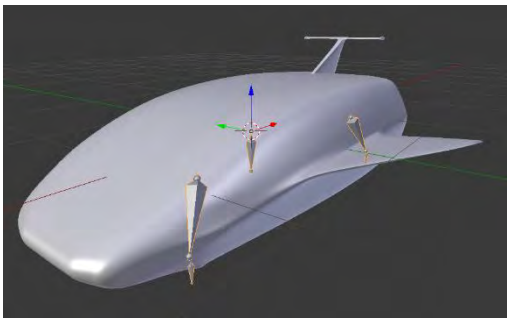
For texturing, I used the texture painting feature of Blender, which allowed me to paint directly onto the 3D model of the ship. I did a lot of the texture painting in orthographic mode, as I found I could get straighter more acccurate lines on the ship.



For the “UberS” logo, I create a small image of just the “UberS” text in Photoshop, and then saved that and used it as a stencil texture in Blender with the texture painting. This allowed me to just paint on the logo.

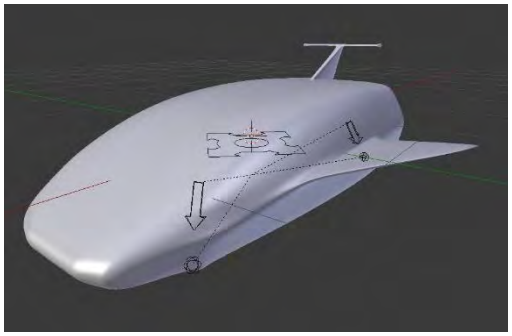
Rigging

To rig the ship, I added an armature and adjusted the bones into the positions they would control, the whole ship, and then child bones from those (detatched), the legs and feet.



To improve the usability of the armature, rather than having the default shape, I create shapes for each handle.

I weighted the bones manually, by selecting the "Parent with empty weights" option to create a vertex group for each bone which was empty.



I then added the vertices that corresponded to each bone to the bone's vertex group, so that the bones for the legs controlled the ships legs and the bones for the 'hatches' controlled each hatch.

HOLOGRAPHIC PHONE

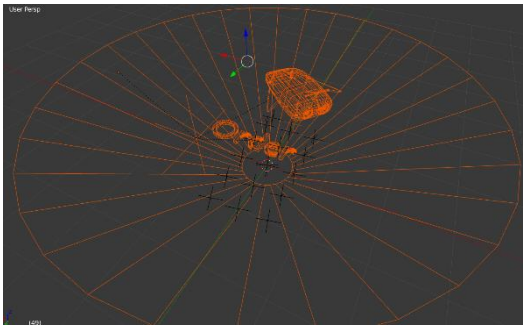
Motion Tracking

For motion tracking the phone, I opened an image with points to track on the phone and set it to full brightness. I used these points to track the phone. Instead of tracking the camera and then tracking the phone as a separate object, I just used the phone to track the motion of the camera which required less work.

Due to the reflections of the sky on the phone screen, the points on the screen weren't very accurate but by setting these points' "influence" to 0.1, which tells Blender to consider these points less accurate than others, I was able to track it properly.

Modelling

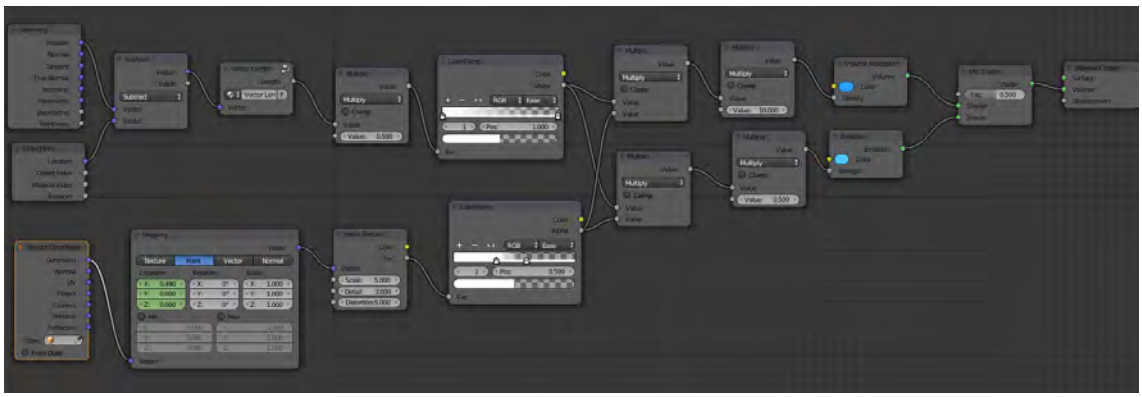
There wasn't much modelling involved in this scene since I had already create the ship's model.



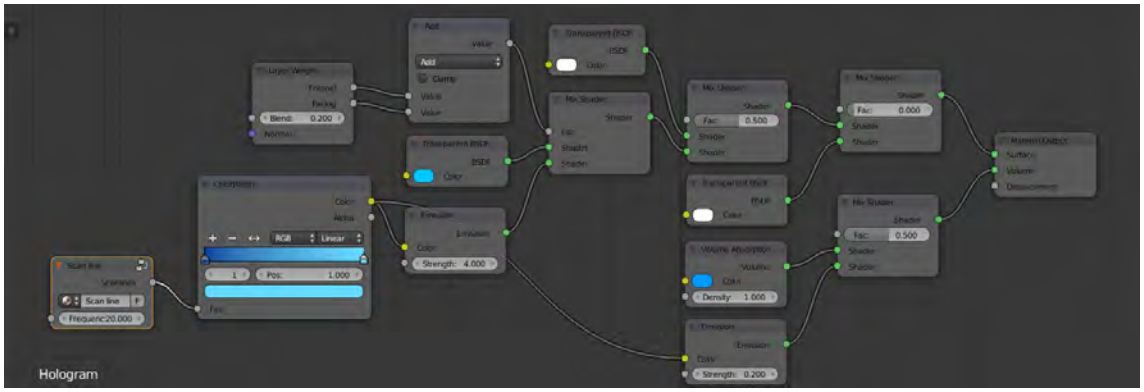
The text was just text objects and the beam that casts the holograms was just a cone.

Materials

For the beam effect I used a mix of a volume absobtion and emission shader as the volume's material. I added a noise texture as well and then animated the coordinates to add a more random effect to the beam. To make the beam intensity falloff the further it is from the screen, I used the object's position value and then got the distance between that and the origin of the beam and used this with a ColorRamp and multiplied it with the intensity of the shader.



