Mixed Reality Visual Effects Shot

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Year: 2009

STATEMENT OF ORIGINALITY

This report is submitted as part requirement for the degree of Multimedia and Digital Systems at the University of Sussex. It is the product of my own labour except where Indicated in the text. The report may be freely copied and distributed provided the source is acknowledged.

(Signature of Student)____________________________

ACKNOWLDGEMENTS

I would like to thank the following people:

My project supervisor Dr.Phil Watten and Fiona Riviera for their support, guidance and motivation throughout the duration of the project.

SUMMARY

Mixed Reality Visual Effects Shot - Final Year Project

This project combines real time recorded footage with Computer Graphics (CG) animated models and effects to create a professional quality Video Effects shot and to investigate Video Effects (VFX) techniques.

The shot will be of a helicopter landing on a solid surface covered with leaves. When the helicopter lands, the cockpit will open and the pilot will jump out, hit the ground and walk off screen.

The helicopter is a computer generated 3D model and it was composited into the real time footage along with other effects created in Adobe After Effects. The computer graphics were created in Autodesk Maya.

The success of this project was mainly due to good planning and a large amount of the total project time was spent breaking each shot down into its most basic elements and seeing how all of the components interacted with each other and with the other shots. A storyboard and shot plan were formulated from the breakdown creating a clear concise view of the scope of the project.

A requirement specification was drawn up which the project had to adhere to if it was to be classed as a success. These will be used to evaluate the final project output.

TABLE OF CONTENTS

INTRODUCTION -1

Over the past decade the video effects industry has exploded. Video effects (VFX) can now be seen in almost every advertisement, TV program and film and there are no signs that its use in the VFX industry will diminish in the foreseeable future.

Video effects made its first appearance in film in the 1970's, one of the films of note being The Andromeda Strain(1971)[1] but it didn't rise in popularity until the 1980s and 1990s. The main reason for this was expense and hardware. In the 1980s hardware which was capable of producing good visual effects was extremely expensive and only dedicated software houses or film companies could afford it, meaning if wanted visual effects was wanted the client had to pay the high prices these companies demanded. Also, there was a severe limit on what hardware could do. Many things seen in more recent films were impossible 20 years ago.

In the last 10 years there has been a huge increase in the power and capabilities of personal computers along with a drop in price which has brought video effects to the masses. In the past it could have cost thousands of pounds to send a film crew and actors to a remote location for filming but now the same shot could be taken from the comfort of a studio using an effect such as green screening for a fraction of the price.

This project will utilize many of the techniques used by VFX studios and explore the advantages of using CG over real life objects such as an animated model of an Apache Helicopter over a real one. In order to do this many other techniques will have to be used to make the whole scene believable.

Another consideration in using computer graphics over real life objects and situations is health and safety. With increasingly perilous stunts being performed in action movies, the safety of the cast and crew is more important than ever before. Using a combination of computer graphics and real time footage can decrease the danger of a stunt or scene immensely, without losing believability or realism.

If a special effects shot is done correctly, the viewer should barely be aware special effects are being used. The shot should look as though it could happen in real life. To achieve this, a VFX artist or team will always have to use many different techniques to trick the viewer into believing the shot.

This project aims to utilise many of these techniques to produce a high quality video effects demo reel. To obtain this output a huge amount of planning and research is required to ensure all the separate components of each shot come together to make a high quality final output.

The success of this project is largely down to time management and effective planning. In order to complete the project on time each section will be broken down into its most basic components and flow and Gantt charts will be drawn up to keep to schedule. It is essential to stay on track with this project because if some sections takes longer than expected or something goes wrong the quality of the entire project will be reduced due to less time being spent on other sections of the project.

In order to produce the desired output for this project it is essential research is done into the software being used and to understand the capabilities of any software chosen. To ensure the best software for the job is chosen, candidate software packages will be evaluated side by side and learnt from scratch if necessary.

PROFESSIONAL ISSUES -2

When planning a project it is important to bear in mind any issues which may arise or it may cause. A video effects shot could be shown at a cinema or broadcast over television so it is important to take into consideration that, for example, people of different religions, age, race and gender may watch it.

Health and Safety – 2.1

The main issue with Health and Safety will be during the filming of the reality footage. There will be numerous people involved and it will be on location, outside. Camera operators will have to be properly trained to use the equipment and care and attention will have to be taken throughout filming will probably take place in a public place and possibly in the vicinity of a road.

Even with the best training accidents can still happen. People can trip over wires and be so focused on the task at hand they forget to be cautions of their surroundings.

In order to take all risks into account a risk assessment will be drawn up and appropriate measures will be put in place to minimise any risks existing or foreseeable.

Ethical Issues - 2.2

In Britain, the British Board of Film Classification (BBFC) has become the standard and accepted regulatory body of films. Although the power to ban, pass, or cut films in fact still remains with local councils, the BBFC is seen as the official regulatory body. Therefore, this short film will be created to be viewable by all ages under the guidelines set out on their website.[2]

As well as adhering to the BBFC's film classification, the production of the film will also adhere to the Code of Conduct and Code of Good Practice of the British Computer Society. Some of the main points which apply to the project[3]:

- *In your professional role you shall have regard for the public health, safety and environment* – A risk assessment will be carried out prior to filming. There are no environmental issues for this project.

- *You shall have regard to the legitimate rights of third parties* – Any members of the public, including actors filmed in the project will be asked to sign release forms giving their permission for their images to be used.

- *You shall conduct your professional activities without discrimination against clients or colleagues* – All relevant laws will be followed.

- *You shall seek to upgrade your professional knowledge and skill, and shall maintain awareness of technological developments, procedures and standards which are relevant to your field* – The project will require the author to upgrade his knowledge and skill in a variety of different means.

- *You shall accept professional responsibility for your work and for the work of colleagues who are defined in a given context as working under your supervision* – All work done for this project will be the responsibility of William Towle.

Risk Assessment – 2.3

The risk assessment for this project must be low to allow it to proceed. There are only minimal risks involved in creating this project and these are all during the on location filming:

- Tripping over cables
- Operating in or near a road
- Weight of cameras
- Falling off a ladder

To combat these four risks the following measures will be in place during filming:

- A single camera will be used powered by battery, so no cables will be present
- An extra helper will be on location with the team to keep a lookout for cars and other possible risks
- All camera operatives will have been appropriately trained by the MTL Live team (Media Technology Labs) at the University of Sussex
- The ladder will be checked before use for any defects, and the actor using the ladder will be asked not to jump off any rung higher than the third step

With these safety measures in place the project can be classed as very low risk.

Copyright – 2.4

When a film, book or information is formulated by persons that media is automatically under copyright to the persons who created it.[4] Using media which is under copyright to another person could put the user in danger of facing legal action. Consequently, it is very important that this project does not infringe any copyright. It must be a entirely original piece of work.

REQUIREMENTS - 3

The requirement of this project is to make an Apache helicopter land in a given area, have a person exit the Apache and make their way away from the helicopter. This requirement will demand many technical aspects such as computer generated models, colour correction and rotoscoping. These technical elements all need to work together to produce a believable and entertaining output. The real goal of the project is to make the end user believe what they are seeing, the end user in this case being a viewer.

In industry the main factors which affect VFX shots are budget and time. Some of the best computer graphics in film are the shots which take hundreds of hours to create, huge amounts of CPU (Processing) power and a whole team of VFX artists. When planning a VFX shot the film producers always have to compromise between quality, cost and time. If a film had unlimited budget and time then amazing VFX shots could be created every time but no film has ever had unlimited budget or time. This is why, from time to time, it is possible to see VFX shots in films which look unbelievable, because the final output has been rushed or because the budget only allowed for a certain number of hours work on the shot.

This project has the same constraints, but on a much smaller scale. This project has a time constraint of eight working weeks which will need to be taken into account when planning the shots and what is possible in that time limit. If this project had unlimited time the final output would be considerably better than at the end of eight working weeks, but just as the major companies, a compromise will have to be made.

Another compromise this project will have to make is in terms of people and computing power. A VFX software house will have as many as 150 employees doing jobs such as 3D modelling, then animators will animate the model, someone will light it and someone else will composite the shot[5]. This project, on the other hand, will be carried out by just one person. Computing power is also an issue, for this project what is possible given the computing power available must be considered. It is no good creating an amazing 3D model which takes eight weeks to render.

REQUIREMENT ANALYSIS - 4

To fulfil the requirement there are two options. Either, a real Apache helicopter could be used or it could be computer generated. Using a real Apache helicopter is unfeasible for a number of reasons, firstly cost. An Apache AH-64 helicopter costs $18 million to buy and thousands of dollars more to run and maintain.

The second reason for not using a real Apache is Health and Safety. The chances of getting permission to land a helicopter on campus are zero and the risk assessment would be huge.

This leaves the project with only one option. The Apache will be computer generated using 3D software. However, only the helicopter need be computer generated, the background/location can be real footage. This will save time modelling, texturing and lighting a background 3D location and will also add realism to the scene.

The actor will have to be filmed both at the location and in front of a green screen. The actor jumping out of the helicopter needs to be filmed in front of a green screen and then composited into the location shot. The actor walking away from the helicopter will be filmed on location.

To make the scene even more realistic, research into the project requirements has been conducted and is shown overleaf. It is extremely important to research the helicopter itself, the environmental effects the helicopter has as it lands and what software will allow the project to be completed to the best possible standard.

PROJECT RESEARCH – 5

3D Modelling – 5.1

3D Modelling is the act of creating a representation of any object in 3D space. The object is made up of polygons - a geometric term for a two-dimensional area[6]. The minimum number of coordinates required to define a polygon is 3 (a triangle). Polygons can contain an unlimited number of coordinates and be irregular in shape. These two-dimensional shapes are joined in 3D space to make 3D objects. For example, the cube shown in figure 5.1.1 is in fact six four sided polygons joined together.

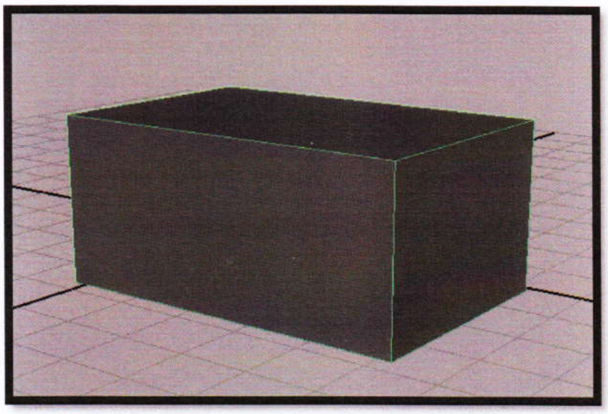
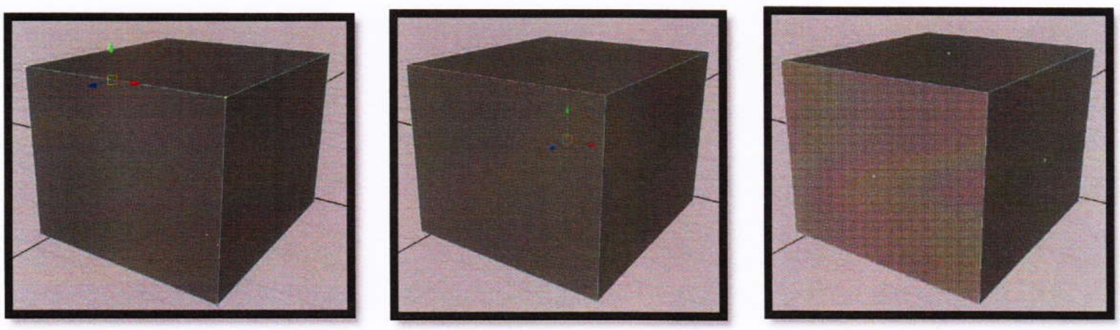


Figure 5.1.1 – A polygon cube

Polygons are comprised of vertices, edges and faces as demonstrated in Figure 5.1.2.



Vertices Selected Edge Selected Face Selected

Figure 5.1.2 – Polygon composition

3D Modelling is a vital element in this project because it is the only way to realistically embed an Apache Helicopter into the scene.

The helicopter will be created starting from a box as shown in figure 2 and developed through a variety of 3D modelling techniques such as extrusion, split polygon and cut faces. These techniques will be explained later in the report.

3D Software Comparison - 5.1.1

There are many 3D modelling packages on the market today, but the two main players are Autodesk 3DS Max and Autodesk Maya. In recent years 3DS Max has become extremely popular in the architectural industry and Maya is more often than not the choice for Film and Television visualisation.

From personally testing each product, in my opinion Maya has the better workflow and has powerful particle effects which could be utilized in the project.

As for 3D modelling potential, both programs perform similarly and can create almost any given object to a high standard. But Maya excels when it comes to NURBSs (Nonuniform rational B-spline) modelling, a type of modelling that Max makes extremely difficult by comparison.

Lighting and texturing possibilities are similar in both programs so for the advantage of workflow and particle effects Autodesk Maya will be used for all 3D Modelling, Texturing and Animation in this project.

Figure 5.1.1.1 – Autodesk 3DS Max logo

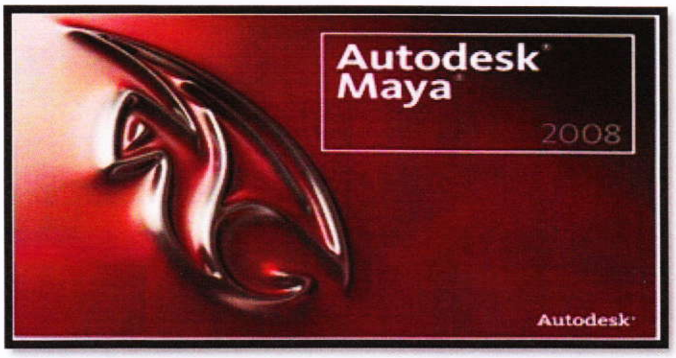


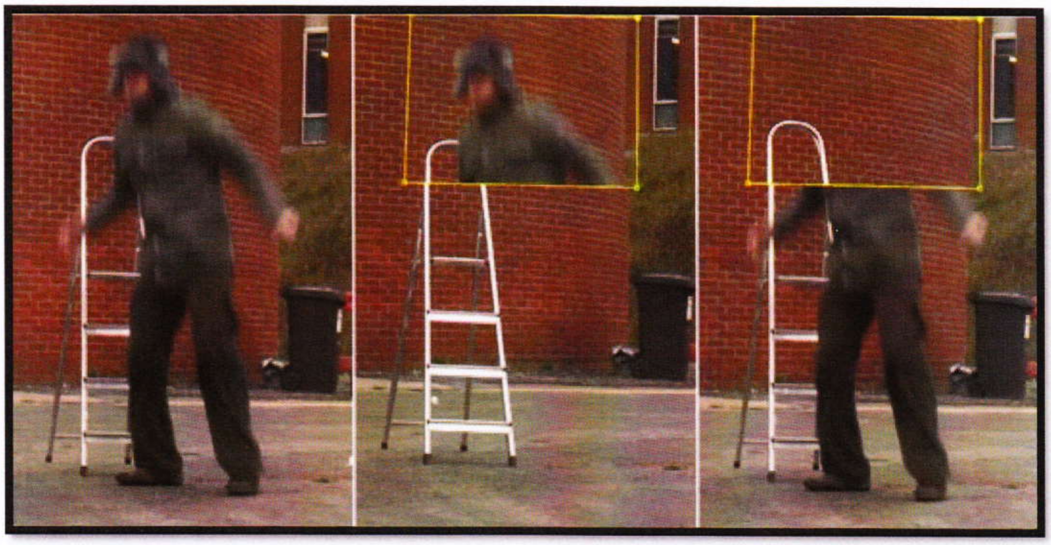
Figure 5.1.1.2 – Autodesk Maya logo

Compositing - 5.2

Compositing is the process of taking the individual components which are intended to make up a single shot and editing them together. For example, taking the images of the 3D helicopter and putting them on the filmed background of the location shoot.

There are a few main tools and methods which will need to be used in the compositing stage. These are:

- **Rotoscoping** – Rotoscoping is the process of drawing a mask (or line) around an object in your scene. This mask can then be told to add or subtract from the footage, as in figure 5.2.1.



No Mask *Add Mask* *Subtract Mask*

Figure 5.2.1 – Rotoscoping example

- **Colour Correction** – Colour correction involves taking the different components which are included in a single shot and altering the hue, saturation, brightness, contrast and RGB (Red, Green and Blue) values of the different components so that they appear to belong in the scene together.

- **Alpha Maps** – Alpha maps are black and white representations of images in a scene. For example, if there was an image of a man on a black background, it is possible to duplicate the image and make the man solid white and leave the background black. White, in terms of an alpha map means 100% opacity and black means 100% transparency. So, in this case, when the unaltered imaged was instructed to use the alpha information of the altered image the man would appear unchanged but now any background could be applied over the black background. An alpha map is shown in figure 5.2.2.

A teapot *A teapot's Alpha Map*

Figure 5.2.2 – Alpha map example

- **Keying** – Keying is a process used when green screening is involved. To remove the green screen from the shot it needs to be keyed out. This involves instructing the software being used to remove any pixels of a defined colour and to replace them with transparency. This allows any background to be applied in place of the green screen. See figure 5.2.3.

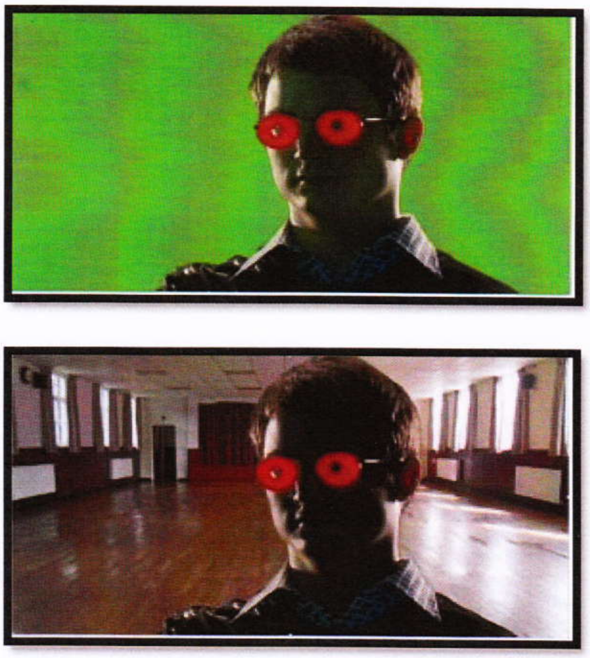


Figure 5.2.3 [7] - *A before and after green screen shot taken from the film Sin City*

Compositing Software Comparison – 5.2.1

There are three main options for the compositing software, and these are:

- Adobe After Effects
- Combustion
- Nuke

Adobe After Effects is the best known compositing software available on the market today[8]. Also, many training videos are available for After Effects created by Adobe and by other users of the software which could be helpful since I have no experience with any of the software.

Combustion is generally considered a very powerful program, but it does involve a steep learning curve and since I have never used it before, I think it would be unwise to step into a new program at the beginning of the project. Another point to consider is the University has no licence for Nuke or Combustion so it is for this reason I will be using Adobe After Effects for the project.

Animation - 5.3

To animate the helicopter, video references of Apaches in flight will be required, in order to copy their movement exactly. It is very important for realism to make the craft look as though it has weight and moves how the viewer would expect a helicopter to move.

The animation will be done within the chosen 3D Modelling package, in this case, Autodesk Maya.

The BBC Motion Gallery has two excellent videos[9] of Apache's in flight, which will be used as reference.

There are also numerous videos on YouTube with useful motion references.

Camera matching – 5.4

Camera matching is the process of tracking defined points in recorded footage. These tracking points then become markers in 3D space when imported into a 3D modelling package such as Autodesk Maya. These markers are used to align 3D objects in the scene and lock them down so they appear to apart of the original footage.

For the camera matching process 2d3's Boujou software will be used. Boujou is widely used in blockbuster films[10] and is the only tracking software available for the project.

PROBLEM AND SOLUTION ANALYSIS - 6

In this project there are some main problem areas which need to be addressed. These are:

- *The Apache Helicopter*
- *Camera-matching the helicopter into real footage*
- *The Pilot*
- *The Environment*

Below is an in-depth consideration of how these problems will be tackled and will form the basis of the requirement specification.

The Apache helicopter will be modelled, textured, lit and animated in Autodesk Maya. The helicopter needs to be close to photo-realistic for the purposes of the scene and this means modelling a 'to scale' helicopter and using a mixture of real and procedural textures.

The lighting on the model is also of paramount importance because no matter how good the model and texturing is, if the lighting is wrong it will not fit into the scene as though it is really there.