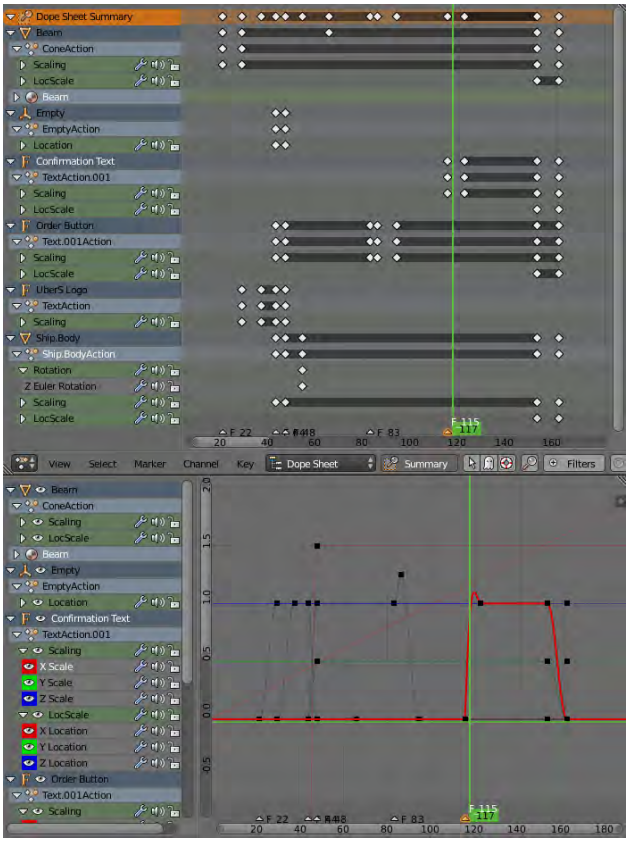
For the hologram material I used both a surface and volume shader. For the surface I used a transparent shader and for the volume I used a mix of a volume absorption and emission shader. I create a scan-line effect using a math node set to sine which I applied to both the surface and volume shader.



Animating

Modelling the scene was fairly simple. First I animated the screen turning on. I animated the holographic 'beam' by scaling it from 0% to 100%, then after a delay, scaling the "UberS" text from 0% to 100%. Then I parented all of the holographic objects (the ship and the text) to an empty. I then animated this empty so that when Isaac swipes, the screen goes from the "UberS" screen to the "Order" screen. The "Order" and "Confirm" text are both animated by scaling them from 100% to 0% or back. And finally everything is scaled from 100% to 0% when the screen turns off.

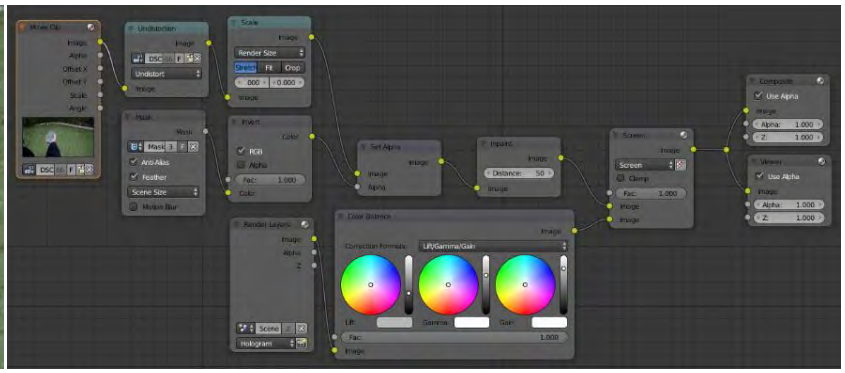
The rotating ship is animated by adding a single rotation key frame, and then adding a “Generator” modifier to the Z rotation channel. This makes the ship rotate at a constant speed infinitely.



For most of the text scaling animations, I used the “Back” dynamic effects so that the animation overshoots and returns to the final position to give the animation a more dynamic look.

Compositing

For compositing I had to mask out the points on the phone screen that were used to track the footage. To do this I added a circular mask and then parented the mask to a tracking point. I did this for each tracking point on the phone screen.



Using this mask, I first inverted the mask factor and put it into a “Set Alpha” node so that the mask punched holes in the image. I then put this through an “Inpaint” node while filled in the holes that were punched out. I then mixed the footage with the rendered hologram using the “Screen” mode, after doing some color correction on the rendered hologram to make it more visible.

I also modelled the rough shape of the phone screen and put it in the scene with a reflective material to add reflections of the hologram on the phone screen.

HDRIs

For lighting my 3D models when rendering and compositing into the footage, I used HDRis (High Dynamic Range images). HDRis provide far more dynamic range (the range between the darkest point in the image, and the lightest point), meaning that they can more accurately capture bright areas of an image (such as a light) and dark areas (such as shadows) which can then be used to get much more detailed and accurate lighting. HDRis are commonly used for lighting 3D models when compositing them into real footage as they help the lighting to match the real footage far more easily and more accurately than manually adjusting light sources in the 3D scene.

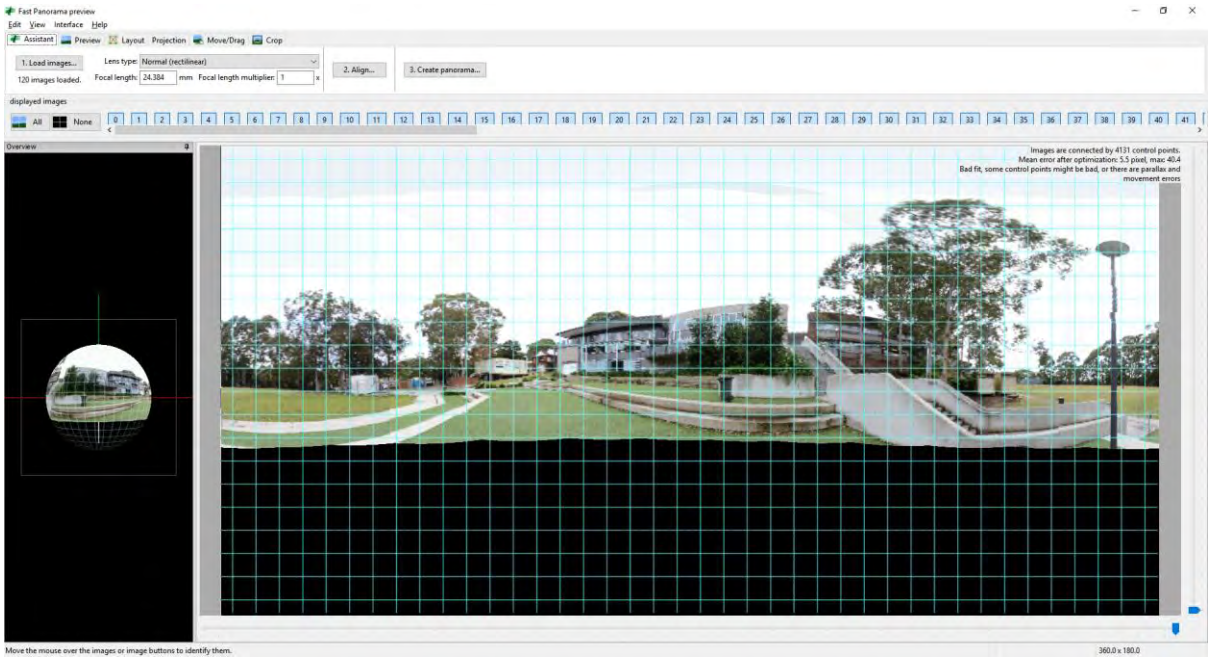
To create them, I shot images with a high dynamic range. In order to do this, I had to shoot the same image at different exposure levels. I shot at 3 different exposure levels for each image, as this was the maximum amount the camera would take using exposure bracketing. Each image was separated by 2 EVs (Exposure Values), which gave a high dynamic range but it was still easy to identify common features of each image.

3 photos taken at -2 EV, ±0 EV, and +2 EV

Combined HDRi

Using exposure bracketing on the camera, I was able to take each of the 3 images, but just holding down the shutter button, and the camera would automatically adjust the shutter speed for each image. I shot the images on a tripod. Since the images have to be 360 degree panoramic images (to get lighting from all directions, I rotated the camera taking images at different angles.

These images were then combined using Hugin, a panorama creation program which supports creating HDRi panoramas.



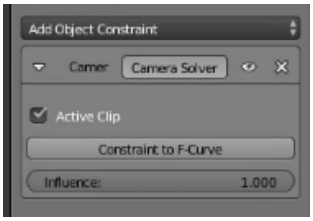
I mostly just used the assistant feature which automatically aligns then images for you by detecting control points between images and then aligning them. I did have to switch to the advanced mode to export the panorama as a HDR image.

The final result isn't perfect, mostly due to the automatic control points being created on leaves of the trees, which move between images. This wasn't a big deal though since the image would be used for lighting, so the best you can see it in the final video is in the reflection of the ships window.

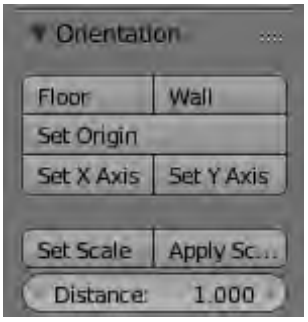
The HDR final image (Tone mapped to demonstrate HDR)

Motion Tracking

Motion tracking in Blender is slightly more work than motion tracking in other programs, such as After Effects, however it allows far more control. Blender provides a “Detect Features” button, however it doesn’t work very well, so instead I added points manually. Some points were difficult to track due to motion blur, but adjust settings such as enabling “Normalize” which adjusts the contrast of the points when tracking and disabling “Prepass” which tries to guess where the point will be before tracking it.



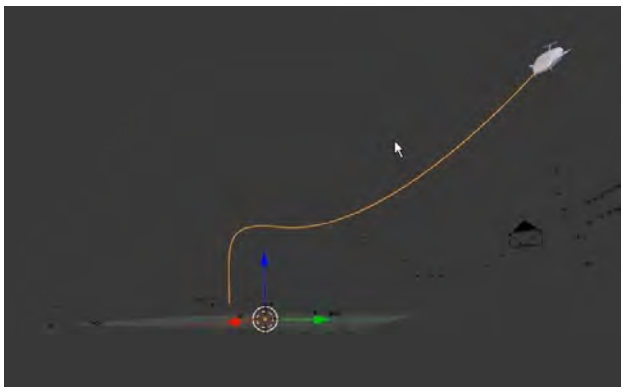
After all the points were tracked, I set up the camera settings to be what I shot on (24mm focal length 35.9mm sensor width) and then set “Refine” to “Focal Length, K1, K2” which would refine the accuracy of the focal length and lens distortion factors, since the lense probably isn’t perfectly accurate. Then I crossed my fingers and pressed the solve button, which is the usual procedure when tracking in Blender. I managed to get a solve error value of around 0.35, which means that the average error between all the points was 0.35 pixels.



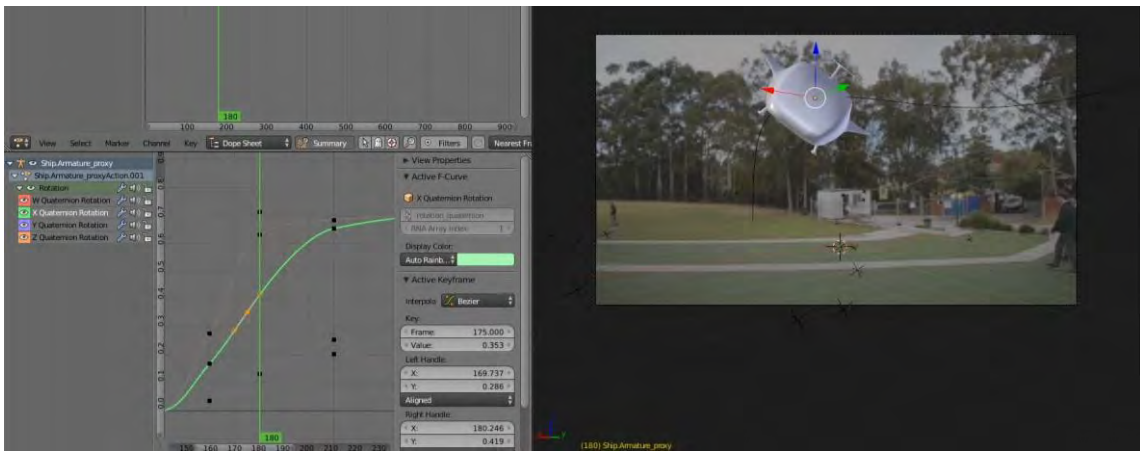
Finally I added a camera solver contraint to the camera in the scene, which makes the camera follow the tracked camera. I also adjusted the positioning and size of the tracking scene by adjust the settings in the “Orientation” panel. I used a cube in the scene to test the positioning, making it appear as if it was on the ground.

Animating

For animating the ship, I used a combination of path and key frame animation. The first thing I did was the position the ship in the place where I wanted it to land. I then create a curve, ending at where the ship was, for the path that the ship would travel and then applied a “Follow Path” constraint to the ship armature. I modified the “Evaluation Time” animation value, to control how the ship slowed down, or sped up throughout the animation to give the animation more natural motion rather than just following the path at a constant speed.



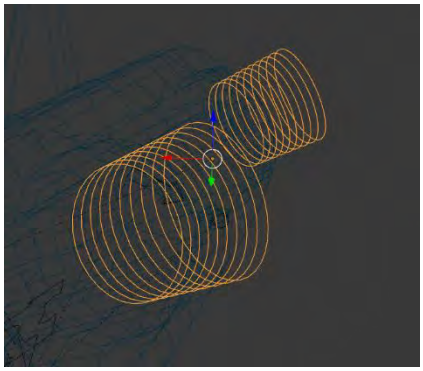
After I was mostly happy with the position-wise movement of the ship, I focused on the rotation. First I create key frames at certain points in the animation with the rotation of the ship I wanted at that position. These were animated together by default by Blender, which didn’t look good at all but was a good starting point to refine the animation. I used Quaternion rotation values (WXYZ) instead of Euler rotation (XYZ) as animating between Euler values is very awkward as each axis isn’t “natural” compared to Quaternion values.