Camera matching the helicopter into the film to a high standard is extremely important. If the helicopter is not properly camera-matched it will look as though it is slipping over the screen. Tracking software made by 2d3 will be used for camera-matching. Boujou is an 'off the shelf' software solution used mainly in the TV and video effects industry. 7

The pilot has to be a real actor due to time and realism constraints. To create a realistic character in a 3D program would take more than the allocated time for the project. The solution is to record two sets of footage and also have some rendered 3D footage.

One set of the footage will be on location at the 'landing' area. The second set will be in a studio with a green screen. The actor will be filmed walking away from a helicopter that is not really there on location and in front of the green screen he will act out jumping down from the helicopter. The rendered footage, along with the two other pieces of footage will then be composited together in Adobe After Effects.

The environment needs to react to the presence of the helicopter. Everything must be taken into consideration such as dust blowing, leaves blowing,, reflections in glass and most importantly, shadows.

The leaves blowing will be simulated by using leaf blowers provided by the University Estates Team. Shots will be taken of people blowing leaves, probably 2-4 shots to simulate the leaves being blown in a circle and then a background matte will be created by compositing out the people and compositing the shots together.

Shadows for the helicopter will be rendered out using Autodesk Maya. These shadows will be rendered out in two passes, one for the shadows the helicopter casts on itself and one for the shadows being cast on the environment. This gives greater control of shadow density and colour in compositing . After the shadows have been rendered out they will be composited into the scene using Adobe After Effects.

From experience filming, if the exposure on the ground is good, more often than not the exposure in the sky is not so good, or vice versa. To combat this, a matte sky will be filmed, camera-matched and keyed into the scene.

All filming for the project will be done using a Sony PMW EX3 in 1920x1080 resolution for a high-quality, high-definition final output.

3D Modelling - 6.1

Figures 6.1.1 – 6.1.5 are main reference pictures which will be used to produce a realistic Apache helicopter:

Figure 6.1.1 – An Apache helicopter from the side

(See Appendix One Fig. 6.1.1 for high res)[11]

Figure 6.1.2 – An Apache helicopter from the front/side

(See Appendix One Fig. 6.1.2 for high res)[12]

Figure 6.1.3 – An Apache helicopter from the front

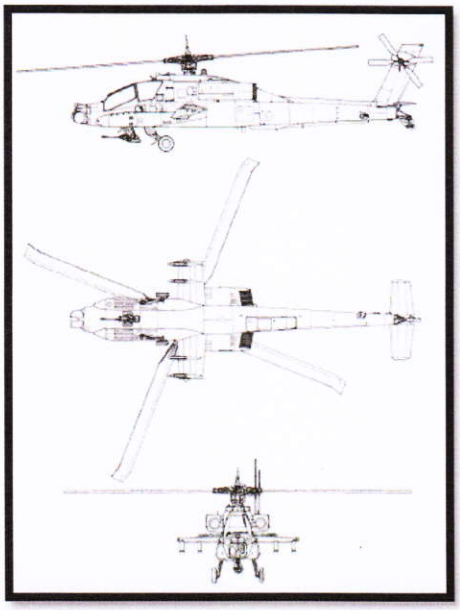
(See Appendix One Fig. 6.1.3 for high res)[13]

Figure 6.1.4 – An Apache helicopter from the side/behind

(See Appendix One Fig. 6.1.4 for high res)[14]

These are high-resolution pictures and they show all views of the aircraft. These pictures can be used as references for shape, colour, basic movement and detail. The pictures on their own, however, are not enough to produce a believable Apache helicopter. To create a believable Apache, side, front and top references images will be required as well as exact measurements.

These are the reference images which will be followed throughout the modelling process along with those shown above.



[15]

Figure 6.1.5 – An orthographic projection of an Apache helicopter

(See Appendix One Fig. 6.1.5 for high res)

As previously stated, measurements will also be required; the following are the specifications of an actual Apache Helicopter:

General	
Country Of Origin	USA
Type	Attack Helicopter
Manufacturer	The Boeing Company
Dimensions	
Main rotor diameter	15.25 m (50.0 ft)
Tail rotor diameter	2.89 m (9.48 ft)
Overall length (turning rotors)	17.74 m (58.2 ft)
Height	4.64 m (15.24 ft)
Fuselage width (at engine nacelles)	2.82 m (9.25 ft)
Wing span	4.99 m (16.37 ft)

[16] [17]

Storyboarding – 6.2

The storyboarding for this project went through many phases. The earliest storyboard, v1, (Fig. 6.2.1) comprised six shots and a total time of 25 seconds. After analysing the time constraints it was decided six shots was too many to get looking professional and to the high quality this project demands. See figure 6.2.1.

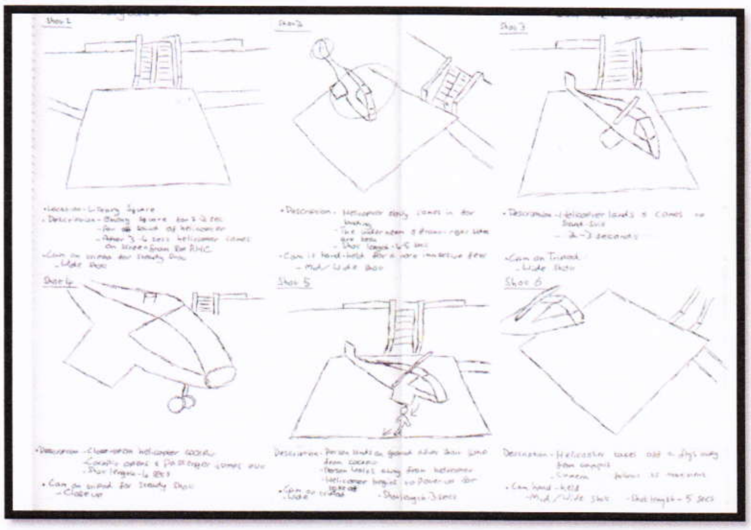


Figure 6.2.1 – Storyboard V1

(See Appendix One Fig 6.2.1 for High Res Version)

Storyboard v1.1 (Fig. 6.2.2) was cut down to just three shots and the planned location was changed from v1. The length was still 25 seconds but after close inspection shot 2 had to be changed because the angle of the helicopter was wrong. See figure 6.2.2

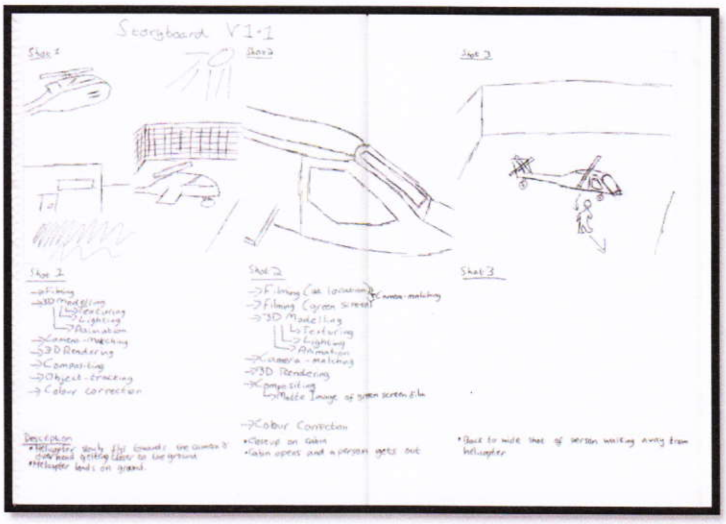


Figure 6.2.2 – Storyboard V1.1

(See Appendix One Fig 6.2.2 for High Res Version)

Storyboard v1.2 (Fig. 6.2.3) was again comprised of the same three shots but with shot 2's angle fixed. After careful analysis of this storyboard it was determined an extra shot was required between shot 2 and shot 3 to make it cut correctly. See figure 6.2.3.

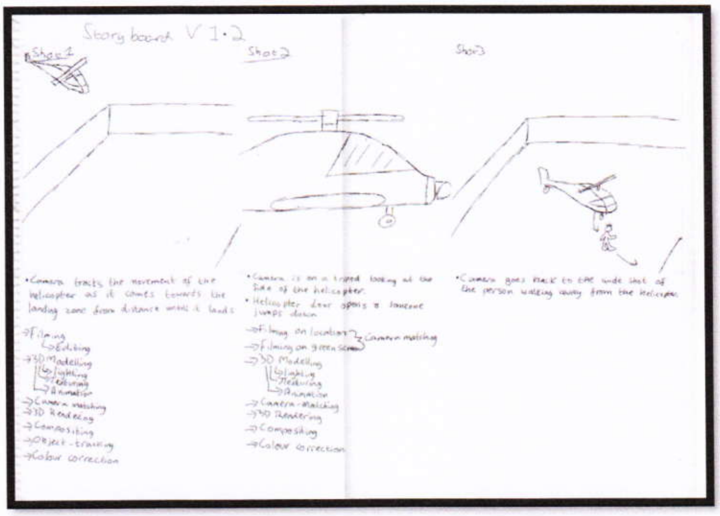


Figure 6.2.3 – Storyboard V1.2

(See Appendix One Fig 6.2.3 for High Res Version)

Storyboard v1.3 (Fig. 6.2.4) is a storyboard made up of photos taken during location scouting combined with actors and the 3D model of the Apache thus far. This storyboard depicts the location and exactly what angle the camera will be filming at. It also helps gauge if the scale of the Apache is correct in comparison with the environment. See figure 6.2.4.

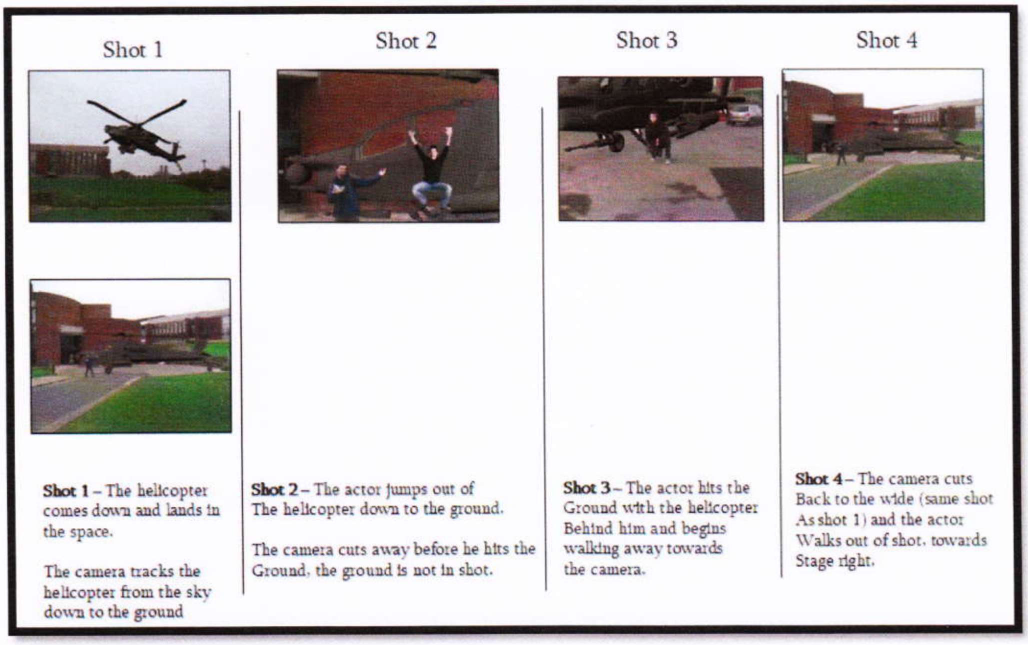


Figure 6.2.4 – Storyboard V1.3

(See Appendix One Fig 6.2.1 for High Res Version)

Filming Requirements – 6.3

Each shot necessary for this project requires a different set of requirements. This section will break down each shot into its composite components.

Shot 1 – 6.3.1

1. Panning camera shot from sky to landing location

    1.1 Actor standing looking at the helicopter

    1.2 As camera pans to location, camera is locked off

    1.3 Blow leaves with leaf-blower

2. Camera match helicopter in scene

3. Animate the helicopter

4. Render the scene

5. Import new sky

6. Add shadows, reflections and dust particles

    6.1 Leaf blowing shot will be edited and composited together

7. Colour correction

8. Sound (Extra feature time permitting)

9. Final output

Shot 2 – 6.3.2

1. Close-up on the cockpit of the helicopter

2. Composite helicopter into scene

3. Animation of the cockpit door opening

4. Actor jumps out the cockpit towards the ground

    4.1 Actor jumping filmed against green screen

    4.1 Green screen film camera matched

5. Rotoscoping

6. Rendering

7. Add shadows, reflections and dust particles

8. Colour Correction

9. Sound (Extra feature time permitting)

10. Final Output

Shot 3 – 6.3.3

1. Close-up on ground as actor hits the floor and walks away

2. Composite helicopter into scene

3. Rotoscoping

4. Rendering

5. Colour Correction

6. Sound (Extra feature time permitting)

7. Final Output

Shot 4 – 6.3.4

1. Wide on actor walking away from the helicopter

2. Composite helicopter into scene

3. Rotoscoping

4. Rendering

5. Colour Correction

6. Sound (Extra feature time permitting)

7. Final Output

PROJECT PLAN - 7

There are many key stages within this project which depend on other stages being completed before they can begin. To ensure the project is being executed in tune with the inter-dependencies of the stages, and to ensure no time is wasted completing tasks which will have to be redone later if done at the wrong time, a Project Flowchart has been created. This is shown in figure 8.1.1.

Project Flowchart - 7.1

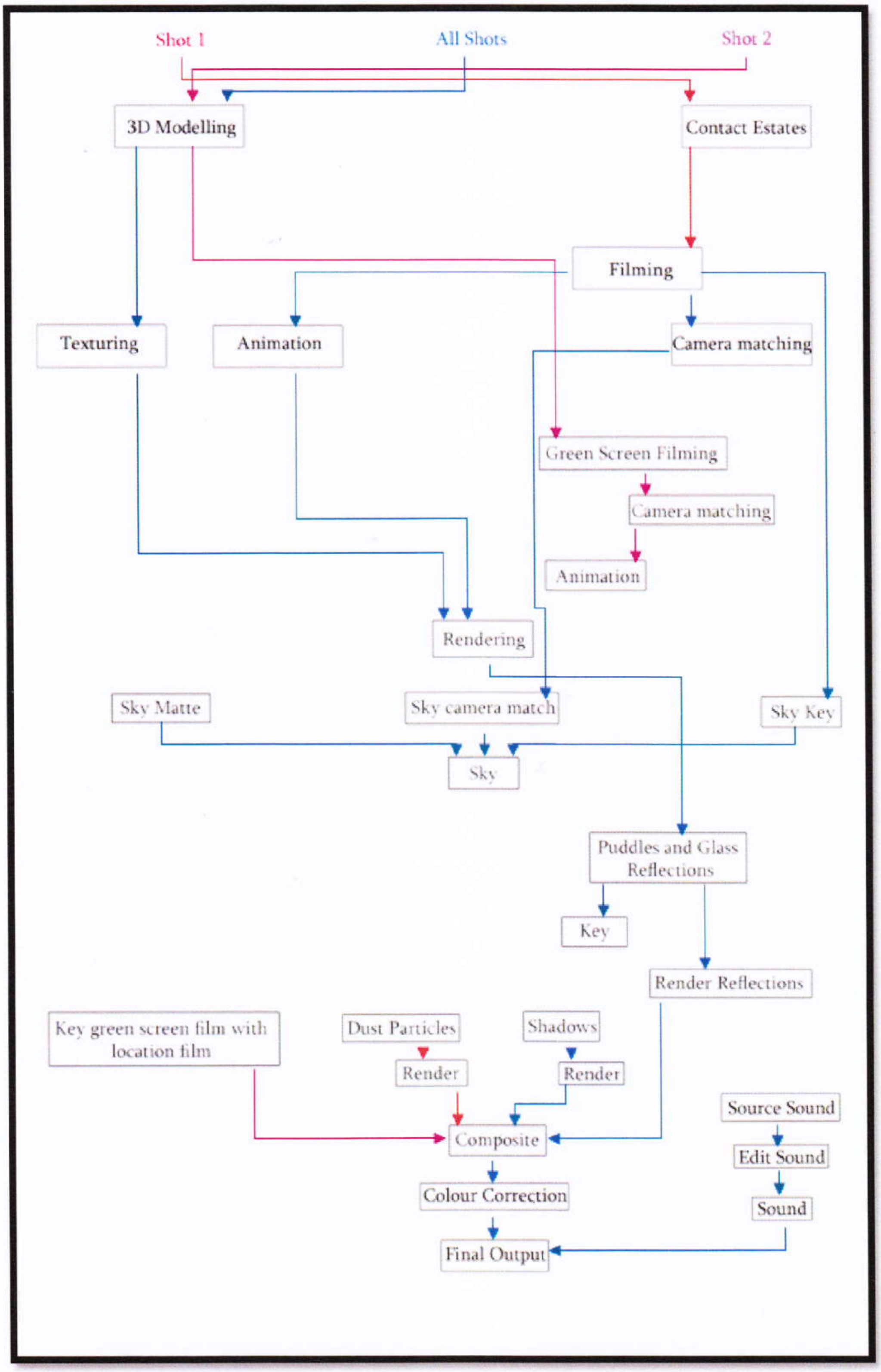


Figure 8.1.1 - *Project flowchart*

Project Flowchart Breakdown – 7.1.1

Shots 1 and 2 are broken down separately in this Flowchart because they require specific components for each shot, as well as components that all the shots need. Shots 3 and 4 are broken down under the 'All Shots' heading as well as the components for Shots 1 and 2 that are common to all the shots in the project.

Which shots the numbers refer to can be found by looking in appendix one, storyboard figure 6.2.4.

Shot 1 Breakdown – Filming for Shot 1 is totally dependent on contacting the University Estates Team has obtain a leaf-blowing machine.

The only other section of the flowchart which is dedicated to Shot 1 is the addition of dust particles to the composite film.

Shot 2 Breakdown – Shot 2 requires the green screen, which is the big difference between this shot and the rest of the project. The first requirement for shot 2 is the completion of the 3D Modelling. After this has been completed, the green screen section can be filmed, camera-matched and rendered.

Later in the project the green screen filming has to be keyed with the on location filming.

All Shots Breakdown – These sub-sections are requirements for all the shots in the project. Every shot requires 3D modelling and filming. After the 3D modelling has been completed, the texturing and rendering can occur, but only after camera-matching, following on from the filming and animation.

After filming, the flowchart can be followed down to keying and camera-matching the new sky from the filming camera-match. These two components plus the Sky Matte all go into creating the new sky.

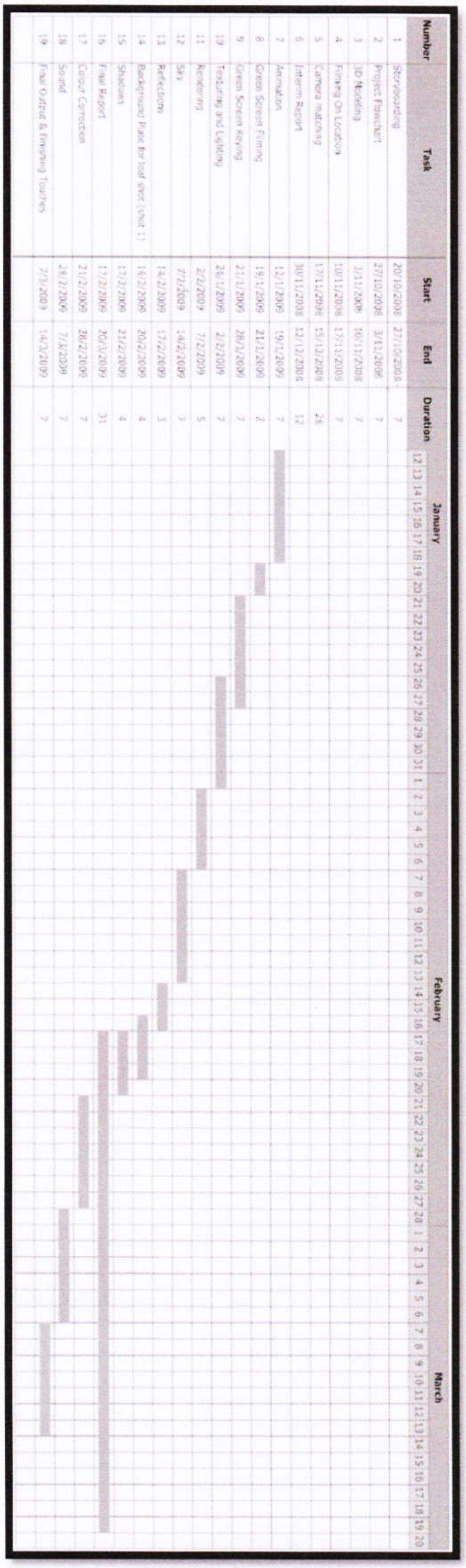
The composite for the project is made up of the dust particles render, shadows, sky and the green screen keying.

After the composite has been created and finalised it can be colour corrected and then sound can be recorded and edited into the scene to create the Final Output.

Gantt chart – 7.2

Another key area of project management is time. This project must be completed within a very strict time scale and to ensure this is done, a Gantt Chart has been drawn up specifying exactly how much time can be spent on each part of the project. If one particular part of the project takes longer than anticipated, that part will have to be put aside and the next part must begin on schedule. In this scenario, hopefully a section will take less time than anticipated and a previous, unfinished section can be completed in the extra time.

The Gantt Chart for the project is shown in figure 7.2.1.



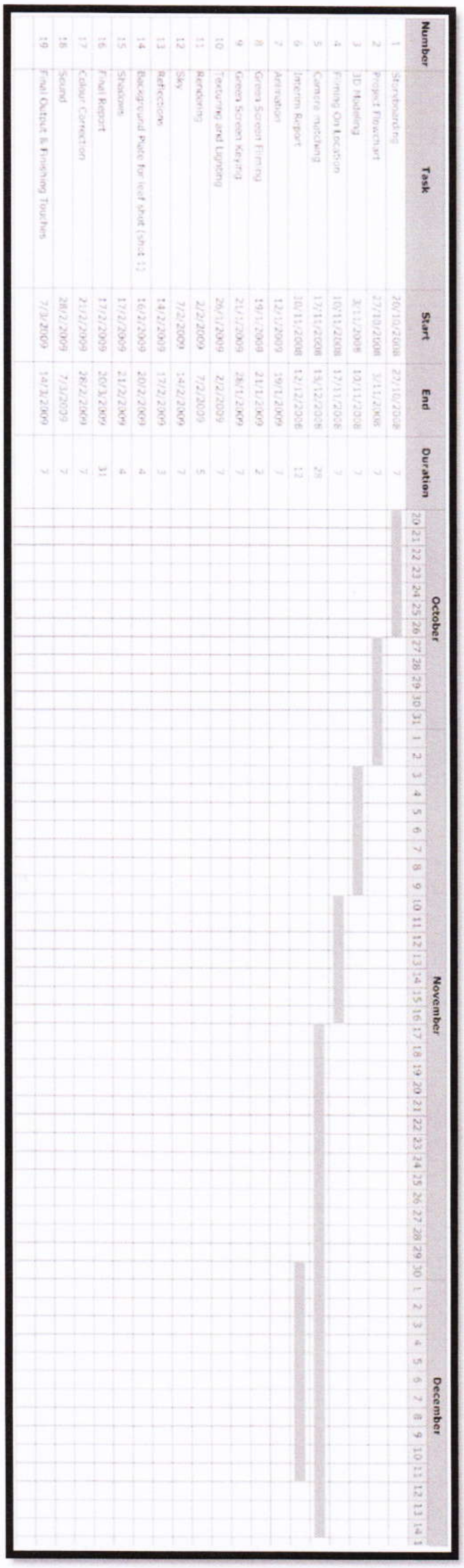


Figure 7.2.1 - *Project Gantt chart*

(See Appendix Fig. 7.2.1 for High Res. Versions)

Contingency – 7.3

This section outlines contingency plans for unforeseen circumstances occurring during filming or working on effects in post production. Contingency plans should decrease the amount of disruption of any such occurrences.

For this project there are two main areas where contingency plans will need to be devised. The first is during filming. Three out of the four shots needed for the project must be filmed outside, this poses a problem in terms of the weather conditions. If it is too cold or raining filming cannot take place. It is therefore important to book more than one day for filming so there is a better chance of good weather. Weather forecasts will also be closely monitored in the run-up to filming days but of course, these are not always accurate.

The second area where contingency is needed is with data storage. Every section of the project will be stored on computer and, from time to time, computers malfunction and data can be lost. It is therefore essential that multiple, regular, secure backups are kept.

IMPLEMENTATION - 8

Filming – 8.1

To ensure filming was as quick a process as possible, every part of the filming process was planned in detail. The shots to be taken were mapped out by the storyboards created above and to make sure each frame captured in the filming process was exactly what was required, rough footage was filmed before the official day of filming. This rough footage was followed to ensure the correct shots were taken on the day.

A week before filming the Estates Team at the University of Sussex was contacted to enquire into the leaf-blower. The Estates Team offered to lend the project a machine for the day and agreed to train one of the filming team in health and safety and correct procedure while in use of the leaf-blower.

Leaves were collected before the filming and stored in a cool, dry place to ensure they would be dry by the time of filming. Wet leaves would not have been blown by the leaf-blowers as well as dry leaves and, for matching environmental conditions, it is better to have dry leaves and need wet leaves, than have wet leaves and need dry leaves.

The location of the shoot was scouted and it was decided tracking markers were needed for shot 1. The weather forecast for the day of the shoot was 17mph winds. Normally, the tracking markers would have been table-tennis balls but due to the wind, golf-balls were bought and stuck down to square cardboard bases to stop them blowing away in the wind and from being blown away by the leaf-blower later in the shot. See figure 8.1.1.

Figure 8.1.1 - *Golf ball glued to cardboard base*

Twelve tracking markers were placed throughout the shot, in the foreground, mid ground and background of the shot to allow tracking of depth. Each marker was measured from two immoveable objects in the scene to get an x and y coordinate for each marker.

Another two markers were put in the scene to mark out the length of the Apache helicopter. These markers, along with shots taken with the actor in, will be used to obtain the correct scale of the Apache when compared to the environment.

The plan had been to film reflections for the scene by rotating the camera 180 degrees and compositing that footage into the shot as reflections in the helicopters windows. Unfortunately, despite having booked the use of the area with the University Estates Team, we were moved on early by security due to there being busses that needed to use the turning circle. Due to this, reflections from recorded footage will not be possible in the project.

The green screen filming was done in the studio and was in fact done in front of a blue screen due to the actors choice of clothing for the outside shoot (he wore green and you can't film a person in green in front of a green screen). For this shot the actor needed to appear to be piloting a helicopter and jumping down from the cockpit after landing.

The studio was lit as closely as possible to the outdoor scene using two spotlights with gauze covering the bulb to make it a softer, more ambient light.

The actor was instructed on how to perform the actions and three takes were filmed. A table was used as the platform for the actor to sit on and jump off and this will have to be removed in the compositing stage. Figure 8.1.2 shows the actor infront of the lit blue screen.

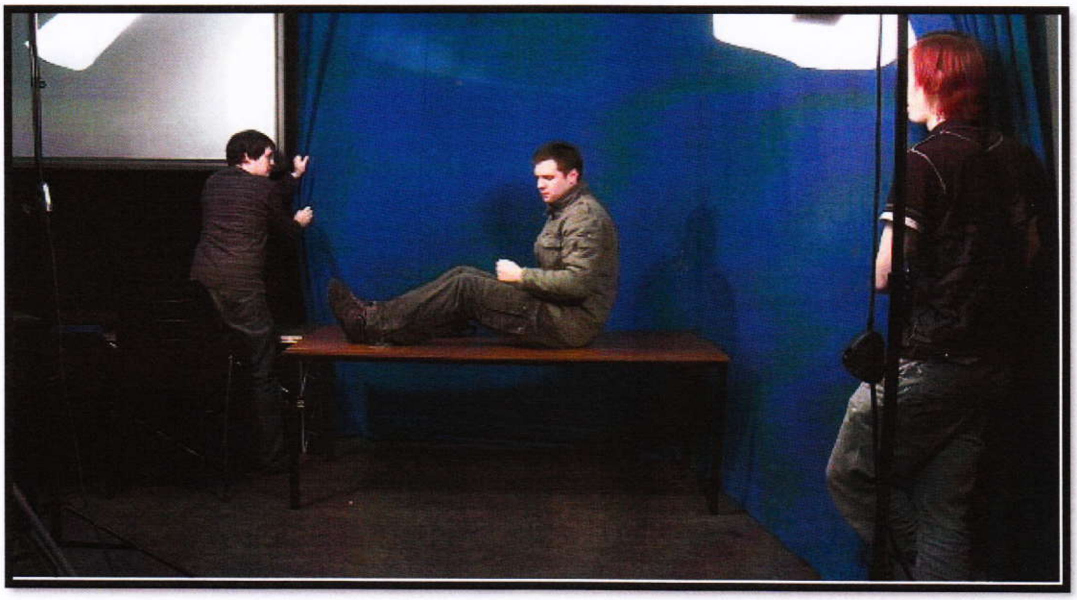


Figure 8.1.2 – The blue screen filming session

Editing – 8.2

The next stage after filming is capturing and editing the footage. The footage is transferred onto Mac Pros in the University edit suite. In the past, video would have had to have been converted from an analogue tape to digital format, this is a process called capturing. Now however, tapes do not have the required storage capacity for HD footage and the footage was filmed straight onto flash memory. This is called ingesting.s

After transferring the data to the Macs, the footage was transferred to a Pc for editing with Adobe Premier Pro. In Premier, the unwanted video can be trimmed to leave just the footage required for the shots. Having unnecessary video in later stages could increase render times, having less video means smaller file sizes and reduced rendering times. Figure 8.2.1 shows the video being edited in Adobe Premier Pro.

Figure 8.2.1 - *Footage in Adobe Premier Pro*

Once editing is complete it must be exported as a file. For this project the footage for each shot was rendered as a series of uncompressed TIFF (Tagged Image File Format) images. It was important that the footage was rendered uncompressed so no image data was lost in the compression process. Another reason for rendering as images is, if Premier were to crash during rendering, all the TIFF files that had been rendered up to that point would still be stored on the system whereas if it was rendered as video and crash, all would be lost.

AUTODESK MAYA 2008 – 8.3

Autodesk Maya 2008 is a 3D Modelling, Rendering and Animating tool often used in the video effects industry. For this project only one 3D Model is required, but it needs to be textured, lit and modelled to a very high standard.

Earlier in the project, research was done into the dimensions and appearance of an Apache helicopter. These references were used to create a believable Apache helicopter in 3D ready to be composited into the scene.

Many techniques were used to model the Apache and as a matter of fact, two were modelled from start to finish. The most important reference for creating the Apache was Figure 5. This image was used as a template from which to create the bulk of the model.

The whole model began as a primitive object, a polygon cube, and was sculpted into the shape of an Apache using the tools provided by Maya.

The main tools used in the production of the Apache are as follows:

- **Extrude** – The process of extending a vertex, edge or face, thereby creating additional faces from surrounding faces.[18] See figure 8.3.1.

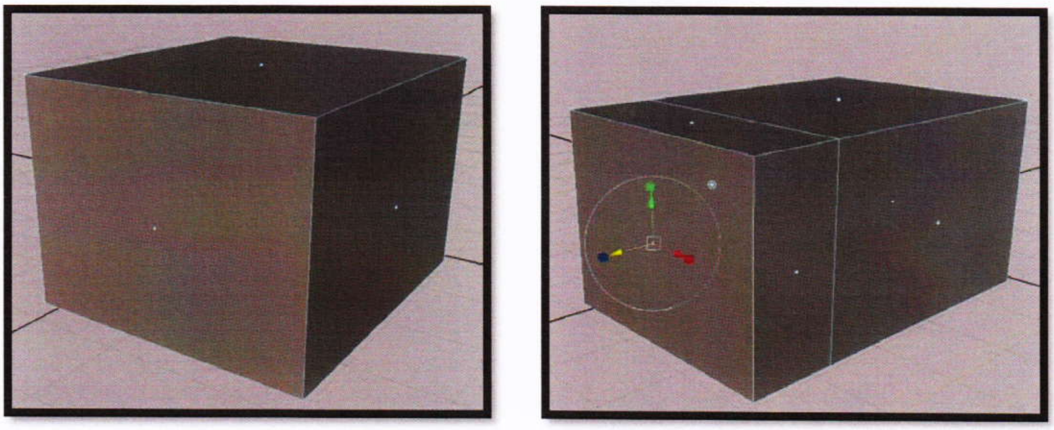


Figure 8.3.1 – Extrusion example

- **Split Polygon** – The Split Polygon Tool allows a polygon face to be split into one or more polygon faces by drawing a line across the faces to specify the location of the split.[19] See figure 8.3.2.

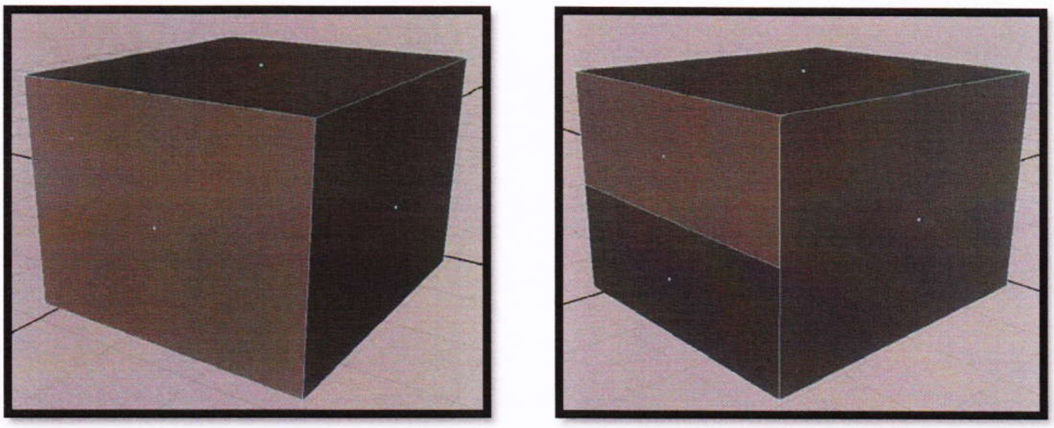


Figure 8.3.2 – Split Polygon example

- **Cut Faces** - Displays a cutting line which can be interactively position in the scene view to specify the location of the cut on the polygon mesh. Like the split polygon tool, but the cut will always be completely straight.[20] See figure 8.3.3.

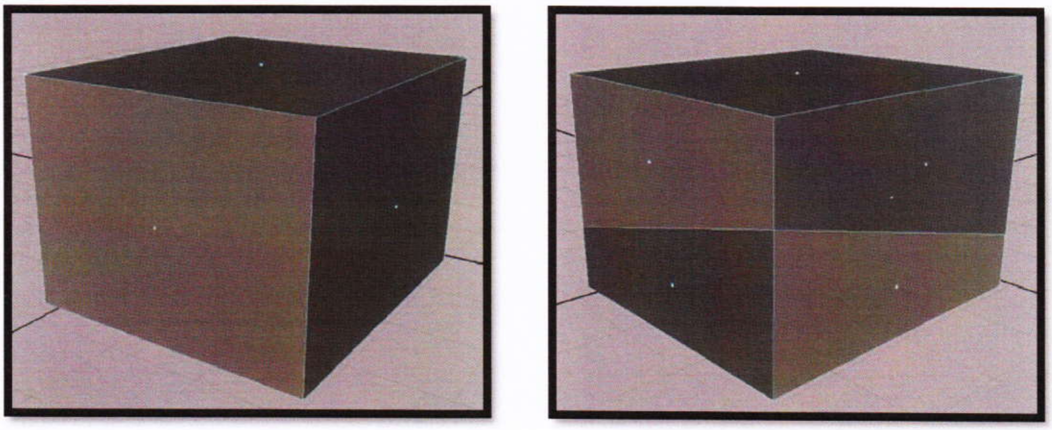


Figure 8.3.3 – Cut Faces example

- **Merge Vertices** –Vertices can be merged into a single vertex using the merge feature. When vertices are merged, coincident edges are also merged automatically (within a specified threshold). See figure 8.3.4.

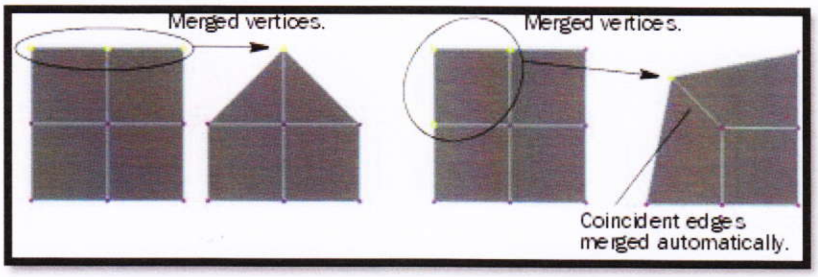


Figure 8.3.4[21] – Merge Vertices example

Along with these polygon modelling tools NURBS were used in part. NURBS stand for Non-Uniform Rational B-spline and they can be thought of as 3D vector graphics. They use a method of mathematically describing curves and surfaces by connecting recorded coordinates. This helps keep the polygon count of scenes down as a smooth NURBS use far fewer polygons than a polygon sphere of the same smoothness.

The Modelling Process – 8.4

One of the most important parts of the modelling process is also the first stage, setting up the blueprints inside the 3D application. The references picture from figure 6.1.5 was loaded into Maya to act as a template. See figure 8.4.1.

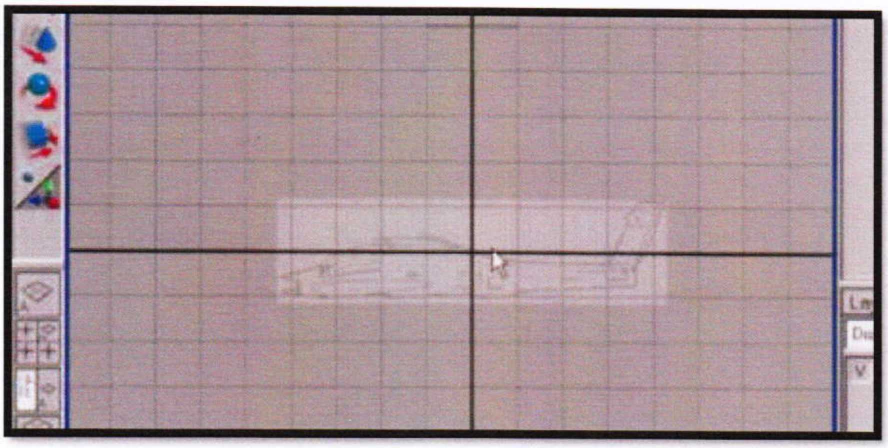


Figure 8.4.1 - *The reference plane within the Maya interface*

Then, a polygon cylinder was created and scaled to fit the tail of the Apache. In vertex mode, the front end of the cylinder was also scaled up to create a tapered effect and several cuts were made across the sphere so more definition could be added later. See figure 8.4.2.

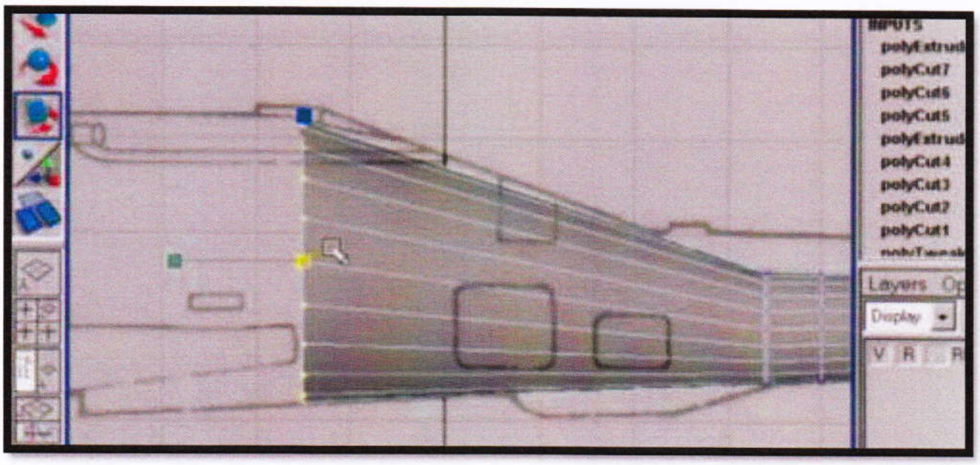


Figure 8.4.2 - *The cylinder being scaled to fit the outline of the Apache*

This mapped out the basic shape of the back end of the Apache. The end vertices were then rearranged and further extruded to create the front end of the Apache. The front end was then sliced to allow for greater manipulation and the template was followed to create the shape. See figure 8.4.3.