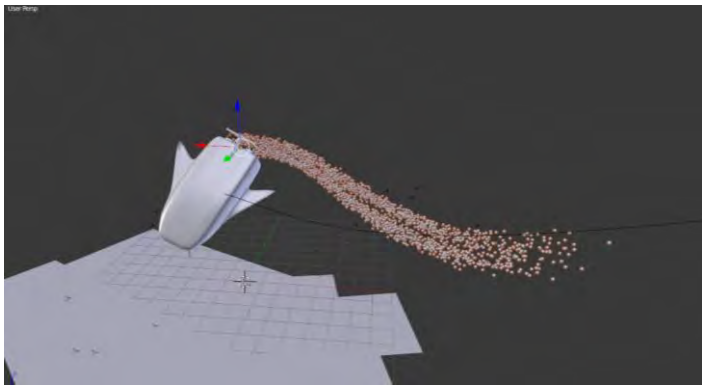


I then modified the curves of the rotation animation to remove the weird changes in rotational velocity, making the movement smoother and look better until it was at a point where I was happy with it.

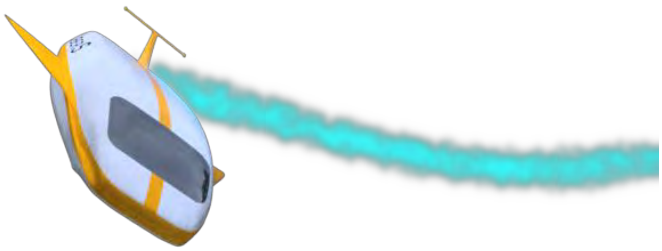
Particles

At first I had a lot of difficulty with the particle effects. I created two circles to be used as particle emitters which I parented to the ship. I added a particle system to each, but for some reason this caused particles to random spawn nowhere near the emitters. I fixed this my combining both circles into a single object. I then had the problem that there were distinct separations between groups of particles, since new particles only spawn every frame. I tried to solve this by using by using a sphere for the emitters and settings the particle system to emit particles within the volume, but this means that I couldn't add any initial velocity to the particles, otherwise they would fly in all directions. Finally, I tried using multiple circles stacked on top of each other, this worked well as there were no gaps between particles and I could control the initial velocity of the particles.



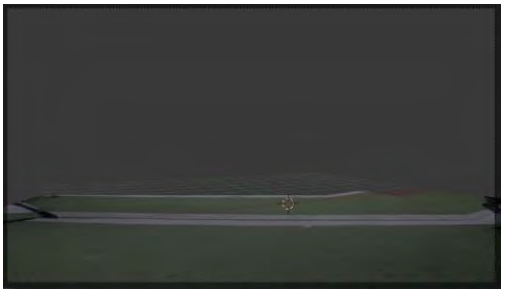


For rendering the particles, I tried different techniques. My plan was to use a "Point Density Texture", which would allow me to create a 3D volume of the particles, so that I could create something like a smoke trail. I quickly realised that this was extremely impractical as it takes a long time to initally calculate the point density texture, and then even longer to render a volume. Instead I tried rendering each particle as a normal object. I first tried rendering them as volumes, but due to enabling motion blur (which I needed to make the CG fit in more with the live action footage), this was extremely slow to render. I then tried using a simple emission shader for each point, and then separate the particles into a separate render layer and apply effects to them.



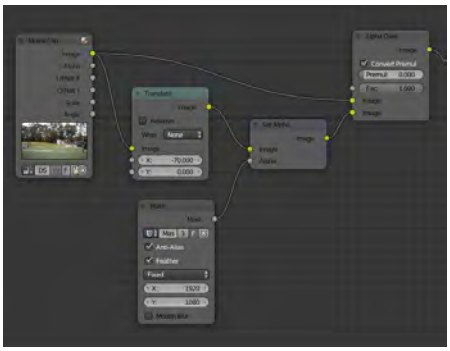
Compositing

For compositing, I split the scene into 3 render layers, one for the ship, one for the particles, and one for the shadows. To render the shadows for the ship, I created a shadow catcher object. I did this by modelling the shape of the ground in the scene, and then UV mapping this object my projecting from the camera's view, and then capturing an image from the video and applying that as the texture. This was done so that the ship would show reflections of the ground and would be lit by the reflected light from the ground.

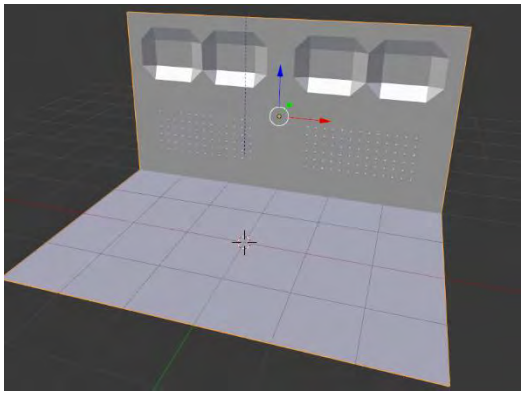


The particles layer was composited by first applying a "Fast Gaussian" blur and a "Fog Glow", and then combining it onto the render of the ship. This was then combined with the undistorted footage, and then mixed with the shadow layer using the "Multiply" mode.

When compositing I also noticed that there is a person in the background of the footage and decided to attempt to remove them. I did this by creating a mask and then tracking the mask onto the person. In the compositor I then basically pasted the footage of the grass to the right of the person over the person.

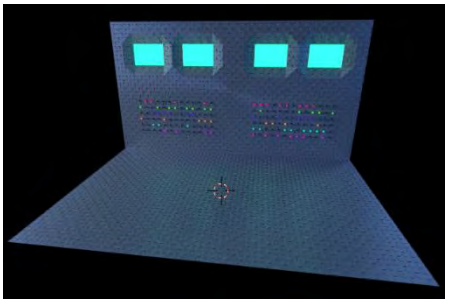


Modelling

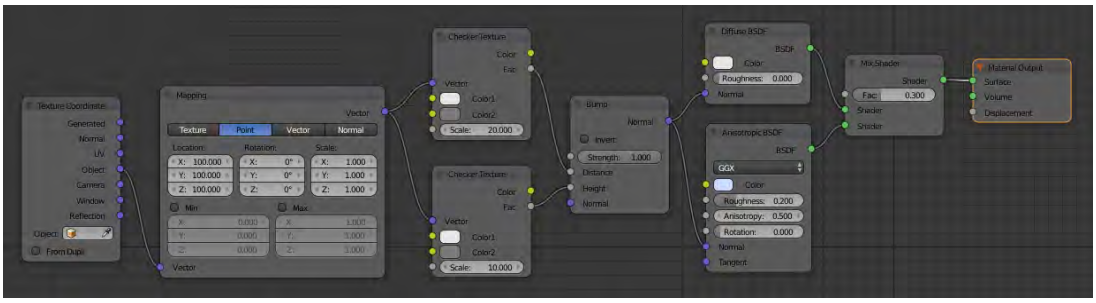


Modelling the ship interior was fairly simple. I added two planes and then joined then, then added loop cuts and indents for the ‘windows’ in the ship. I also added two planes with a particle system for the lights on the wall of the ship.