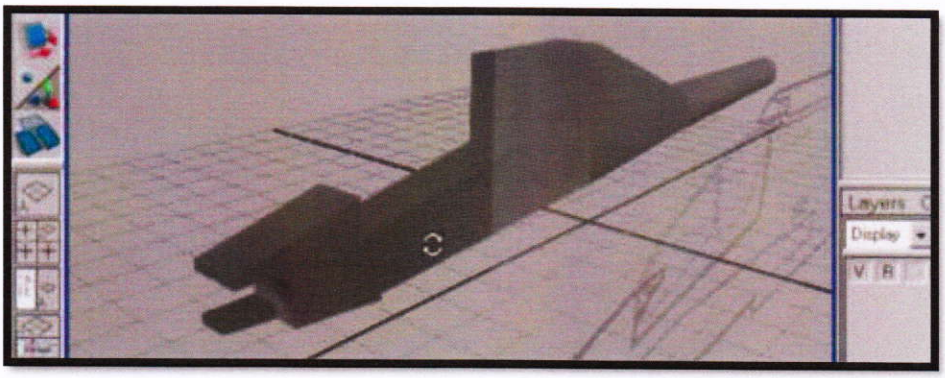


Figure 8.4.3 - *The basic body shape of the Apache*

To start modelling the inside and more detailed sections such as the air-intake on the roof of the helicopter the reference pictures were needed. More geometry was added to the roof section and a proxy copy of the helicopter was made. This proxy had a smooth and symmetry modifier added to it. The smooth modifier keeps to the shape of the geometry but more geometry is added to make, for example, corners smoother. The symmetry modifier mirrors the model and thus creates an exact replica of what is present, in this case, creating the left hand side of the Apache. Using a mixture of slice, cut faces and extrude, a basic shape for the interior and roof air intake were created. See figure 8.4.4.

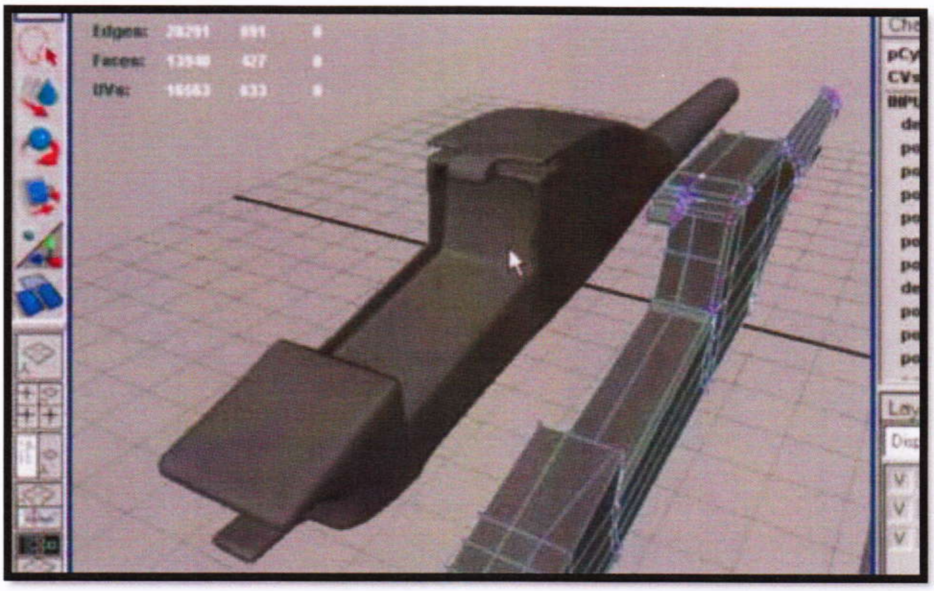


Figure 8.4.4 - *On the left, the smooth proxy with the symmetry modifier. On the right, the non-smoothed mesh*

More geometry was needed for the nose section of the helicopter and to create the landing gear encasings. The references pictures proved extremely important in creating these sections as they were very poorly depicted in the template. In the nose section a mixture of NURB's and polygon objects were used to create the require shapes. After referring to the reference pictures and adjusting vertices. Figure 8.4.5 shows the result.

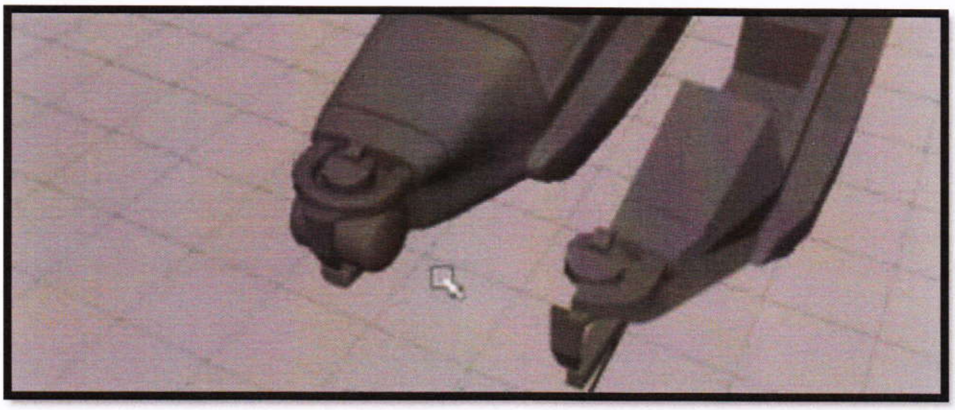


Figure 8.4.5 - *Modelling the nose of the Apache*

Onto the engines, the part of the engine which connects the engine to the helicopter was modelled first. A polygon cube was created and cut down each edge, see figure 8.4.6. One of these edges was then deleted to leave a triangular shaped object.

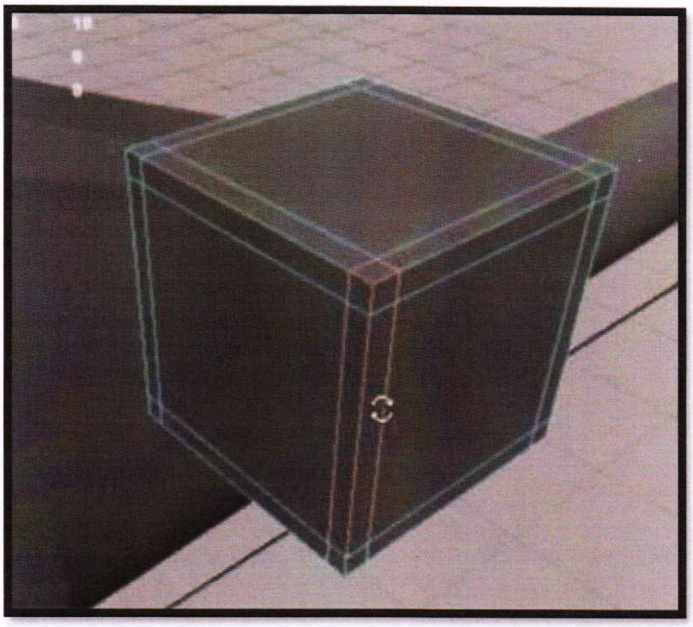


Figure 8.4.6 - *The cube to connect the engine to the body cut down each edge*

The insides of the engines was an extremely complicated piece. It involved cutting a cube into segments and scaling them to the edges of the cube, then, the rear face of the cube was extruded inwards and out of the other end of the cube. The whole cube was then scaled down width wise to turn it into a rectangular shape. This shape was duplicated twice to leave three copies of the object to act as the inner engines. The faces closest to each other were deleted to allow the objects to be 'welded' together using the merge vertices tool to make a single object. See figure 8.4.7.

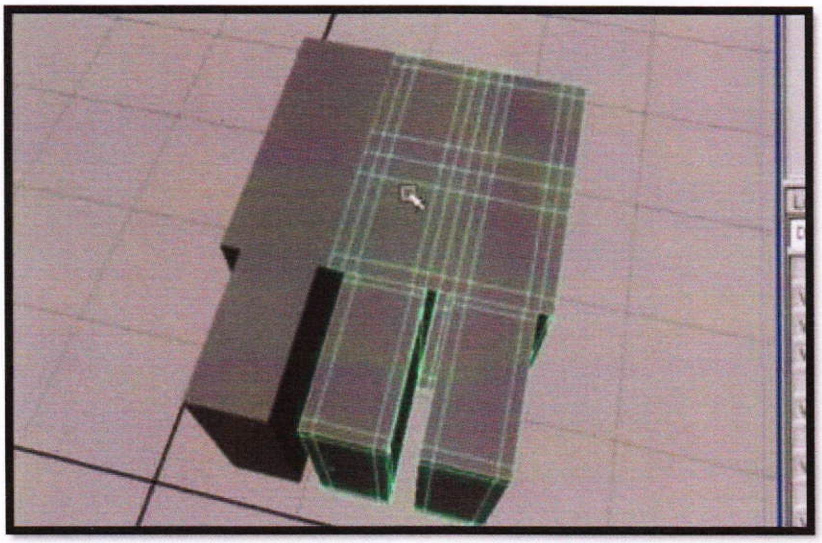


Figure 8.4.7 - *The inner engine being modelled*

The rest of the modelling process used all the tools listed above and the techniques discussed thus far. See figures 8.4.8 through 8.4.15 for screenshots of the rest of the modelling process.

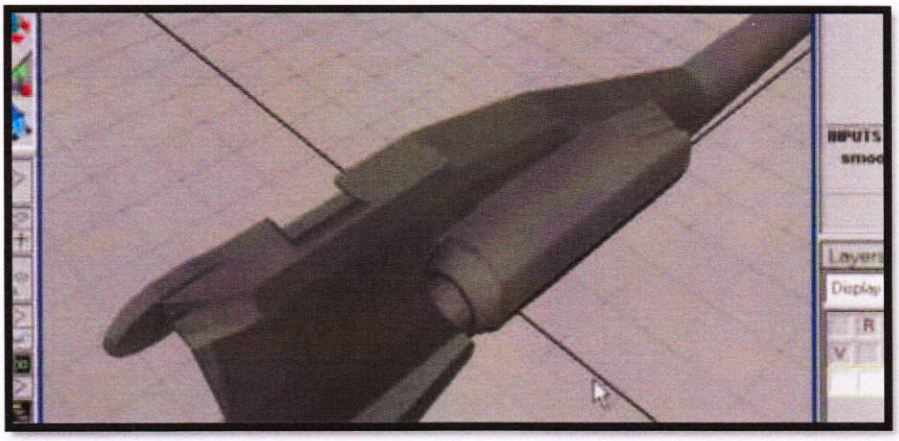


Figure 8.4.8 - *The engine connected to the body of the Apache*

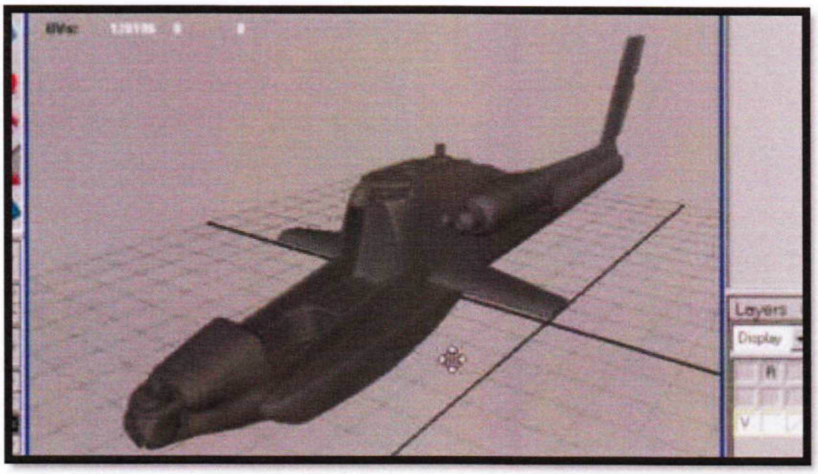


Figure 8.4.9 - *The smooth proxy with more detail and wings added*

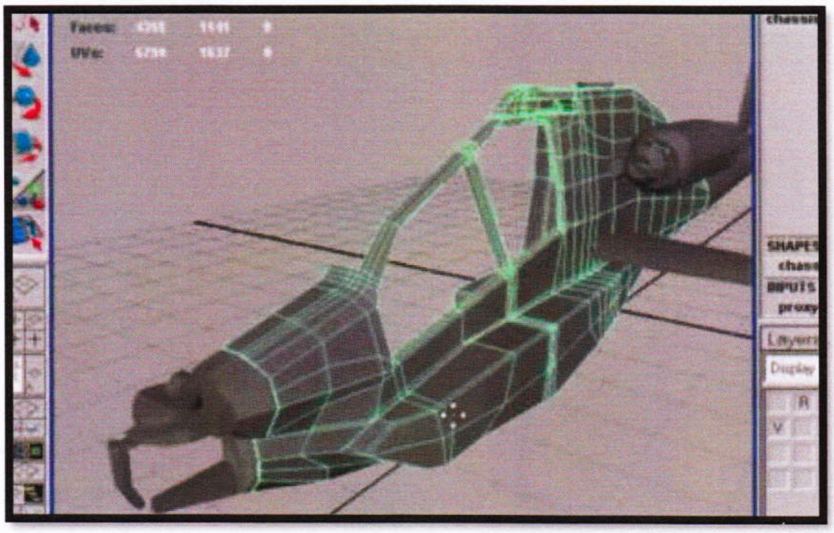


Figure 8.4.10 - *Adding more geometry to the body and creating the cockpit*

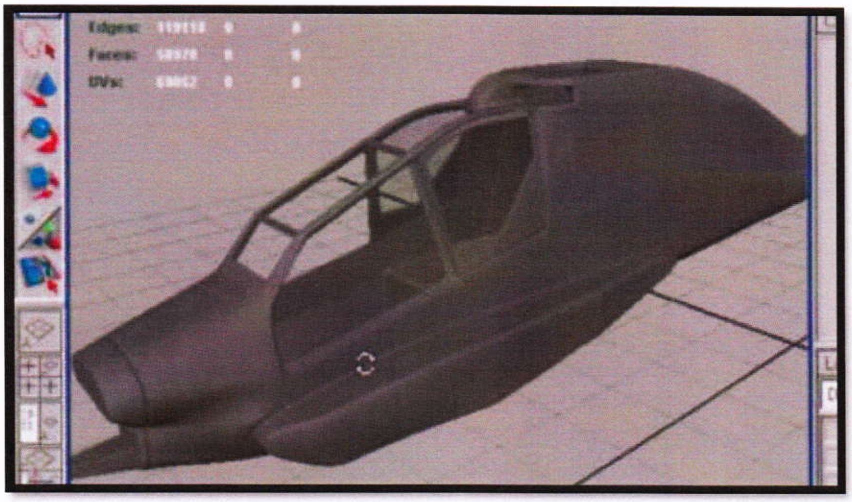


Figure 8.4.11 - *The completed and smoothed cockpit*

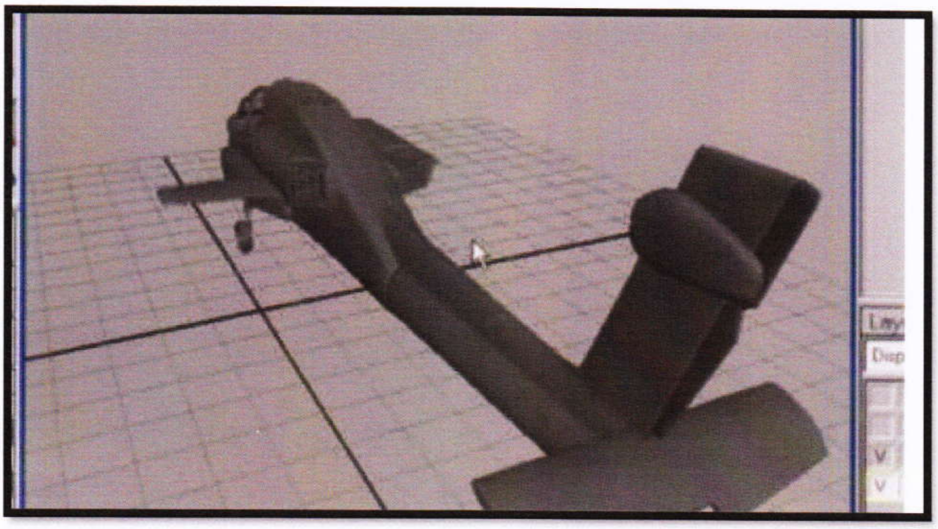


Figure 8.4.12 - *The tail section smoothed*

Figure 8.4.13 - *The apache weapons systems modelled*

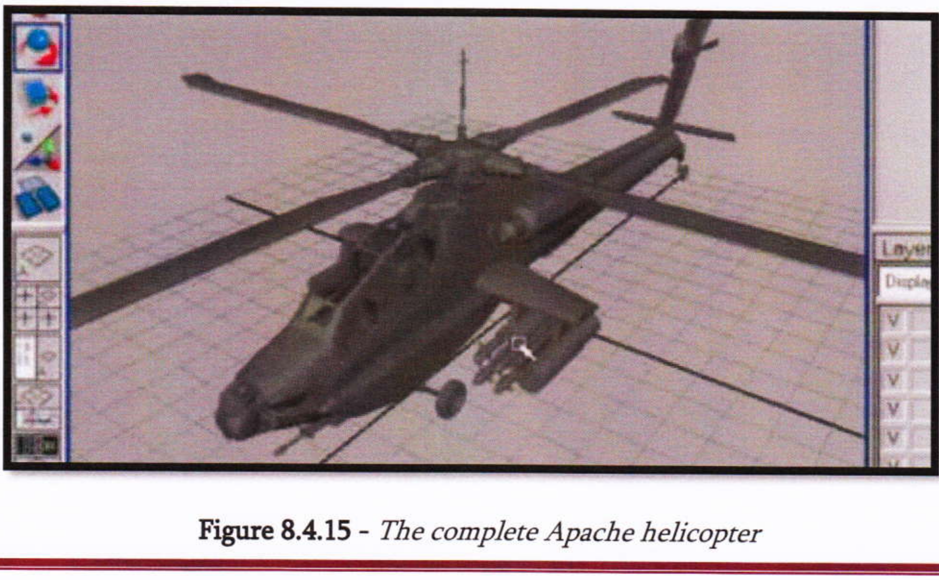


Figure 8.4.15 - *The complete Apache helicopter*

looking good.

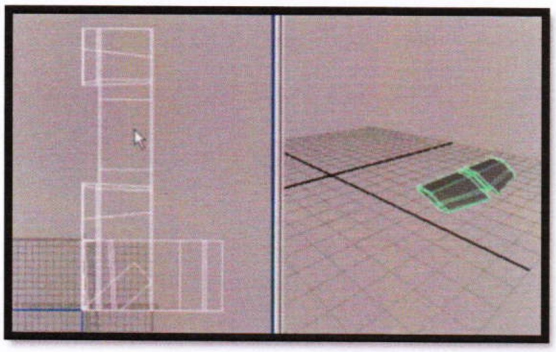
The Texturing Process – 8.5

After the modelling process was complete the Apache needed to be textured. From looking at reference pictures of Apaches on the internet a general idea of colour, specularity and bumpyness was obtained.

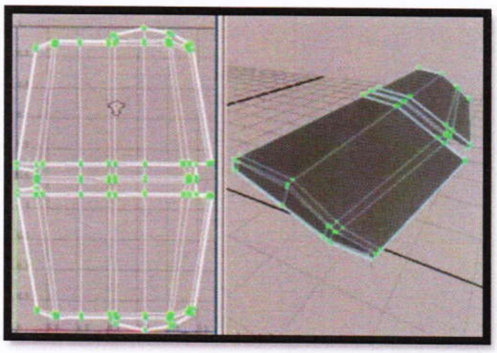
The way this is done is by laying out an objects UV texture map. UV's are two-dimensional coordinates that reside with the polygon information for a 3D surface. UVs control the placement of a texture map on a 3D model by correlating the pixel position of the 2D texture map to the vertex positions on the model so that the texture gets positioned (mapped) correctly.

Using Maya's UV Texture Editor 3D objects have to be broken into flat sections ready for the texture to be applied. There is no way to apply flat textures made in Adobe Photoshop straight to a 3D object. Each orthographic section of the object must be cut away from the rest of the object and 'stitched' back together to create a flat 2D template. For example, with the Apache, the left and right hand orthographic views were cut away from the top and bottom views. This allows for textures to be applied to all orthographic views but, there will be a seam between the right hand view and the top and bottom views, for example, where the two textures do not completely line up.

Figure 8.5.1 shows the UV's being laid out within Maya.



To the left, unmapped UV's and the corresponding 3D object on the right



To the left, the mapped UV's and the corresponding 3D object on the right

Figure 8.5.1 – UV unwrapping process

During the process of laying out the UVs a checkerboard texture is applied to the section of the model being prepared for texturing. This checkerboard will show if there is any warping or any seams present in the UV layout. UV's can warp when a smooth modifier is applied to the model and seams occur when UVs have been incorrectly stitched together or not stitched at all. The checkerboard map will make these stand out. See figure 8.5.2.