Materials

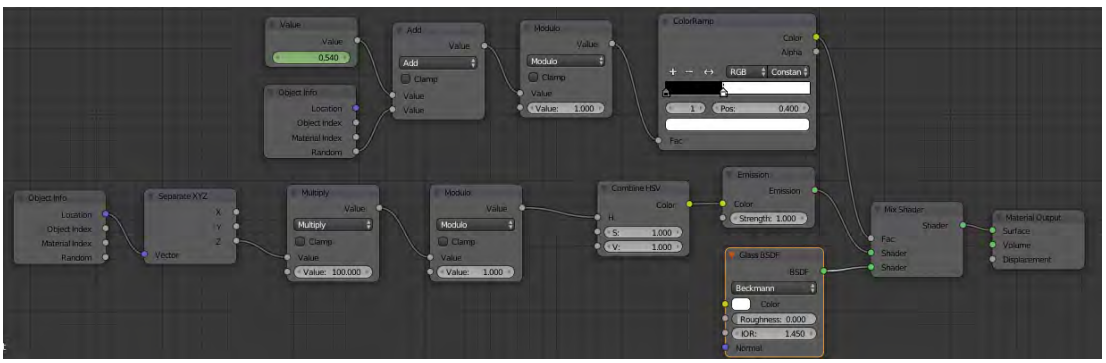


The material for the walls of the ship was a mix of a “Diffuse” and “Anisotropic” shader with a bump map that was made using 2 checker textures, with one set as the height, and one set as the distance inputs to the “Bump” node.



For the ‘windows’ I used a mix of an “Emission” and a “Diffuse” shader and animated the factor value to create a pulsing effect.

For the lights, I used a mix of a “Glass” and “Emission” shader with the colour of the light determined by its Z position. For the random turning on and off of lights I used a animated value and then added it with the random value and then passed it through a “Modulo” and “ColorRamp” node to get a value of 1 or 0.



Green Screen

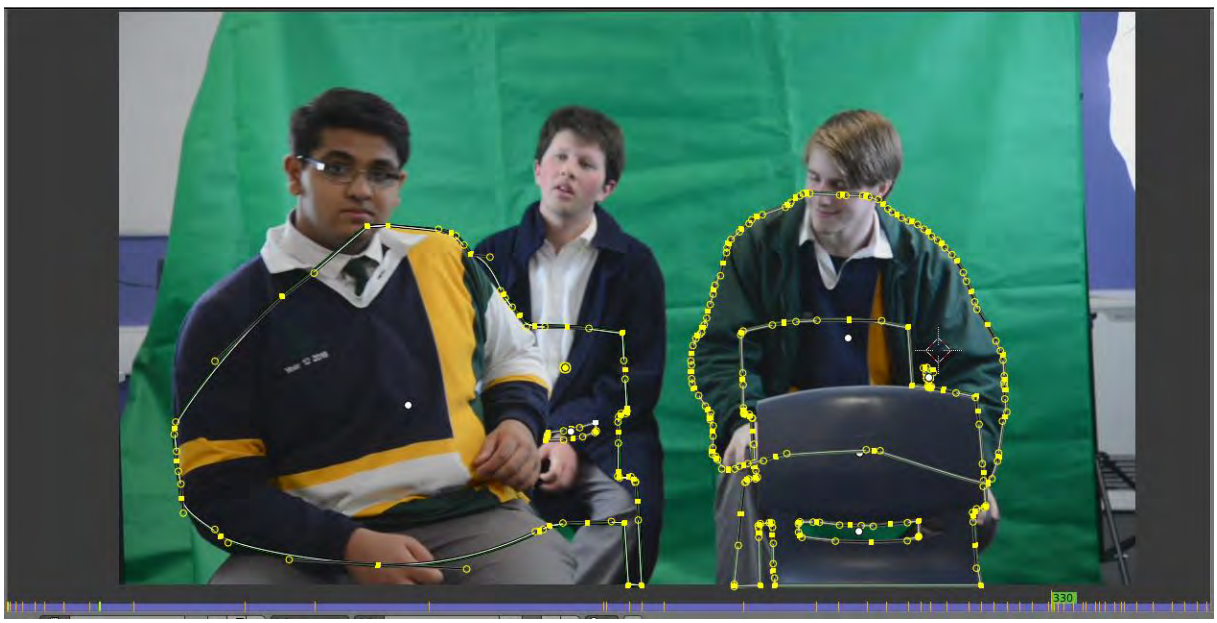
To set up the green screen I used a green screen kit which came with two lights and a stands. I set up the lights to light the green screen to reduce the amount of shadows as best I could. Due to the limited space of where I was shooting, there were still a lot of shadows on the screen.

Keying and Rotoscoping

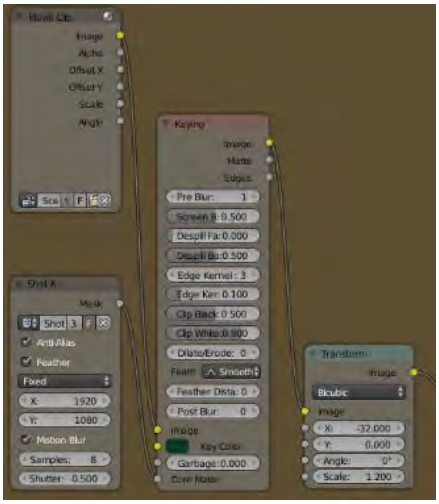
When I first tried to key the footage, there were a lot of problems. Because the green screen had too many shadows I had to have very aggressive settings for the keying, due to this a lot of the foreground was being cut away. Some of my actors were also where dark green, which was picked up by the keying.

To fix these issues I needed to rotoscope the footage. This would be a very long and repetitive task, so I decided to only rotoscope the parts that were absolutely necessary, which was the green parts and some parts that were being cut into.

To do this I used Blender's masking tools, creating different masks for different things in the scene, such as the chairs and PB and Jasper. I then went through the footage and animated the mask by adding shape keys. This took a long time, about 5-6 hours total.



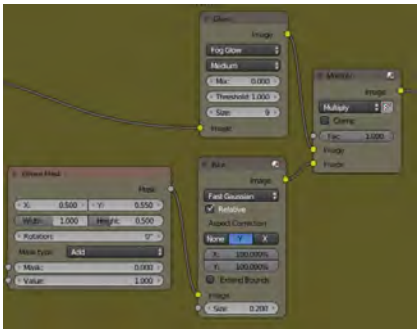
Once this was done I was able to key the footage well enough for it to be usable. I used a “Keying” node and used the rotoscoped mask as the “Core Matte” which meant that it wouldn’t be keyed out even if it was green in those areas.



I then added a “Color Spill” node to remove the green fringe and make any errors on the edges of the mask less noticeable.

Compositing

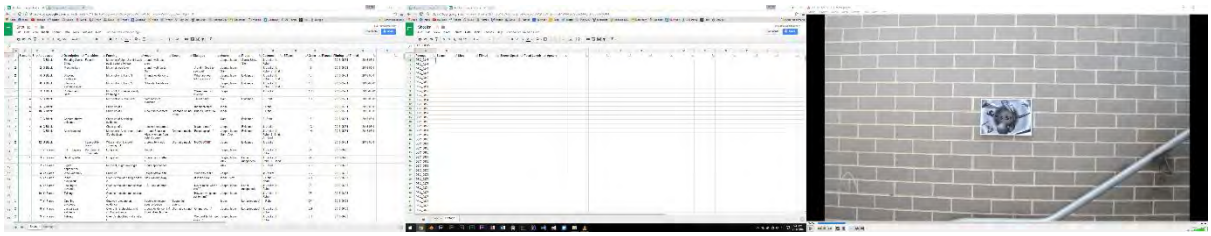
For compositing the scene, I colour corrected the keying footage to make it fit in the scene more by giving it a dark blue look. I then combined this with the rendered scene, which I very slightly blurred to make it slightly out of focus.

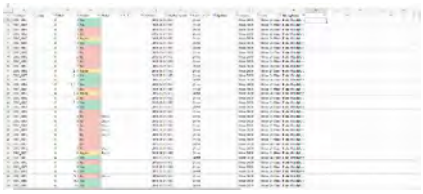


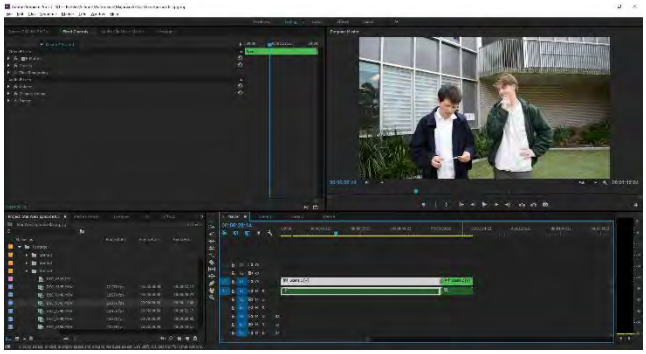
I also added a “Fog Glow” effect to make the ‘windows’ and the lights glow when they light up. I also added a vignette effect using an “Ellipse Mask” and “Fast Gaussian” blur and then mixing it with the footage using the “Multiply” mode.

EDITING

In order to edit the footage together, I needed to organise the footage I had taken so that I knew which shot each one was, and which footage was actually usable. To do this I created another spreadsheet, and entered all the footage that was taken. I added columns for details such as which footage would be used for VFX, the shutter speed, focal length, aperture and the camera and microphone. I then went through the footage, with the storyboard and shot list open, and recorded all the details for each piece of footage. Having 3 screens made this very easy, as I could just have each window open on each screen.

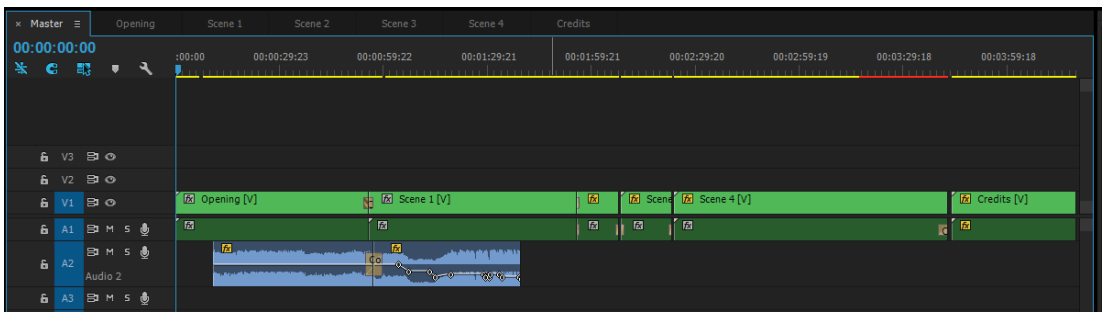






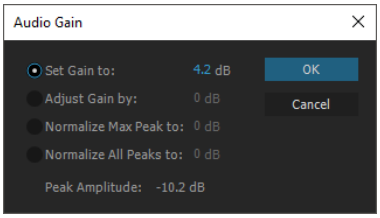
Once all the footage was organised I started to edit. I created a Premiere project and imported all the footage, sorting it into bins for each scene. I created a sequence for each scene, and also a master sequence for combining the scenes together. Most of the editing was fairly simple. I decided to edit before doing any VFX, so that I knew exactly the VFX that were going to be in the video, and I didn't do any extra unnecessary work. For some scenes, I added a warp stabiliser to improve the quality of shaky footage, as I didn't have a gimbal or camera stabiliser for moving shots, however most shots were taken on a tripod.

I split the editing into separate sequences for each scene and for the opening and credits.



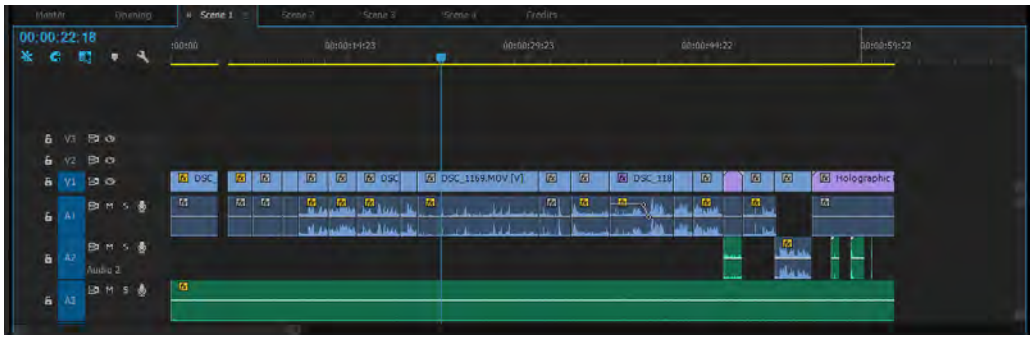
SOUND

For sound I started by adjusting the gain of all the different audio clips in Premiere. I aimed to have dialog -6dB. I chose this level as it was similar to most other online content, and if I needed to have sounds louder (such as loud music or sound effects) I could make it louder without clipping or distortion.



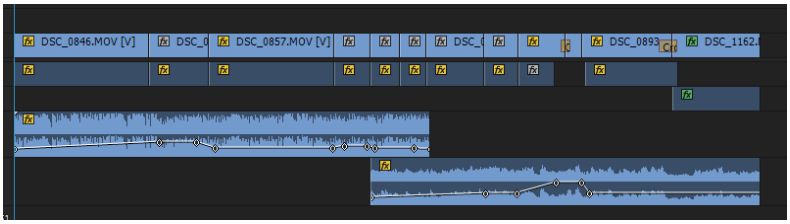
I also went through and animated the volume values if there was unwanted background noise such as people speaking. Normally this would be very noticeable but I planned to cover it up with music and background sound effects.