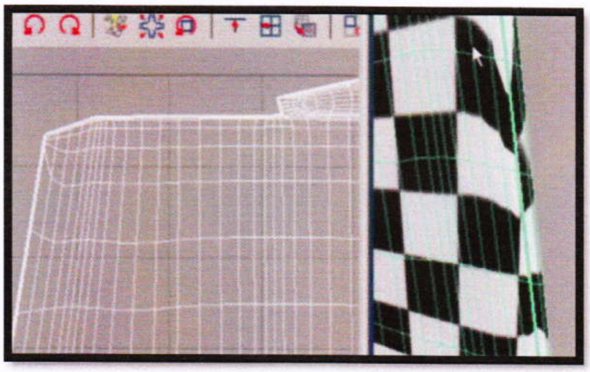


Figure 8.5.2 - *3D object with checkerboard map applied and texture stretching*

Once the UVs have been laid out they are then rendered out as images. These images are then taken into Adobe Photoshop to act as a template on which to draw the textures.

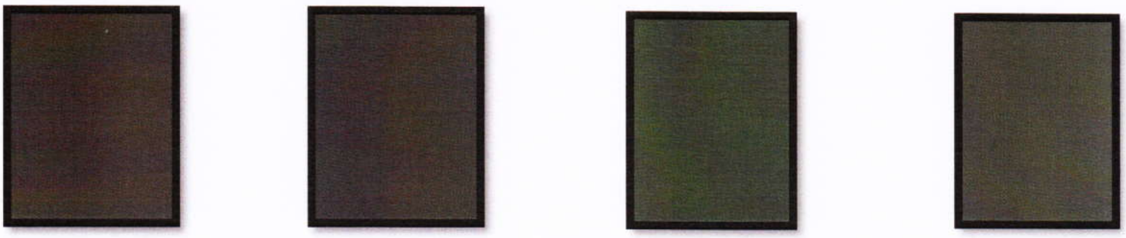
To create the textures a variety of Photoshop tools were used. These include:

- **Layers** – Layers are the single most important aspect of texturing in photoshop, without layers it would be impossible to build up a texture using different effects, layer modes and colours, all of which are essential for texturing.
- **Solid Colour fill** – This fills the selected layer or selection with a solid colour which can then be edited with effects, drawn on, scaled etc.
- **Hue & Saturation** – The hue effect allows the colour of a layer to be altered by inputting values. Saturation allows a colour to be infused with more white or black. Reducing the amount of white in the colour often gives grungy, military colours, so this is used in this project.
- **Brightness & Contrast** – Changes how bright a colour or object is. Contrast is the difference in colour from one object to another. For example, an object with low contrast will
- **Levels** – Remaps the images tonal range, Input Levels are used to reset the black, mid tone and white points of the image's tonal range to fit more of the digital tonal range. Output Levels resets the beginning and end points of the digital tonal range to something smaller than 0 - 255.
- **Noise** – Noise is any unwanted pixels of random colour in a picture or video. These are unavoidable artefacts recorded when taking the footage.
- **Difference Clouds** – The Difference Clouds filter uses randomly generated values that vary between the foreground and background colour in the toolbox to produce a cloud pattern. When this filter is applied, portions of the image are inverted in a cloud pattern.
- **Brush & Line tools** – Standard paintbrush and line creation tools.

To create the textures multiple layers were used. The first layer defined the colour of the Apache. This started out as a solid colour and was then altered using the Hue & Saturation, Brightness &

Contrast and Levels tools. The colour was picked by comparing colours created in Photoshop to the reference Apache photographs.

The colour went through five or six stages until one was picked. Early colour tests were thought to look too brown when tests were conducted, this led to the colour being changed a number of times until a highly saturated, darkened green was picked as the diffuse colour. This colour matched up well with some of the reference pictures and looked convincing when applied to the 3D model. See figure 8.5.3.



Stages of colour development – Far left is the earliest version, far right is the final choice

Figure 8.5.3

To make the texture more believable more than just a matte colour was required. From looking at the reference pictures it is possible to see dirt, burn marks, areas of darker/lighter colour, oil stains, bumps, rivets and many other small details all of which help make the Apache look real.

A new layer was made in the Photoshop document and this layer was for making the rivets and lines seen on an Apache. Figure 6.1.5 was used extensively as a reference as to where the lines and rivets should go. Rivets were made from black circles and the lines where different metal plates overlap on the real Apache were made from black lines or boxes. These lines and circles were applied over the background colour according to figure 6.1.5 and the other reference pictures. This layer also went through multiple phases in its development until a configuration which matched up with a real Apache and looked good on the model was found.

The next layer was the dirt/grime layer. This layer has all the dirt and burn marks etc on it. Mud splatters were applied using custom paint brushes downloaded from a Photoshop website. These were coloured brown and blurred using a Gaussian blur so the edges weren't too sharp. The mud splatters were generally concentrated around the bottom of the helicopter.

The burn marks and oil stains were created by using a soft circular paintbrush. Some of the brush strokes also had their opacity lowered for a more subtle effect. These marks were generally concentrated around the rotor blades and the front and rear of the engines.

Because the Apaches in the reference photos are never one shade throughout, another layer was made just above the diffuse colour layer. This layer had a difference clouds effect applied to it to create random colour variation. This layer then had a Screen blending mode applied to it so the areas of black blended into the diffuse colour, creating areas of darker and lighter colour. See figure 8.5.4.

Helicopter texture with difference map applied

Figure 8.5.4

The next layer was a grime layer. This layer was made using Photoshops brush tool with a soft edge selected. The grime was then blurred and made slightly transparent. Figure 8.5.5.

Helicopter texture with grime layer added

Figure 8.5.5

The next stage was to make the Apache appear bumpy and not perfectly smooth. The only real way to do this other than making the actual model bumpy which would take a long time and send the polygon count through the roof is by using bump mapping. Bump mapping is a computer graphics technique where each pixel refers to a height map before being rendered, so, the lighting in the 3D scene reflects off the texture at different angels and shadows are generated making it look as though the surface of the model is bumpy.

The colour texture map created above was duplicated and turned into a black and white image. Bump maps work by looking at the white and black parts of an image and it interprets the white parts to be higher than the black parts and grey to be somewhere in between. So, all the rivets were turned white to make them stand out and all the lines were kept black so they would as though they are sinking into the helicopter. To adjust the amount the rivets stood out and lines sunk in the opacity was lowered so the white rivets/ black lines took on some of the properties of the grey diffuse behind.

The difference cloud layer was turned off and in its place a small amount monochromatic noise was generated, this made the surface of the helicopter appear bumpy and not perfectly flat. See figure 8.5.6.

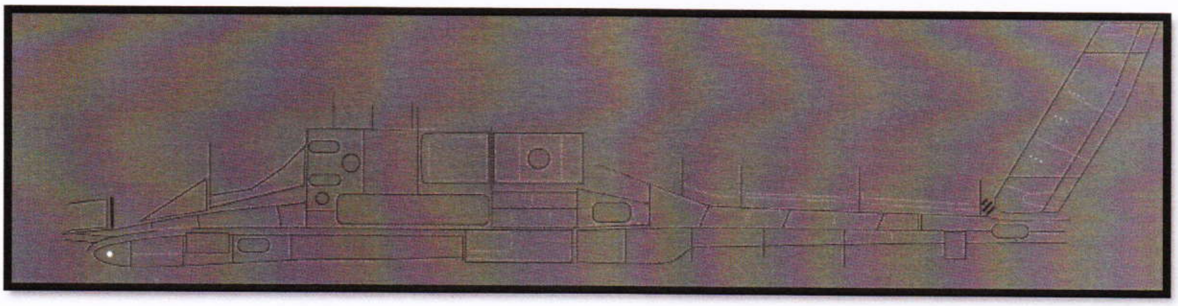


Figure 8.5.6 - *Helicopter bump map texture*

One last texture layer needed to be made after the bump map was complete and that was a Specular Map. The specular map is another black and white map like the bump map except the white sections of the image reflect more light than the darker sections. So, the areas where there are dirt and oil stains were kept dark and the difference clouds layer was turned back on so different parts of the Apache will reflect different amounts of light. As a whole, the specular map was kept quite dull, not going above the mid-grey range because Apache helicopter are designed to be quite a matt colour and not reflect light. See figure 8.5.7.

Figure 8.5.7 - *Helicopter specular map texture*

Once all the different layers had been made in Photoshop they needed to be applied to the Apache in Maya. This involved using Maya's Hypershade editor.

The Hypershade editor is Maya's inbuilt texture manager. Using the Hypershade editor it is possible to create or load in and edit textures. To apply the textures created above a new surface shader was created. Surface shaders are the fundamental building block which makes up a material. There are many surface shaders but the two used in this project are the Lambert and Anisotropic shaders.

Lambert materials are a flat material type that gives a smooth look without specular highlights. It calculates without taking into account surface or reflectivity, which gives a matte, chalk-like appearance. Lambert material is ideal for surfaces that don't have highlights, like the surface of an Apache helicopter.

Anisotropic shaders stretch highlights and rotate them based on the viewer's position. Anisotropic materials are ideal for materials such as hair, feathers, glass, and metal. See figure 8.5.8.

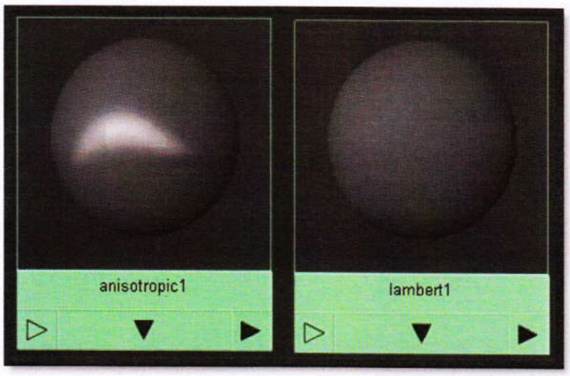


Figure 8.5.8 - *An example of an Anisotropic material and a Lambert material*

For the body of the Apache a new lambert material was created and three file nodes were created inside the lambert shader, this auto-creates a place2dtexture node for each file node. See figure 8.5.9

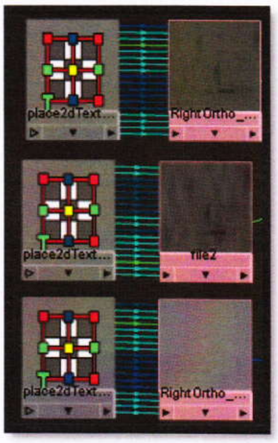


Figure 8.5.9 - *Inside the lambert shader, three file nodes and three place2dtexture nodes*

The file nodes simply provide a link to the texture file created earlier in Photoshop. The place2dtexture nodes contains the UV texture coordinates of the model and place the texture defined in the file node onto the model according to the UV coordinates.

The specular and diffuse texture maps can be directly assigned to the surface shader, giving the shader the colour and specularity desired, the bump map however, needs another node called a bump2d node. This node interprets the colours in the bump texture map as a height map and makes different parts of the texture appear as though they are standing out or going down into the model. See figure 8.5.10.

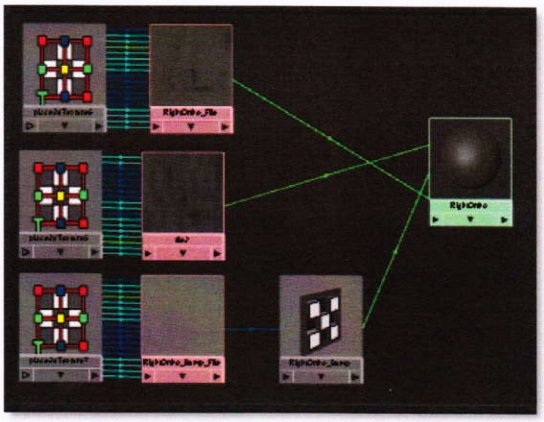


Figure 8.5.10 - *All the nodes connecting to the Lambert surface shader*

To create the texture for the glass windows a procedural texture was created inside the Hypershade editor.

First, an Anisotropic surface shader was imported and two ramp nodes were created inside of it, this also created two place2dtexture nodes. One ramp was made to have a slow gradient going from black to white and the other was just plain white. See figure 8.5.11.

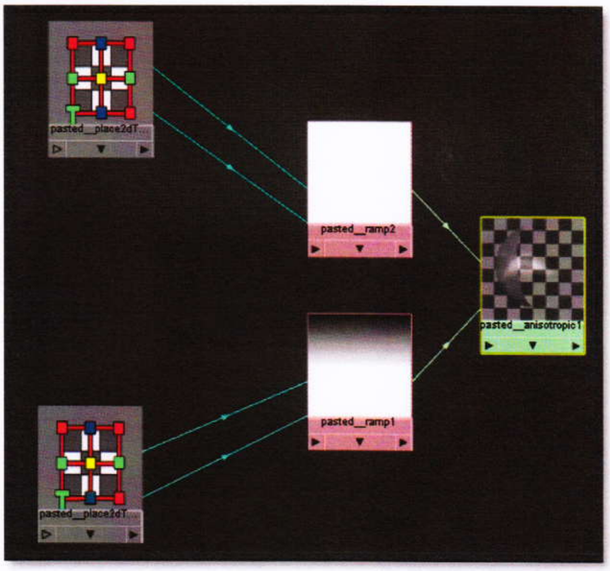


Figure 8.5.11 - *Two ramp nodes linked to an anisotropic surface shader*

A samplerInfo node was also placed inside the shader, this node provides the user with information about each point on a surface as it is being sampled, or calculated, for rendering purposes. This node was connected to both ramps and the anisotropic shader was then applied to the model. See figure 8.5.12.

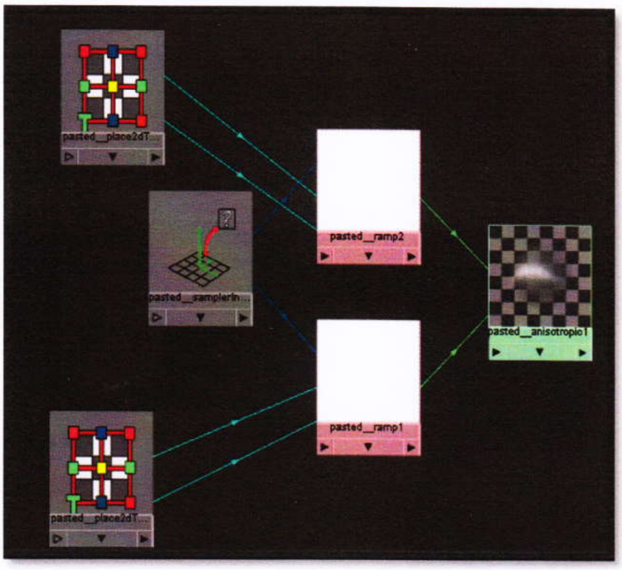


Figure 8.5.12 - *The complete shader network for the glass material*

Camera Matching – 8.6

For the project to be a success the footage for shot 1 needs to be camera matched so the 3D model can be animated and look as though it belongs in the scene. To track the scene the footage, which was stored as an uncompressed Tiff sequence, was imported into Boujou. Within Boujou, firstly the virtual camera needed to be setup to match the camera used to film the footage.

The aperture size of the camera was input into Boujou along with the frame rate and image size. The focal length should also have been input but unfortunately this was not recorded on the day of filming so a best guess had to be made.

The next stage was to track features within the scene. There are two main types of tracking, Free Move and Nodal Pan.

Nodal Pan is a technical term that means the camera is rotating around its optical axis. Most often however, the cameras will pivot around the tripod's head pivot point and not the optical axis meaning it is not a true nodal pan but a program like Boujou will still be able to calculate it correctly.[22] P103

Free Move applies to camera shots where the camera moves throughout the scene on a track or possibly even hand held. Both solutions use parallax to produce solutions. Parallax is the amount of perspective in an image. Generally, it is used to mean the change of perspective from one frame to another, this is also called parallax shift.[23] P265

Boujou works by tracking areas of contrast, so, if there is a white mark in front of a black solid it can track the movement of the white mark anywhere on the screen. This is where the golf balls which were put throughout the scene were used. Boujou was able to lock onto the white golf balls, along with many other tracking points such as the corners of buildings and produce a low quality track. The reason the track was low quality is sometimes the tracking points slips. This can occur if there is a point being tracked within a large area of similar contrasting pixels. Boujou cannot tell the difference between one area of pixels from another when going between frames so the track can slip, creating a wobble in the track.

The picture below shows a camera track. The crosses are the tracked points and the golden tails shows the movement of the track point. If the camera move is smooth the tails should to be a smooth line. If there is a wobbly line these track points must be deleted in every frame to ensure a good track. In this project all the tracking points had smooth tails. See Figure 8.6.1.

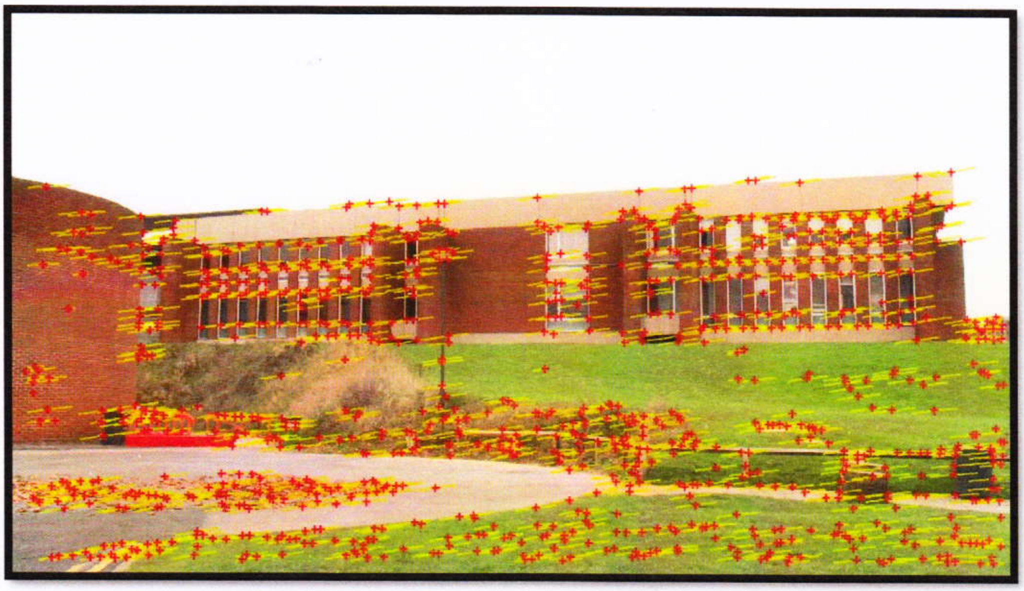


Figure 8.6.1 - *Track points and their tails within Boujou*

Once all the track points are smooth it is time to do a camera solve. This further analyses the tracked points and chooses some of them on which to base the final camera movements. It is possible to increase the sensitivity of a camera solve to include more or less tracking points.

Once the camera solve is complete the scene will be full of gold and blue dots. The Gold dots are the tracking markers being used in the current frame selection and the blue ones are tracks not currently in use. See figure 8.6.2.

Figure 8.6.2 - *Blue and gold tracking markers within Boujou*

The camera solve provided by Boujou was not perfect. To solve this, scene geometry was added in Boujou. The first piece of geometry to add is a 3D object. This object can be attached to a track point and then, if the footage is played through it should be obvious from the 3D object if the scene is tracked properly. If the object stays static within the scene the track is good, if it slides or wobbles the track needs refining.

To refine the track multiple track points can be selected that are known to be on a plane with one another. Boujou can then be told that the selected points are on a plane and take that into consideration when creating the camera solve. Another way is to select two tracking points which you know the distance between. For example, the length between each golf ball to each other golf ball was measured on the day of filming so track points attached to the golf balls were selected and Boujou was told the distance between the points.

All the above had to be done to make a good track for this project. After the quality of the track was acceptable the scene was exported as a Maya scene file and opened in Maya.

Once in Maya, the Boujou file provides the background image sequence, the recorded footage is played within the Maya interface, the camera is setup to the same specification as was defined within Boujou and the tracking points are displayed as Maya reference markers.

The scene must first be orientated within Maya, because of how the scene is exported from Boujou sometimes it is at 90 degrees to the Maya grid, but this is an easy fix, simply rotating the scene 90 degrees in the opposite direction. Then, using the reference markers, the markers which should be on the floor are orientated to be flat against the Maya grid. See figure 8.6.3.

Figure 8.6.3 - *The Boujou scene orientated within Maya*

Once the scene is orientated correctly 3D geometry must be added. For this project a plane will be create in the scene over the tarmac seen in the image sequence to act as the floor. Using the reference markers the plane must be positioned in such a way that it is locked in place over the tarmac. The plane does not move in 3D space, it is a static object and it's the image sequence and camera that pans down in the scene. Getting the plane in the exact position where the tarmac should be was an extremely time consuming exercise and required hours of tweaking as the reference markers can only be used as a rough estimate of where in the scene it needs to be. See figure 8.6.4.

Figure 8.6.4 - *The plane in position within Maya*

After the plane was locked in position where the tarmac should be the helicopter needed to be animated.

Animation – 8.7

Animating in Maya is done by the use of Keyframes. Keyframe animation is where keyframes are placed on certain frames within the scene. A keyframe stores information on the objects attributes such as position and scale. If two keyframes are placed on the timeline with different attributes, Maya will automatically interpolate between the keyframes to get the object from one position to another in the required amount of time.

The animation needed to be the length of the recorded footage. To ensure the helicopter landed at the right time a keyframe was placed at the end of the footage and the helicopter was moved into its landing position on the plane. Using the image sequence within Maya the starting position was also chosen. It was important to get the starting position correct because otherwise the helicopter would look too big or too small to begin with and have to move too quickly or too slowly to get to the end position.

More keyframes were added to refine the animation and to keep it looking believable against the background image sequence. Once the basic animation was complete it had to be refined using the Maya curve editor shown in figure 8.7.1.

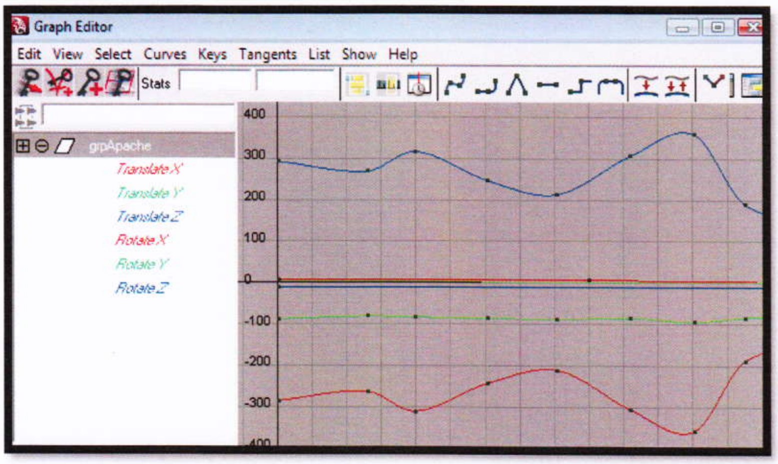


Figure 8.7.1 - *The Maya curve editor*

The curve editor allows the user to alter everything about an animation but it was mostly used to add small detailed movement such as the helicopter being caught in a gust of wind or a small wobble when coming in to land. It can also be used to change the speed of movement. When Maya interpolates between two keyframes it will do it via the fastest route possible which is a straight line and objects vary rarely move or accelerate in a linear fashion in the real world. This is when the curves can be used to create more realistic motion by increasing and decreasing speed.

During the animation of the helicopter landing, after placing the keyframes at the beginning and end, one was placed roughly ¾ of the way through for when the helicopter should stop moving forwards and begin its decent to the floor. At this time the animation was all looking very linear, like the helicopter was attached to a string. To make it less linear the animation curve editor was used to make it look as though the helicopter is caught in a cross-wind; it sways as it comes into land and doesn't come in totally flat. Little details help to make it look more believable and more like how a real Apache lands.

One of the hardest parts of creating a realistic animation was the landing. When a helicopter the size and weight of an Apache lands there is enormous stress on the landing gear. To show this stress the landing gear was animated separately to the rest of the helicopter. As the wheels touch the ground a keyframe was added to the position of the wheels, this was so the body of the helicopter continues to move downwards while the wheels stay stationary. Along with this, the body's downward motion was slowed using the curve editor, making the motion take longer over time. This created the effect of suspension taking the weight of the helicopter. Of course, with suspension, once the springs take the weight of the object they should spring back up a little. To animate this the body was raised over a few frames and the curve editor was used to make the motion slow to begin with, as the springs begin to push the helicopter up, speed up as they take the strain and then slow down again as they reach the maximum weight they can lift.

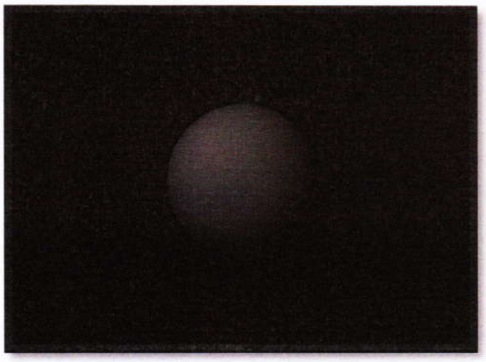
Another large part of the animation was the rotor blades. These were the easiest bit of the animation. All that had to be done was select the rotors and tell them to spin quickly between the first and the last keyframes. A few different setting were tried out before a realistic speed was decided upon but this was a straightforward process.

The last part of animation for the project was opening the door for the pilot to get out. The idea was that the door should be on some sort of hydraulic system so it would be quite linear compared to if a person was to push it open. The basic linear animation was applied using keyframes and the animation curves were altered to give it a slow in slow out feel. This means the door begins to open slowly, speeds up as it swings open and then slows down again gradually as it opens to its maximum angle.

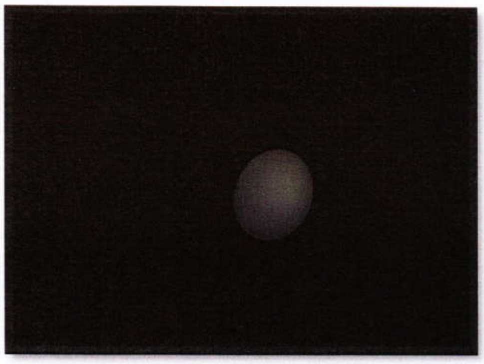
Lighting – 8.8

Lighting the scene was a long process. Within Maya there are a number of different standard lights and these are:

- **Spotlight** – By the definition, this is like a spotlight or torchlight. A circle of light is emitted from the source and it follows the inverse square law. See figure 8.8.1.



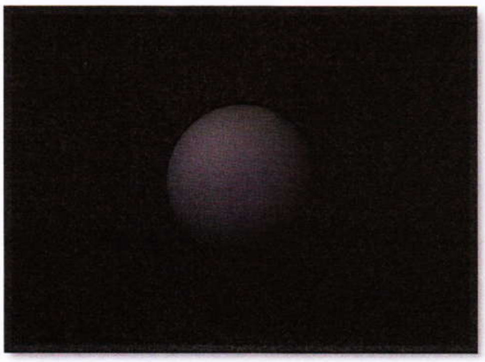
A sphere rendered using Maya's default lighting



A sphere rendered using a Maya spotlight

Figure 8.8.1

- **Directional Light** – The directional light emits light only in the direction it is pointing but not in a beam. Anything which is in the path of the directional light will be evenly lit. It is a good sun emulator. See figure 8.8.2.

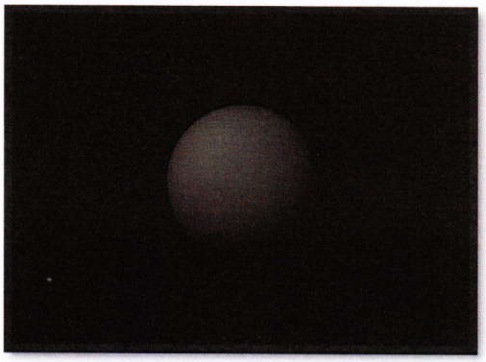


A sphere rendered using Maya's default lighting

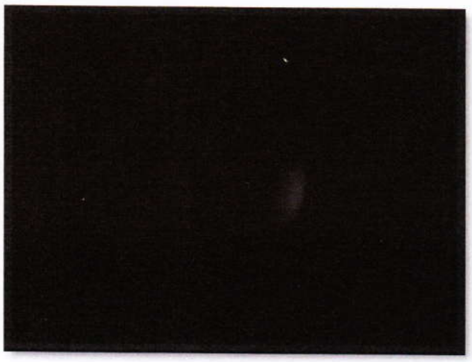
A sphere rendered using a Maya directional light

Figure 8.8.2

Volume Light – Has a visible range of influence that allows the user to see exactly where the light dies out. By default, the light intensity falls off linearly from the light's centre point to the visible outer boundary. This type of light is ideal for interior lighting, because lights should fade with distance. See figure 8.8.3.



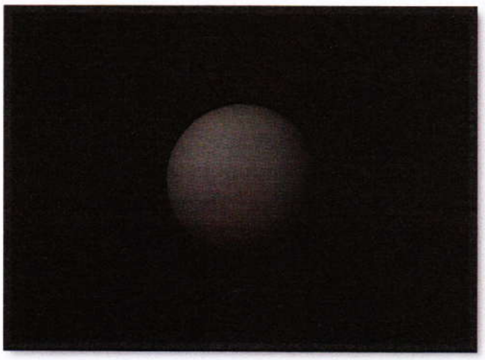
A sphere rendered using Maya's default Lighting



A sphere rendered using a Maya volume light

Figure 8.8.3

- **Area Light** – The area light does not come from an infinitely small point in space like the spotlight. The area light emits light from a rectangular area in space which can be scaled. Area lights give shadows which soften with distance and is good for interior rendering. See figure 8.8.4.

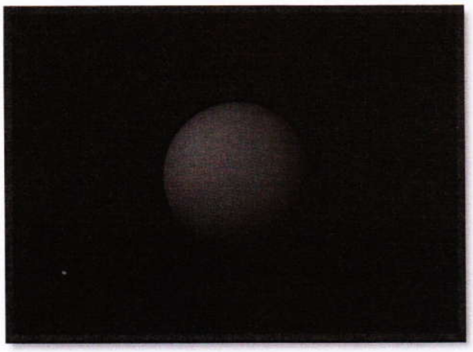


A sphere rendered using Maya's default lighting

A sphere rendered using a Maya area light

Figure 8.8.4

- **Point Light** – Unlike the Directional light, which has light rays that are parallel to each other, a Point light casts rays of light evenly in every direction from a point. Point lights are sometimes used for simulating omni directional light sources, such as light bulbs. See figure 8.4.5.



A sphere rendered using Maya's default lighting *A sphere rendered using a Maya point light*

Figure 8.4.5

Another important part of rendering is picking the right rendering software. Maya comes with three default renderers. These are:

- Maya Hardware Renderer – Uses the computers GPU to render
- Maya Software Renderer – Mainly used for particle renders
- Mental Ray – Enables raytracing which is a technique for generating an image by tracing the path of light through pixels in an image plane. Raytracing is capable of producing photorealistic images.

The rendering setup was extremely important in making the helicopters believable. Within the render setup menu there are tens of options to choose from. Some of the most important options are:

- **Final Gather** – This is an effect available only when using Mental Ray and it uses Raytracing. Final Gather calculates the diffuse reflections of light rays within a scene. Diffuse reflections are the effects of reflected light which have bounced off one surface onto another diffuse surface. This happens in real life so it is important to take this into account when trying to make a realistic scene. Final Gather light calculations are divided into two components:

  1. Direct Illumination:

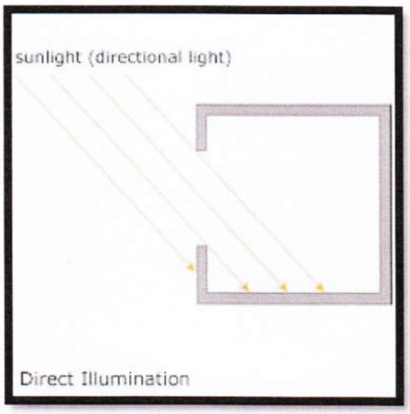


Figure 8.8.6 [24] – Direct Illumination

  2. Indirect Illumination:

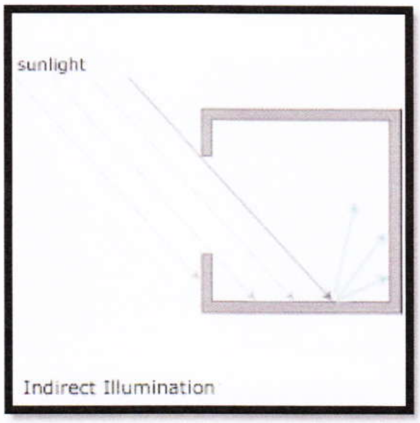
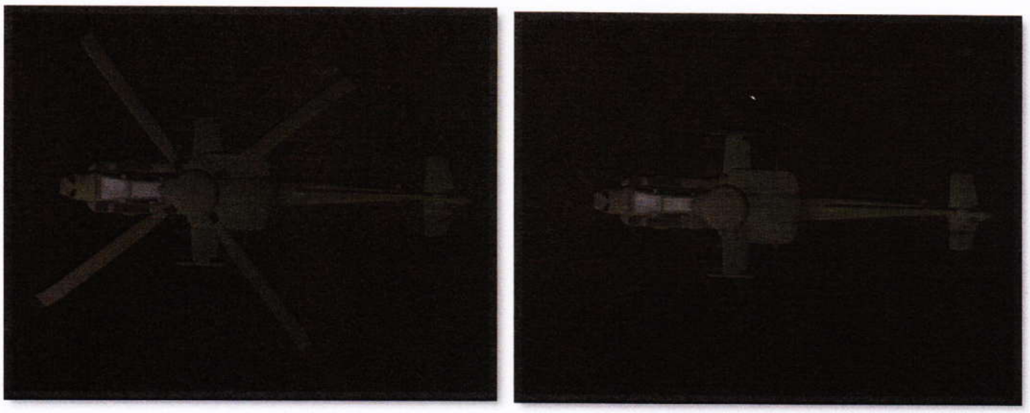


Figure 8.8.7 [25] – Indirect Illumination

Final Gather first calculates the direct illumination in the same way a normal renderer would. In this stage the basic light distribution across a scene is calculated.

It is in the second stage, Indirect Illumination, that Final Gather really comes into its own, It determines the light intensity at any given point by examining the colour values found within the hemisphere around that point. This is added to the light intensity calculated from the direct illumination.

- **Motion Blur** – Occurs everywhere we look in real life where fast moving objects are concerned. Motion blur blurs fast moving objects such as if a hand is waved or rotors on a helicopter spinning. See figure 8.8.8.



Helicopter with no motion blur *Helicopter with motion blur*

Figure 8.8.8 – Motion blur example

- **Anti -aliasing** – Because pixels are square, it is impossible to obtain a true soft edge as would be seen in real life, if you zoom into the pixels far enough you will see a line of square blocks. Anti-aliasing blurs this line so the edge is not as defined to give a softer, more realistic edge. This is shown in figure 8.8.9.

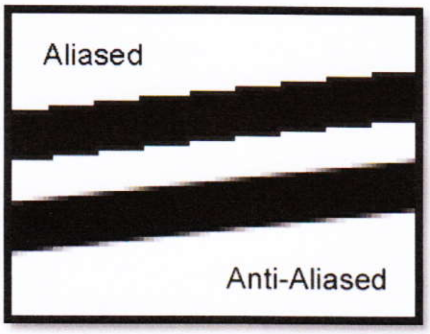


Figure 8.8.9 [26] – Anti-aliasing example

- **Raytracing** – Raytracing is the tracking of rays of light as they pass through transparent objects such as glass. As the rays pass through the material they will get refracted and refractions will only be traced a certain amount of times. See figure 8.8.10.

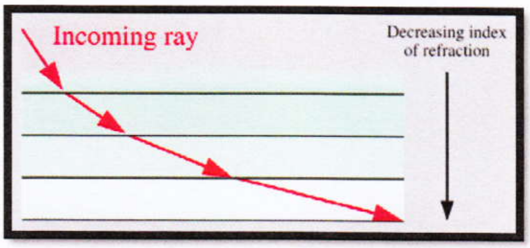


Figure 8.8.10 [27] – Raytracing example

- **Image Size** – This is the resolution of the output image. For this project they will need to match the image size of the recorded footage which is HD 1920 x 1080.
- **Image File Output** – This specifies the output image format. There are many different options such as jpeg, tiff or movie formats such as avi and mov.

To light the helicopter scene extensive testing was done using all the lights above. As stated previously, lighting the helicopter is an extremely important part of the production process. From the camera tracking, the scene in Maya still has the filmed footage in the background, this acted as a helpful guide, displaying what the lighting looked like on the day of filming.

The lighting in the 3D scene was designed to light the model in a way that matched the lighting conditions on the day, after the lighting tests had been conducted it was decided to light the scene using Area lights and Final Gather. The combination of the two tools gave a very realistic outdoor lighting solution.

LIGHTING TESTS – 8.9

On the day of filming the lighting at the location was unusual. The sky was completely white with clouds and there were no gaps. Whereas long shadows would generally be expected at 3pm in the afternoon on this day there were almost no shadows and a very ambient, linear light. This is a challenge to match in 3D because none of the standard lights on their own will match these conditions.

Mental Ray was chosen as the rendering engine due to its speed and ability to use the Final Gather function.

To begin, an ambient light source was added, this is shown in figure 8.9.1.

Figure 8.9.1 - *Maya scene lit with an ambient light*

As can be seen, the shadows are very intense and the colour of the helicopter looks a little saturated. The ambient light was removed and a direction light was put in its place. See figure 8.9.2.

Figure 8.9.2 - *Maya scene lit with a directional light*

Using the directional light the shadows look more defined and the colours appear brighter, this is a much better result than with the ambient light. Although this result is a good one, the area light was tried next. See figure 8.9.3.

Figure 8.9.3 - *Maya scene lit with an area light*

The colours are less vivid with the area light and the shadows are even softer than with the directional light. Had the conditions been sunny the directional light would have been chosen but, to match the filming conditions the area light was chosen as the main light source after this test.

The next phase of lighting was to light the object evenly, by looking at figure 8.9.3 it can be seen that the tail section is a lot darker than the cockpit. This was fixed with the addition of two more area lights, turning on final gather and creating a sphere around the scene for the lights to bounce off. See figure 8.9.4.

Figure 8.9.4 - *Maya scene lit with three area light and Final Gather*

Turning on final gather has made the image dark, this is due to the calculation of light bounces. Also, the three lights are casting three shadows which is incorrect as there should only be one. Shadows for all three area lights were turned off and a single spotlight was added. See figure 8.9.5.

Figure 8.9.5 - *Maya scene lit with three area lights, Final Gather and one shadow*

The scene is now looking much lighter with soft shadows beneath the helicopter which is exactly what is required. However, the tail is still dark and the colour of the helicopter itself is not pronounced. This was fixed by adding two point lights. All the lights in the scene were then given coloured shades to match the colour of the lighting to the background. See figure 8.9.6.

Figure 8.9.6 - *Maya scene lit with three area lights, Final Gather and two point lights*

The lighting for the scene was now complete, figure 8.9.7 shows how the lights were configured in the scene to give maximum illumination. See figure 8.9.7.

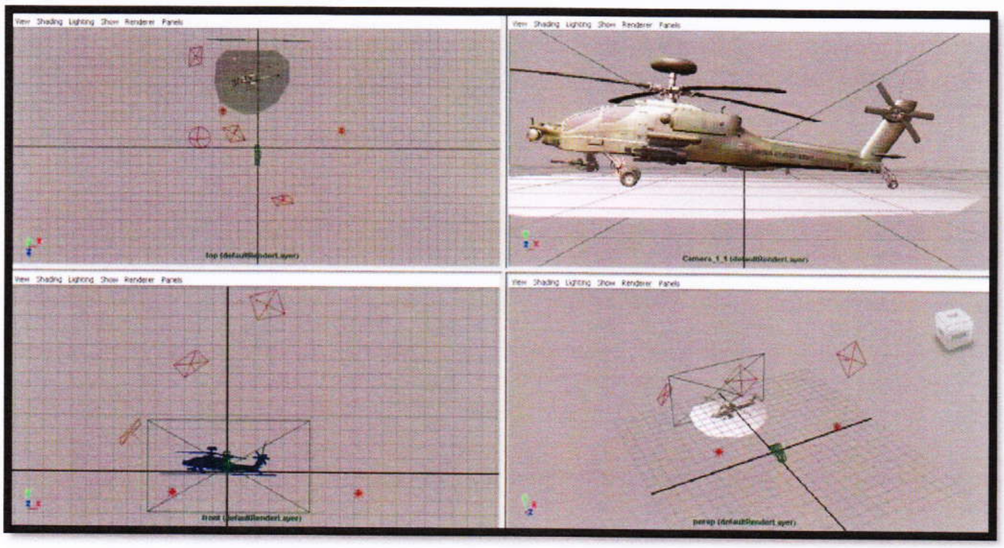


Figure 8.9.7 - *Lighting setup within the Maya interface*

(see Appendix One Figure 8.9.7 for high res.)