For scene 1 and two I added an ambient background sound effect as well as other sound effects such as a 'swipe' and beeps for the holographic phone. All of the sound effects I used were from the YouTube Audio Library and are completely copyright free.



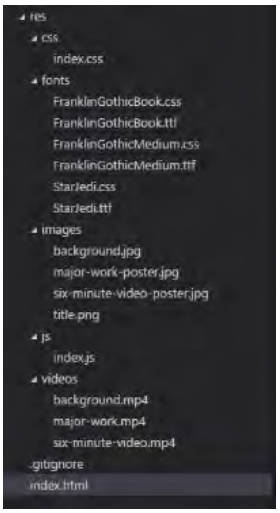
For the sound effects in scene 2 (this ship landing) and scene 3 (inside the ship) I used an air conditioner sound effect and combined it with the PitchShifter effect. I then key framed the pitch and volume to make it sound like the ship was actually approaching the camera.

Adding music was fairly simple. I added the audio tracks and then adjusted the gain. Since dialog had to be heard over the music I key framed the volume of the tracks to make dialog more audible. I also used it for cross-fading between music.



WEBSITE

For creating the website, I started by creating the basic files to code the website in. I organised everything into folders under a 'res' folder, such as CSS, JavaScript, images, videos and fonts. Even though the website would be small and only really one HTML page, having separate folders helped to keep things organised.



I then started by creating the header at the top of the page. I originally tried to do with completely with HTML and fonts, but eventually I gave up and decided to use an image for the main title, then HTML for the subtitles.

```
<header id="header" class="no-select">
    <img id="title" src="res/images/title.png">
    <h2 id="subtitle1">Episode 0.5: The Prequel Prequel Sequel</h2>
    <h3 id="subtitle2">2016 HSC Multimedia Major Work</h3>
</header>
```

I used CSS to define the layout, centering the text and adding margins between each line, and for the style, adding the custom font and changing the colour of the text.

I then added a background to the page. I wanted the background to be the starts from the opening and the credits of my major work, and I decided that I would make it animated. To do this I exported a looping section from the rendered stars and encoded it to be a small as possible so it was suitable for the website. The background video ended up being about 2 seconds and 254 KB.

To put the background on the website I added it using a <video> tag set to autoplay and to loop. I then used CSS to position this behind all other elements on the page (using the z-index value) and to fill the entire size of the page. I also added a static image in case the video is not supported in a user's browser and to display before the video loads.

```
/* BACKGROUND */

#background-container #background {
    position: fixed;
    top: 50%;
    left: 50%;
    min-width: 100%;
    min-height: 100%;
    width: auto;
    height: auto;
    z-index: -100;
    -ms-transform: translateX(-50%) translateY(-50%);
    -moz-transform: translateX(-50%) translateY(-50%);
    -webkit-transform: translateX(-50%) translateY(-50%);
    transform: translateX(-50%) translateY(-50%);
    background: url("../images/background.jpg") no-repeat;
    background-size: cover;
}
```

I then added the navigation at the bottom of the page. I used a list (the <ul> tag) of links (<a> tags) which linked to hashes on the page (putting a # value at the end of the URL which represents a certain section of the page). I used a CSS class to differentiate the currently selected item. I positioned the navigation element at the bottom of the window using CSS as I wanted the webpage to scale to the size of the window.

```
<nav id="nav">
    <ul id="list" class="no-select">
        <a href="#ship"><li id="ship" class="list-item">Ship</li></a>
        <a href="#major-work"><li id="major-work" class="list-item selected">Major Work</li></a>
        <a href="#six-minute-video"><li id="six-minute-video" class="list-item">6 Minute Video</li></a>
    </ul>
</nav>
```

I then added the actual content. I used CSS to make the element fill the entire window and then added padding so that I would be restricted to show between the header at the top

and the navigation at the bottom. This took a lot of fiddling with the CSS to make it work properly but eventually I managed to get it to work.

The content contained 3 items, a 3D view of the ship that I created, the main video for my major work, and my six minute video. Again, I used a CSS class to differentiate the currently selected item and then used CSS to hide the non-selected items.

For the six-minute video and major work video I just used a <video> tag with the controls shown. For the interactive 3D model of my ship I used a site called sketchfab. I uploaded my model and the textures for it, then configured the materials and embedded it in my website.

To actually make the navigation work to switch pages, I needed to add JavaScript to switch the CSS classes between the elements in the navigation element and the content.

```
function removeClassName(elem, className) {
    elem.className = elem.className.replace(new RegExp("\\b" + className + "\\b"), "");
}

function addClassName(elem, className) {
    elem.className = elem.className + " " + className;
}

function selectPagerItem(item) {
    function select(parent) {
        // Deselect old item
        removeClassName(parent.querySelector(".selected"), "selected");
        // Select new item
        addClassName(parent.querySelector("#" + item), "selected");
    }

    select(document.querySelector("#nav #list"));
    select(document.querySelector("#pager"));
}

function selectPagerHashItem() {
var selectedItem = window.location.hash.substr(1) || MAJOR_WORK;
    selectPagerItem(selectedItem);
}

window.onload = selectPagerHashItem
window.onhashchange = selectPagerHashItem
```

I did this by creating a function to remove the ‘selected’ CSS class from the previously selected element, and to add the CSS class to the new element. The selected element was determined by the hash value at the end of the URL. This function is run when the page loads and when the URL hash changes.

Finally I added animations to make the website more pleasant to use. For the navigation element this was pretty easy, I just used CSS transitions to automatically transition between the selected and non-selected state. Animations for the content was a lot more difficult. What I had to do was use JavaScript to implement them as CSS transitions don’t work for showing and hiding elements.

The final website.

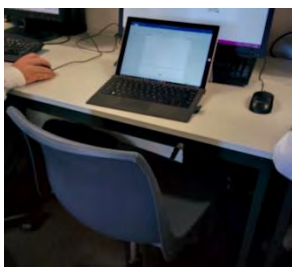
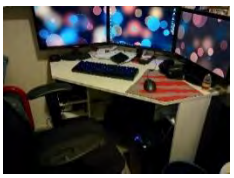
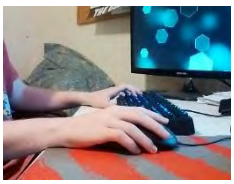
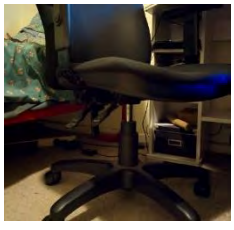
WHS

ERGONOMICS

Ergonomics is the process of designing in a way that a product or workplace is comfortable and easy to use and not causing injuring or strain through normal use.