As can be seen in figure 8.9.7, the directional lights have been arranged in an arc to provide the maximum amount of light coverage. The closest directional light is the weakest in intensity and the other lights placed further away have a higher intensity based on their distance from the target object. This creates a more ambient light.

The two point lights have different intensities also, the closer point light is coloured pink/red and has a low intensity, this was in an attempt to match the colour of the scene to the colour of the footage. The other point light is slightly more intense and has a blue tint.

RENDERING – 8.10

Rendering can be an extremely time consuming process, especially when there is a high polygon object and lighting involved. The helicopter in the project is fairly low poly (about 100,000) but the scene does include three lights and Final Gather. Final Gather is an extremely processing intensive task as it calculates light ray bounces and this will take a long time.

A compromise must be made when planning a render between time and quality. For this scene to appear believable it needs Motion Blur, Anti-Aliasing and Raytracing but by editing the settings within each of these categories and performing many tens of test renders, a quick yet high quality solution was found.

To obtain the greatest amount of control in the compositing stage of the project the 3D scene was rendered out in three separate passes, one for the diffuse colour, one for specularity and one for shadows. This means each attribute can be edited separately in post-production and will give the best result if used properly, the only downside of this is it will triple the total render time. The other option was to render all the passes out in one file, this would be a quicker option but give almost no control in postproduction. For example, if the specular level was thought to be too high in post, there would be very little that could be done to fix this problem, whereas if each pass is separate the specular layer can be turned down.

The files will be rendered out as .TIFF images containing RGBA information. RGB are the Red, Green and Blue colour channels and the A is the Alpha channel. The alpha channel is extremely important for post-production work in After Effects. The alpha channel contains transparency information. Everything that is white is opaque and everything black is transparent. This will be used extensively when compositing the helicopter onto the recorded background footage. See figures 8.10.1 through 8.10.4.

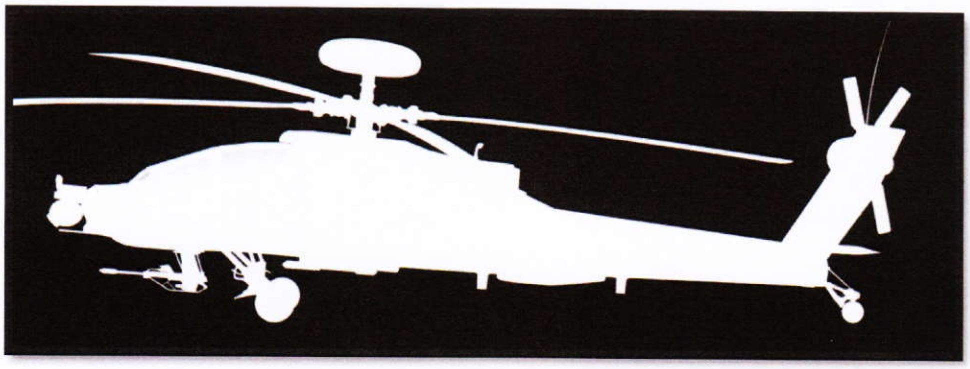


Figure 8.10.1 - *Helicopter Alpha Channel*

Figure 8.10.2 - *Helicopter Red Channel*

Figure 8.10.3 - *Helicopter Green Channel*

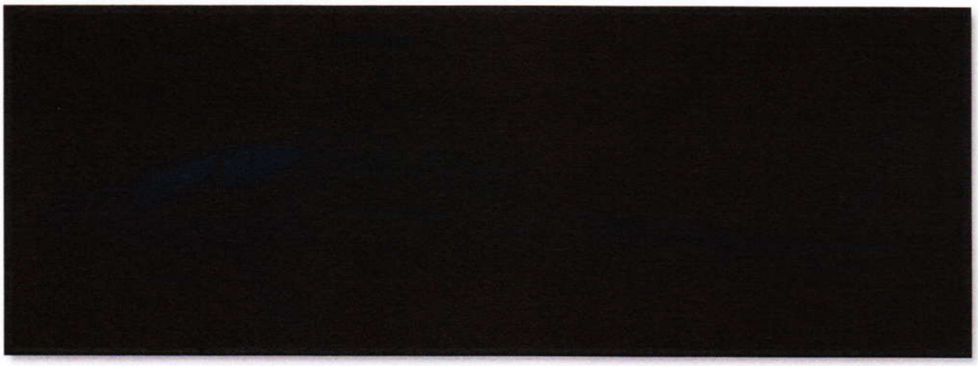


Figure 8.10.4 - *Helicopter Blue Channel*

Compositing – 8.11

The compositing stage of this project is all done in Adobe After Effects. During the compositing it was decided that shots 1 and 2 did not cut together correctly, it looked wrong when going between the two shots so it was decided to extend shot 1 to include shot 2. So the actor jumping out the helicopter is now filmed from the position of shot 1.

For shot 1, first the filmed footage was imported (the slow pan down from the sky) and placed into a new composition with the settings shown in figure 8.11.1.

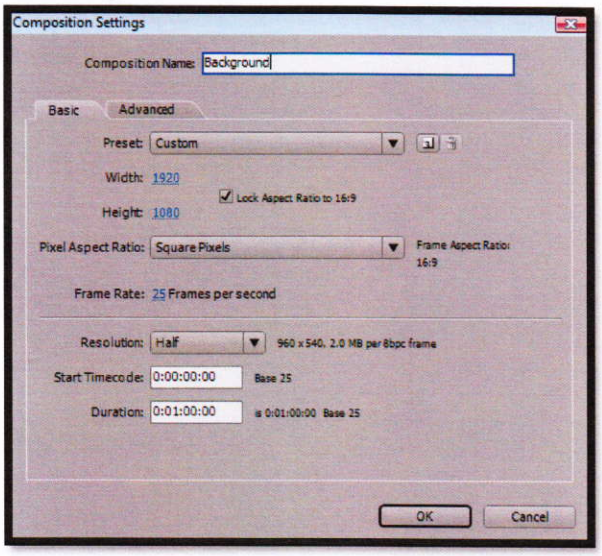


Figure 8.11.1 - *Adobe After Effects composition settings dialogue*

This sets up a new HD working area inside After Effects. The next step is to drag the imported background footage into the work area. This makes the footage appear on screen and allows it to be edited.

Next, the .TIFF sequences of the rendered 3D scene were imported to the work area, the timings were matched up to that of the background footage and the layers were organised as follows, shadow layer, specular layer then diffuse layer. The shadow layer had a 'Difference' layer mode applied to it. This makes invisible any areas of the current selected layer that are the same as the layer below and any areas of difference visible, so in this case it will cast shadows over the layers below. The shadow layer pass was in fact done with two separate passes. One pass for the shadows being cast by the body e.g. wings and wheels and another pass for the shadows made by the rotor blades. This was done to have more control over the density of the shadows.

For example, the body was casting a large dark shadow on the floor which did not fit the scene, due to having two passes it was possible to tone these shadows down while keeping the lighter shadows cast by the rotor blades highly defined.

Both the shadow layers had their opacity turned down to make them more transparent and also had a Gaussian blur applied to them to soften the edges.

The specular layer had an 'Add' layer mode applied, this simply adds the two overlying pixel values together to create the finished result, so the specularity is added to the diffuse layer beneath it. The diffuse layer on the bottom of the stack was left with a 'normal' layer mode, which means it behaves normally.

The effect of each layer on the scene is shown in figure 8.11.2 through 8.11.7.

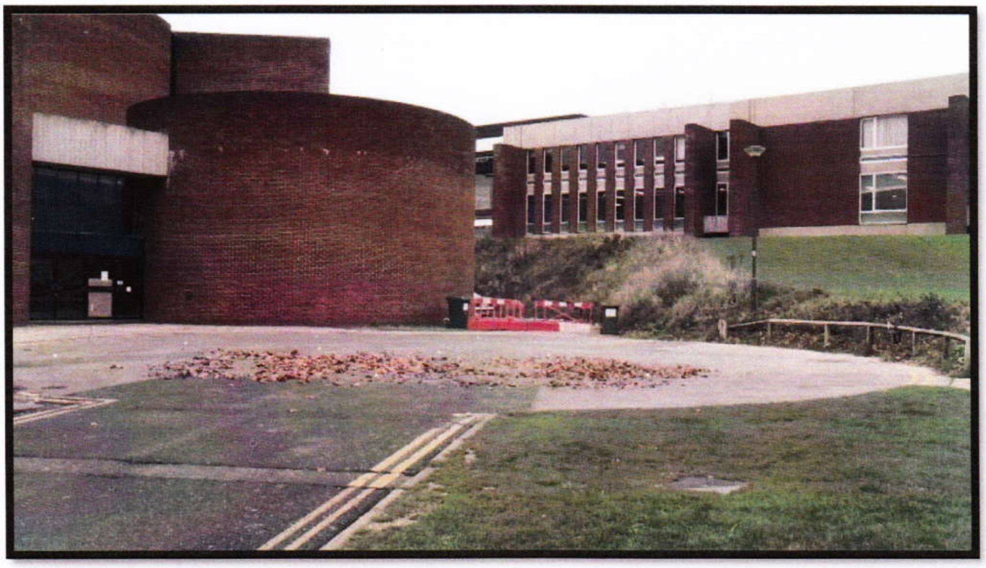


Figure 8.11.2 - *Clean plate*

(See Appendix Fig. 8.11.2 for high res.)

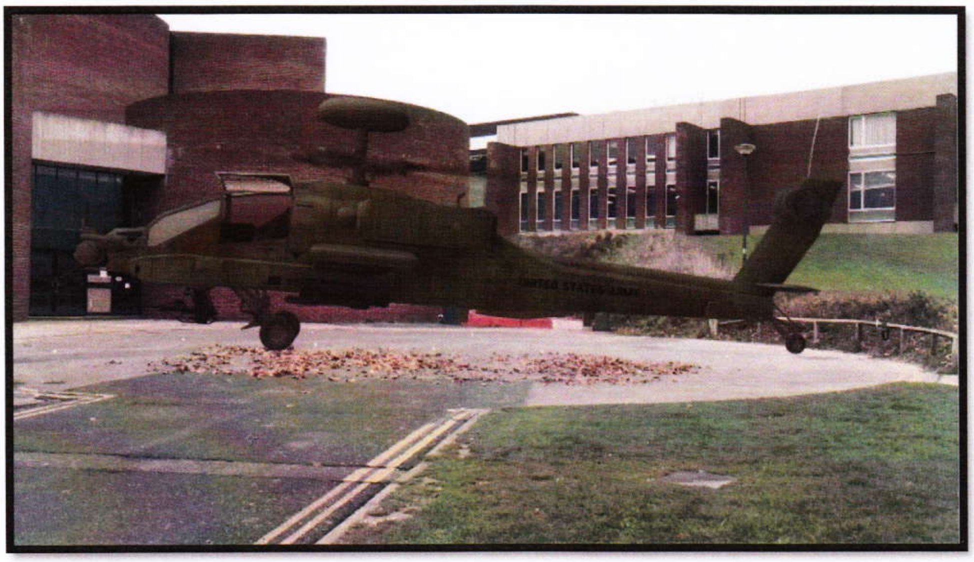


Figure 8.11.3 - *Diffuse layer pass*

(See Appendix Fig. 56 for high res.)

Figure 8.11.4 - *Diffuse and Specular layer pass*

(See Appendix Fig. 8.11.4 for high res.)

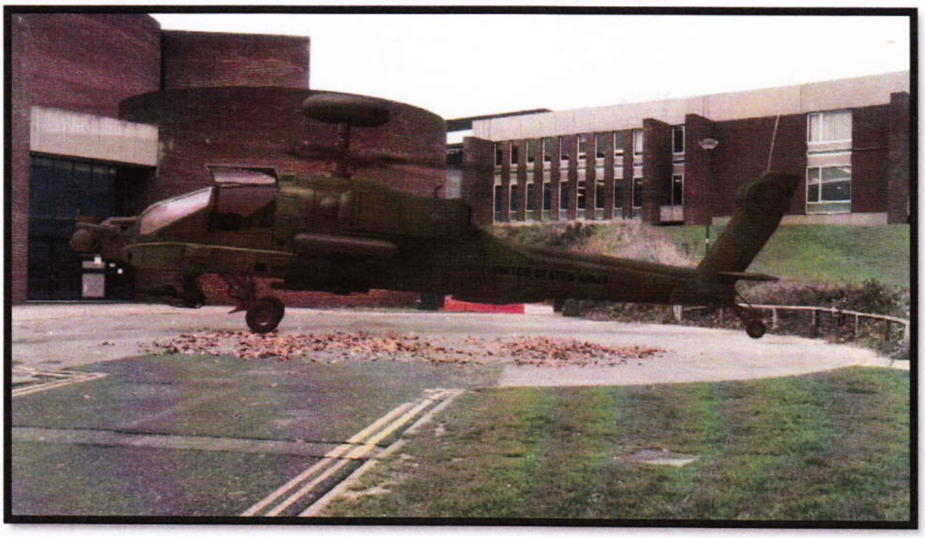


Figure 8.11.5 - *Diffuse, Specular and Body Shadow layer pass*

(See Appendix Fig. 8.11.5 for high res.)

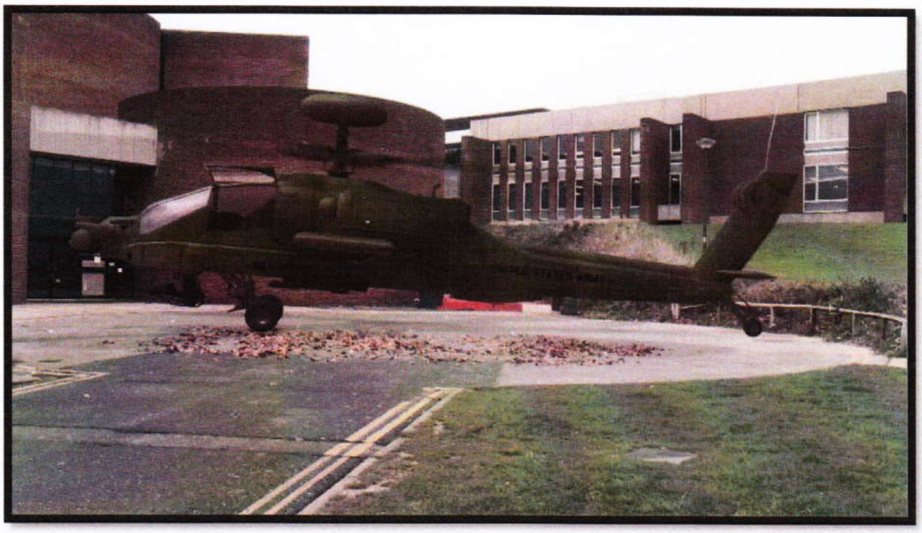


Figure 8.11.6 - *Diffuse, Specular, Body Shadow and Rotor Shadow layer pass*

(See Appendix Fig. 8.11.6 for high res.)

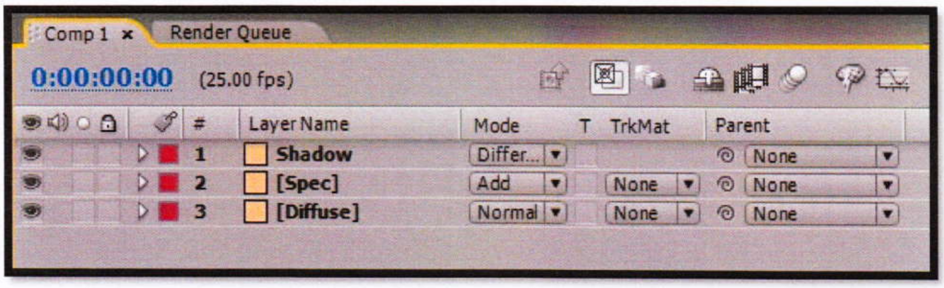


Figure 8.11.7 – *The After Effects layer stack*

The next stage was to replace the sky in shot 1. To do this an alpha map of the background layer was made, this meant converting the sky to a complete black colour (transparent) and the buildings etc to white (opaque). A duplicate copy of the background layer was made and using the Levels and Hue and Saturation tools an adequate alpha map was made. See figure 8.11.8.

Figure 8.11.8 - *The alpha map of the footage*

This only needed to be a rough map; because of the colour of the sky it was impossible to get total blacks and totals whites in the shot. So, as well as using an alpha map a mask was also used to cut out the sky. This mask was animated over time using keyframe animation to keep it 'stuck' to the edges of the building. When this was complete the new sky was imported and figure 8.11.9 shows the final result.

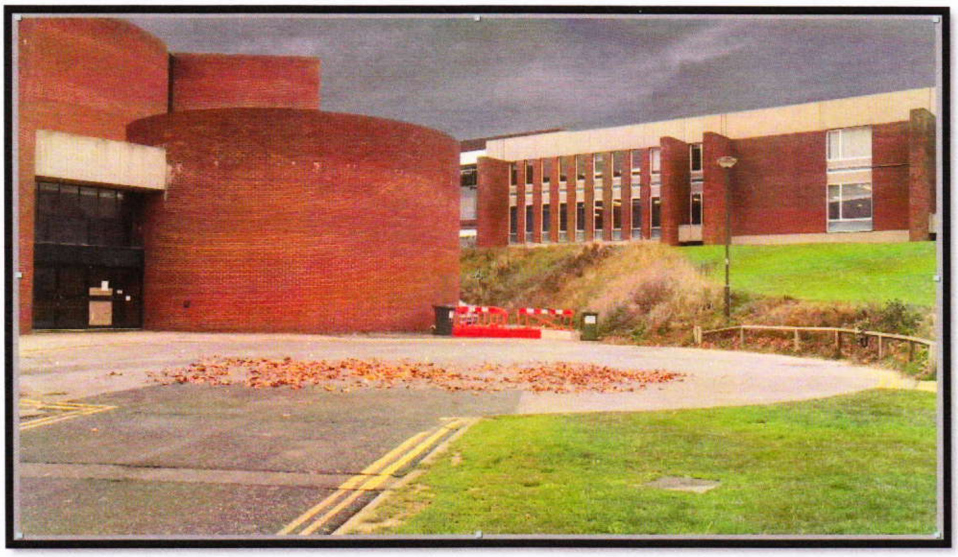


Figure 8.11.9 - *The scene with the sky replaced*

As can be seen in figure 8.11.9, the sky is in place but does not fit into the scene. The whole scene needs colour correcting to make it believable. The background footage was colour corrected using the 'Colour Balance' and 'Hue and Saturation' tools. The sky is very grey and leans towards the blue side of the spectrum, the colour is also quite washed out. So, to recreate this, the saturation of the background was taken down to make it look almost black and white, then the reds and greens were lowered and the blues slightly boosted. Figure 8.11.10 shows the final result.

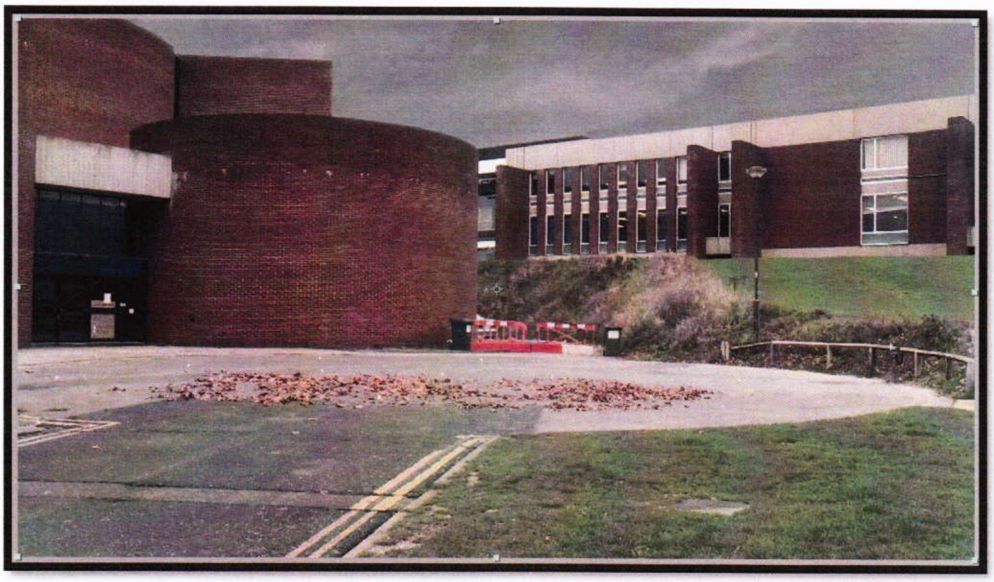


Figure 8.11.10 - *The scene with colour correction*

The helicopter also had to be colour corrected to fit into the new look of the scene. This was done by tweaking the colour settings on the Diffuse layer and lowering the opacity of the specular level so the helicopter appears less shiny. The result is shown in figure 8.11.11 and 8.11.12.