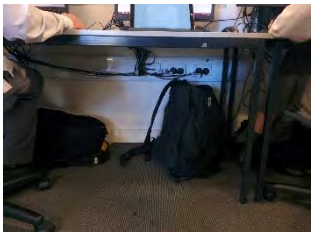
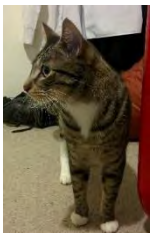
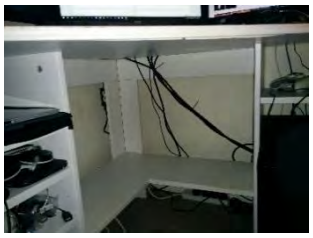
Some examples of ergonomic features are:

Chairs	- Adjustable height - Lumbar support - Adjustable arm rests
Desk	- Adjustable height - Enough legroom
Monitor	- Adjustable height - Adjustable tilt
Keyboard	- Adjustable height - Wrist rest
Posture	- Elbows level with keyboard - Feet flat on floor - Back straight

Classroom		Home	
Good	Bad	Good	Bad
- Adjustable height chairs - Decent amount of legroom - Height and tilt adjustable monitors - Adjustable height keyboard	- Fixed height desks - No lumbar support or padding - No armrests - No wrist rests	- Adjustable height chair - Adjustable arm rests - Adjustable height keyboard	- Fixed height desk - Not much leg room - Fixed height monitors
 		  	

HAZARDS

Hazards in the workplace can be dangerous to workers. Hazards include things such as obstructions, fire hazards, cables that may be tripped on, or poor visibility.

Classroom		Home	
Good	Bad	Good	Bad
- Cables out of the way - Fire extinguisher - Well lit - Evacuation plan	- Bags under desks - Chairs around room	- Cables out of the way - Smoke alarms	- No fire extinguisher - No evacuation plan - Hazards (such as shoes) on floor - Cat can get in the way
 		 	

SIGNAGE

Signage is used so that everyone who is in the workspace knows of certain rules and information. It must be displayed clearly and be visible from a wide angle.

Classroom		Home	
Good	Bad	Good	Bad
- Evacuation plan on door - Clearly visible signage - Signage for fire extinguisher			- No signage at all
 			

FILMING

There are lots of important health and safety rules when filming since filming involves working with equipment that can be potentially dangerous or hazardous, such as heavy lights on stands that may fall over if not properly set up, and cables that could be tripped over if tangled or poorly placed.

Lighting

When setting up lighting it is important to follow rules to make sure they don't get knocked over or hurt anyone:

- Make sure the lighting stand is stable before extending the height by adding a sandbag to the bottom
- Use gloves when adjusting lights after they have been on for a while because they will be hot
- Make sure the horizontal bars at the bottom of the stand don't go past horizontal with the ground

Cables

When rolling cables on set it is important to make sure they won't be in the way and to make it hard for people to trip over them.

- Cables should be kept out of the way by running them along the edges of the set, and by routing them in a way so they cross walkways in as short of a distance as possible.
- Cables should be taped down flat using Gaff tape and should not have any kinks or be tangled in any way.

EVALUATION

Overall I am very happy with how my major work turned. The final product is high quality, in terms of the technical skills that I used. The story, acting and writing are not very good, however these were not the focus of my major work. I planned to show many different skills such as 3D modelling, compositing, video editing, filming, sound and website development, which I think I did a good job of all of showing all of these skills with high quality.

Statement of Intent

"For my Major Work I intend to create a short film, presented on a website which I will create myself. The short film will be a parody of Star Wars and will include multiple effects such as a CG space ship, which I will create myself, and will be motion tracked and composited into the video. I will also have a 3D holographic display effect in the video. I will create the website myself using HTML, CSS and JavaScript."

The final product of my major work is almost exactly what I set out to complete. I created the short film by myself, doing all of the production myself with friends acting in it. The film parodies Star Wars well, emulating the style such as the opening and basing the characters on Star Wars character. I successfully achieve the CG space ship and 3D holographic display effect, and I think that both effects were high quality and exactly what I wanted them to be. I created the website completely by myself and I think I made it well designed and aesthetically pleasing.

Research

The large amount of detailed research that I did, including 3D modelling and rendering, file types and hardware, allowed me to make informed decisions on how to best complete my major work to the highest quality. While I had a lot of prior knowledge on these topics, researching helped me to fill in gaps in my knowledge and to make sure that what I knew was correct information.

Planning

Despite doing extensive planning ahead, including my time plan, finance plan and shot list, I still had issues, mainly with time management and unexpected delays. I knew this from the beginning, mentioning it in my SWOT analysis. However, I managed to complete my major work on time and with a high quality result. If I hadn't done as much planning as I did, it would be unlikely that my major work would have turned out as well as it did.

Construction

The construction had a few problems however I managed to overcome these problems, such as using rotoscoping to fix errors with my green screen keying, and by spending extra time on my major work to catch up after delays and to finish on time. Other than those issues the construction of my major work went fairly smoothly, mostly due to the amount of testing and prototyping that I did in the initial stages to ensure that I could achieve the effects in my major work. Having more time and better skills, specifically artistic skills, would have allowed to increase the quality of the end product, however I am very happy with how it turned out as it is.

Ship

I am happy with how the ship turned out. The design for it is basic but the 3D modelling, texturing and materials are all high quality and I think I did a good job.

Holographic Phone

The holographic phone effect is exactly what I wanted it to be. Thanks to the amount of testing that I did, I was able to figure out the tracking, compositing and materials to make the effect high quality. The animation and design could have had more detail however I think that the final result was still impressive.

Ship Landing

The ship landing is one of the best effects in my major work. It took a lot of work animating, compositing and tracking, especially tracking… Without the large amount of testing that I did with motion tracking in Blender I don't think I would have been able to do it. The result was another impressive effect in my major work, and only has a few minor problems, such as the particle trail in the window not being blurred (which I only realised

when it was too late) and a slight seam between the ship and the shadow, which isn't noticeable in the final product.

Ship Interior

The scene in the interior of the ship was probably one of the worst effects in my major work. Due to being time constrained with getting everyone involved organised, and the small amount of time I had to film, the green screen was not very well set up and led me to having to rotoscope most of the scene. While this took a long time and a lot of work, the final result was still not very high quality as there are many problems with the chroma keying. I think I did well with managing to make the effect work though, and it is passable in the final product.

Editing

The editing in the final product is high quality. I used several effects such as slow motion (using optical flow) and colour correction to improve the quality of the final product. I am happy with the overall editing in the video and also the opening crawl and credits, as they add to the effect of it being a parody of Star Wars.

Sound

The sound in my major work is an area which I think I should have spent a lot more time researching and focussing on. While all the dialogue is audible in the final product, using an on camera mic meant that lots of background noise was picked up which is also audible in the final products. The sound effects, such as ambient sounds and the sounds for the holographic phone, were basic but I think they were good enough and helped to cover up issues such as background noise. The music was good enough well timed, however I think I could have done a better job transitioning between different tracks.

Website

I am extremely happy with how the website turned out. I managed to achieve the exact design that I wanted, and I had to solve many problems such as the complex layouts and transitions however I think I did a very good job. I like the simple design of fitting everything into the window and switching between pages.

Overall

Overall I think I did a very good job with my major work and I am happy with how it turned out. It does have a few problems but it also has many impressive effects and is overall very high quality.