Figure 8.11.11 - *Helicopter with no colour correction*

Figure 8.11.12 - *Helicopter with colour correction*

For shot 1 the blue screen and surroundings had to be keyed out of the blue screen footage. This was done by importing the footage into After Effects and using the Keylight function. What keylight does is any pixel of a defined colour transparent. So, if it is told to get rid of a blue colour from a blue screen it will do so and allow you to see the layer behind the screen. See figures 8.11.13 and 8.11.14.

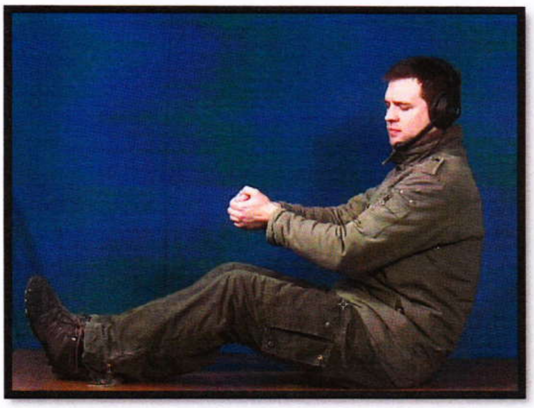


Figure 8.11.13 - *Before*

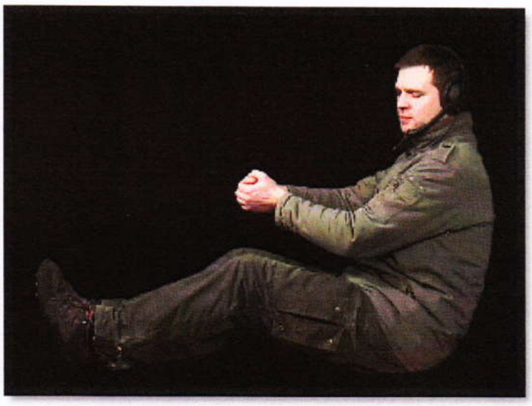
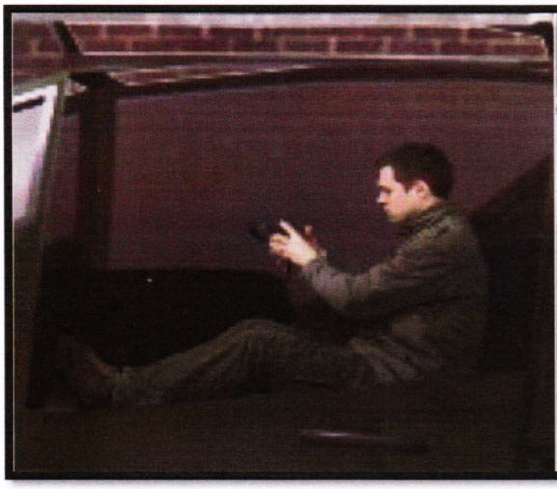


Figure 8.11.14 - *After*

In figure 8.11.15 the table the actor is sitting on has also been taken out the scene. This was masked out using a keyframed mask. Masking is the process of cutting something out of a scene. Here the table has been 'cut out' of the footage. The red line in figure 8.11.15 shows the mask.

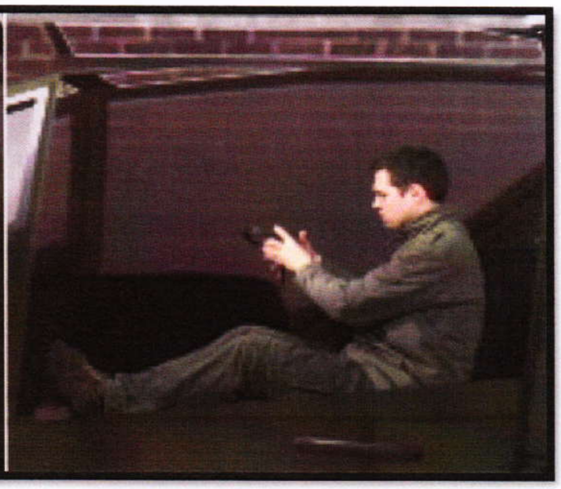
Figure 8.11.15 - *Actor with table and background removed*

This footage was then imported into the same scene as the rest of shot 1 and the blue screen footage was scaled down so the actor would fit inside the helicopter. The blue screen footage was then colour corrected to match the rest of the footage. See figures 8.11.16 and 8.11.17.



Actor with no Colour Correction

Figure 8.11.16



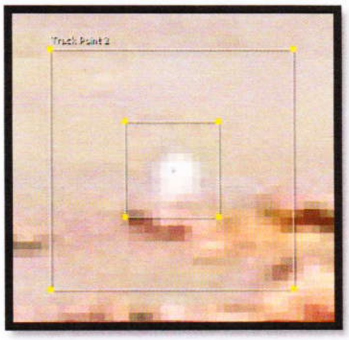
Actor with Colour Correction

Figure 8.11.17

The next stage of shot 1 was to key in the new sky. At this point the sky was a still image and did not move with the scene so it looked very strange as the building appeared to pass it by. To make the sky picture move with the scene part of the background scene had to be motion tracked.

Motion tracking in After Effects is much the same as 3D tracking in Boujou. A point in the scene is chosen and After Effects is told to keep track of how those pixels move throughout the animation. The point picked for tracking has to be high contrast so for this one of the golf balls was chosen.

After Effects recorded the motion of the golf ball throughout the animation and this movement data was applied to the sky image. This locked the image of the sky to the position of the golf ball in every frame of the sequence so the sky moved with the rest of the scene. See figures 8.11.18 and 8.11.19.



Selecting the golf ball as the tracking point

Figure 8.11.18

Grey line shows the path of motion

Figure 8.11.19

Another problem with the sky is that it is a still image. A difference between a still image and a piece of video is the video has noise which changes each frame and a still image does not. When a still image is embedded with video it is be instantly noticeable due to this lack of defects. So, to solve this problem noise or grain can be added using After Effects. The 'Add Grain' tool was applied to the sky and using the customisable settings the noise was made to match that of the rest of the image.

Shots 3 and 4 were assembled and colour corrected just as shot 1. The big difference in shots 3 and 4 is the masking. In shots 3 and 4 the actor is jumping off a ladder and walking out of view of the camera. In shot 3 the helicopter has to be put in the scene behind the actor and it is the same situation in shot 4. The only way to accomplish this in the case of this project is to mask the actor out. This is an extremely time consuming and labour intensive process but it is the only way to get good results.

To mask the actor out in both scenes different masks were used for his head, body, right and left arm and right and left leg. Although this may sound like more work, it is actual a far more efficient work flow to manage six different masks than one large one. See figure 8.11.20.

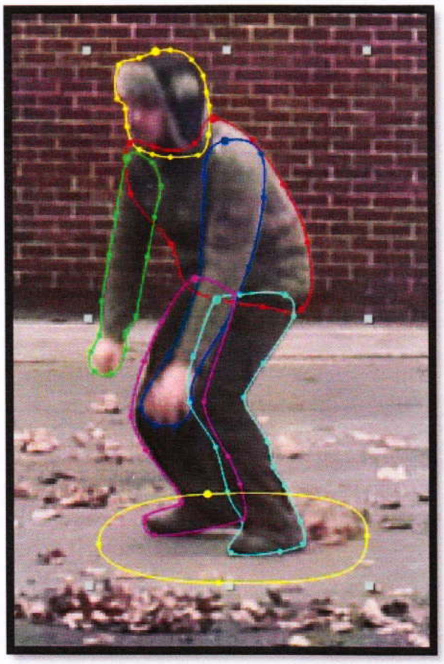


Figure 8.11.20 - *The actor being masked*

The masks were keyframe animated over time and Bezier points were used to keep the mask close to the edge of the actor. Bezier points are points in the mask which have been converted into a corner containing tangent handles. These tangent handles can be manipulated to curve the mask.

Due to the nature of the movement it was very hard if not impossible for After Effects to correctly interpolate between frames, but by placing a keyframe at the beginning of the sequence and at the next point where the movement drastically changes, After Effects at least gets the mask somewhere close to where it should be and this does speed up the masking process.

Once the masking was complete, motion blur was applied to the footage which ever so slightly blurred the edges of the actor. This concealed the fact it was a separate piece of footage from the background. Another Effects which helps to conceal the cut is feathering. Feathering takes place starting from the line of the mask and creates a gradient going from transparent to opaque over a specified amount of pixels, in this case roughly 2 pixels. This effect softens the edge between the two pieces of footage. See figures 8.11.21 and 8.11.22.

Actors arm with no motion blur

Figure 8.11.21

Actors arm with motion blur

Figure 8.11.22

To add a further level of realism to the scene the leaves on the ground need to be animated. On the day of filming, shots of a man with a leaf blower running throughout the shot blowing leaves were recorded. These shots were edited in After Effects so the timing of the blowing leaves corresponded with the helicopter coming into land so it looked like the helicopter was blowing the leaves.

The leaf shots were duplicated and placed so they covered the landing area. To completely cover the area the shots were masked and cut to size. See figures 8.11.23 and 8.11.24.

Figure 8.11.23 - *Original Footage*

Figure 8.11.24 - *Footage with animated leaves*

Some of the masks were scaled down, some scaled up and some had their opacity altered to hide the fact they were duplicates of each other. Currently, the leaf shots included the leaves and their background, which in this case was the floor and grass in some cases. The background needed to be keyed out to just leave the leaves. This was done by making an alpha map of the footage. This alpha map needed to by more accurate than the one used for the sky earlier in the project.

First, the footage was duplicated and, using the Hue/Saturation controls the Yellows, Blues, Greens, Cyans and Magentas were removed leaving just the reds. The reds were tweaked to leave as much of the leaves as possible and drop as many of the other reds in the scene. See figure 8.11.25.

Figure 8.11.25 - *Footage with all colour bar the red range removed*

Still using the Hue/Saturation tool, the reds were converted into whites. See figure 8.11.26.

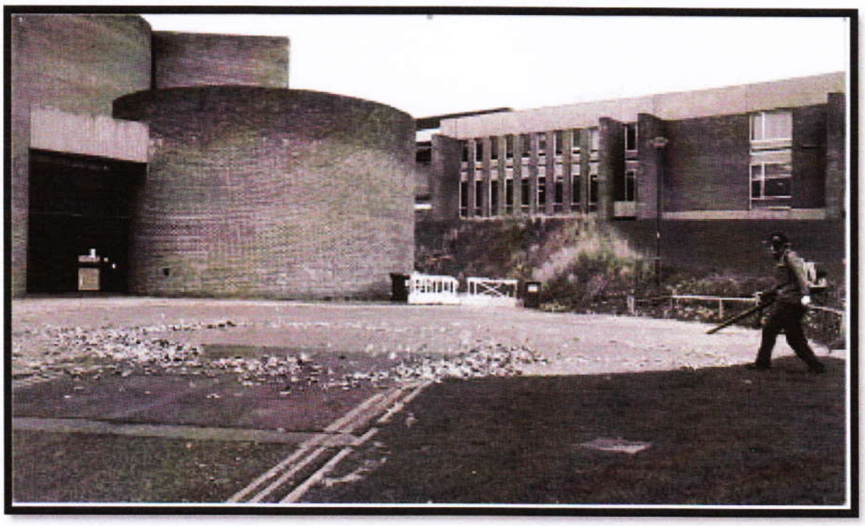


Figure 8.11.26 - *Reds converted into whites*

Using the levels tool the gamma was lowered to remove even more of the background. See figure 8.11.27.

Figure 8.11.27 - *Scene darkened to bring out the whites*

The other duplicate of the layer was colour corrected to match the rest of the scene and the layers Track Mat was set to luminance. This means the black sections of the image will be transparent and the white sections will be opaque as defined by the alpha map.

After this process was complete, it was decided that there was not enough footage of blowing leaves to make the shot believable. At this stage there were two options. The first was to create fake leaves in Maya and the second was to try and find stock footage of blowing leaves.

Stock footage is footage recorded by a company which is then sold to VFX artists for use in video effects shots. Since this project was to a strict timeframe, it was decided to look for stock footage of leaves instead of making CG leaves in Maya which could have taken a week to two weeks to accomplish. After searching, stock footage of blowing leaves was found on www.artbeats.com. Artbeats are a company which provide royalty free stock footage which is perfect for a project of this nature. The stock footage was bought, an alpha map was created for it and it was composited into the scene. See figure 8.11.28.

Figure 8.11.28 - *Leaf composite complete*
(See Appendix One Fig 8.11.28 for High Res. Version)

The stock footage was duplicated a number of times throughout the scene to provide better leaf coverage of the whole area. Every duplicate was masked to hide the edges of the footage and some was made more transparent than others to hide the fact they were duplicates.

The next stage for all the shots was to add dust particles. To simulate the landing of a helicopter the particles would have to be frantic and chaotic. Stock footage of dust particles being blown across a camera was chosen as the best method for portraying the effect. The footage was again acquired from www.artbeats.com. The footage was added to the composite and screened over all the other layers. This means the black parts of the image are turned transparent and the white stays solid. The footage was duplicated and time remapped in the After Effects to last the entire length of the sequence. It was also made slightly transparent and darkened using the levels tool. This particular piece of footage was also used on shots 3 and 4 for consistency.

The penultimate stage for all the shots was airbrushing. Every frame in the project so far contains small details which are not wanted in the final composite, these are the white golf balls, the two white markers and, in shot 3, the ladder the actor jumps off. All these objects must be airbrushed out of each frame. This is a time consuming and tedious process.

For shot three the background was taken into Photoshop and using the Clone Stamp tool the airbrushing or cloning process began. Cloning works by selecting an area in the image you wish to duplicate, in this case the wall behind the ladder or the ground. It then requires the user to paint over the undesired object and to try and keep the duplication as inconspicuous as possible. See figures 8.11.28 and 8.11.29.

Figure 8.11.28 - *Shot 3 with the ladder and golf balls*

Figure 8.11.29 - *Shot 3 with the ladder and gold balls removed*

For shot three this image was then imported back into After Effects and used as the background for the shot with the grain effect added to it to hide the fact it was a still image. For shots 1 and 4 the objects had to be removed frame by frame using the same process within After Effects.

After reviewing the footage so far it was decided that the leaves on the ground in the original footage should be removed. This was because those leaves are static. The static leaves needed to be removed to keep the scene realistic, because these leaves would have been blown away by the helicopter.

At first, a still image from the original footage sequence was taken into Adobe Photoshop and the leaves were removed using the Patch and Clone Stamp tools. This did not produce the desired effect, the ground looked as though it had been duplicated (which it had). This was due to there not being enough tarmac in the shot to clone. This is shown in figure 8.11.30

Figure 8.11.30 – Shot 1 with cloned floor

The problem was finally solved by using Maya. The ground plane which had been used earlier to help track the footage was altered to exactly match the landing space and the planes UVs were laid out ready to texture using the same process as used when texturing the Apache.

These UVs were exported into Adobe Photoshop and was covered with duplicates of a tarmac texture. This tarmac texture had very basic colour correction applied to it within Photoshop.

The texture was then applied to the plane in Maya and the sequence was rendered out.

Once back in After Effects, first, the new sequence was imported and further colour correction was used to match the plane with the scene. Because the footage had been tracked using Boujou and Maya, the plane was perfectly placed with no alterations.

A mask was applied to the plane with a feather of about 20 pixels. Feathering applies a gradient which begins at the line of a mask. The gradient starts at opaque and slowly moves down to totally transparent over a defined number of pixels, in this case, 20 pixels. This hides the harsh edges of the plane and creates the illusion it belongs in the scene. This however, did not work as planned. The mask itself had to be tracked onto the footage and this was extremely difficult and needed almost complete manual tracking which was very time consuming. Instead of wasting time tracking the footage, Maya was opened and using the Hypershade editor the material for the ground texture was given an opacity map. An opacity map works in the same way as an alpha map. It is a black and white image which defines areas of transparency. The opacity map was created in Photoshop with a soft edge brush which produces the same effect as a feathered mask in After Effects. This was then rendered out and colour corrected in After Effects. The final result is shown in figure 8.11.30.

Figure 8.11.30 – Shot 1 with feathered 3D floor

The mask was then tracked within After Effects so it stayed in the same place throughout the scene.

The final stage for all three shots was to add camera shake. Camera shake moves the image on screen on both the X and Y axis. It can also be told to rotate the footage ever so slightly. Using After Effects' Wiggler tool the footage can be automatically shaken to give the effect the camera is trembling in a persons hands or being blown by the wind the helicopter is creating.

First, the current composition is selected and a new composition is created with the current one within it. Then, keyframes are placed on the Position and Rotation transform options at the beginning and end of the footage as shown in figure 8.11.30.

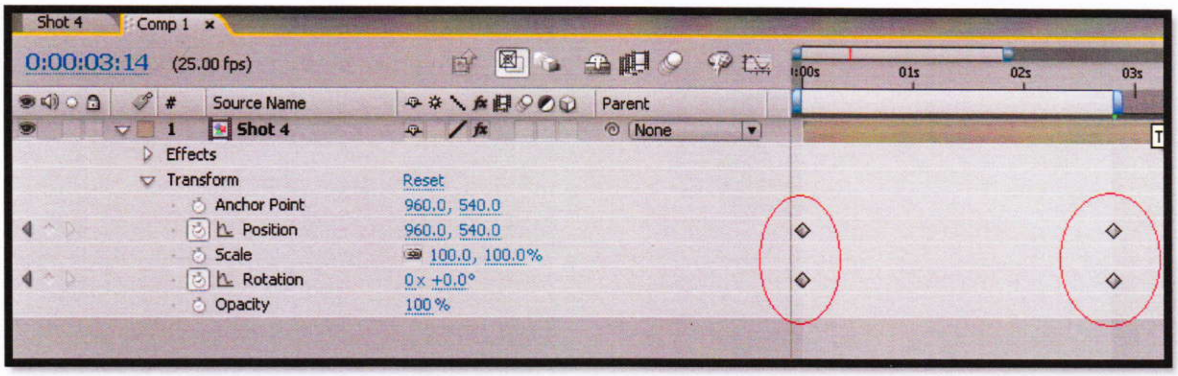


Figure 8.11.30 – *Keyframes places at the beginning and end of the shot*

Next, using The Wiggler, a frequency and magnitude is selected. Frequency is how many times/ second the footage moves and magnitude defines by how many pixels. See figure 8.11.31.

Figure 8.11.31 – *The Wiggler options*

The noise type option was set to jagged for a rougher movement and then the edges of the footage were mirrored using the Mirror Edges tool. It is essential to mirror the edges because otherwise the footage will move and leave black spaces where there is not enough footage to fill the window.

Once The Wigger tool is applied, it adds keyframes according to the set frequency which is defined by the magnitude. This creates random movement.

More often than not, using The Wiggler on its own is not enough, it will not create the correct effect. The keyframes it added automatically will have to be manually edited frame by frame to create the desired effect. Figure 8.11.32 shows the end result.

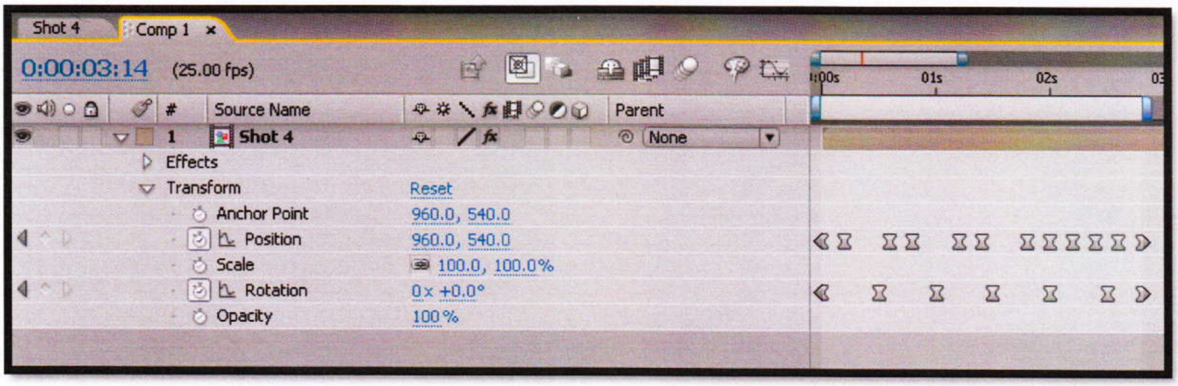


Figure 8.11.32 – The Wiggler applied and edited

FINAL RENDERS - 9

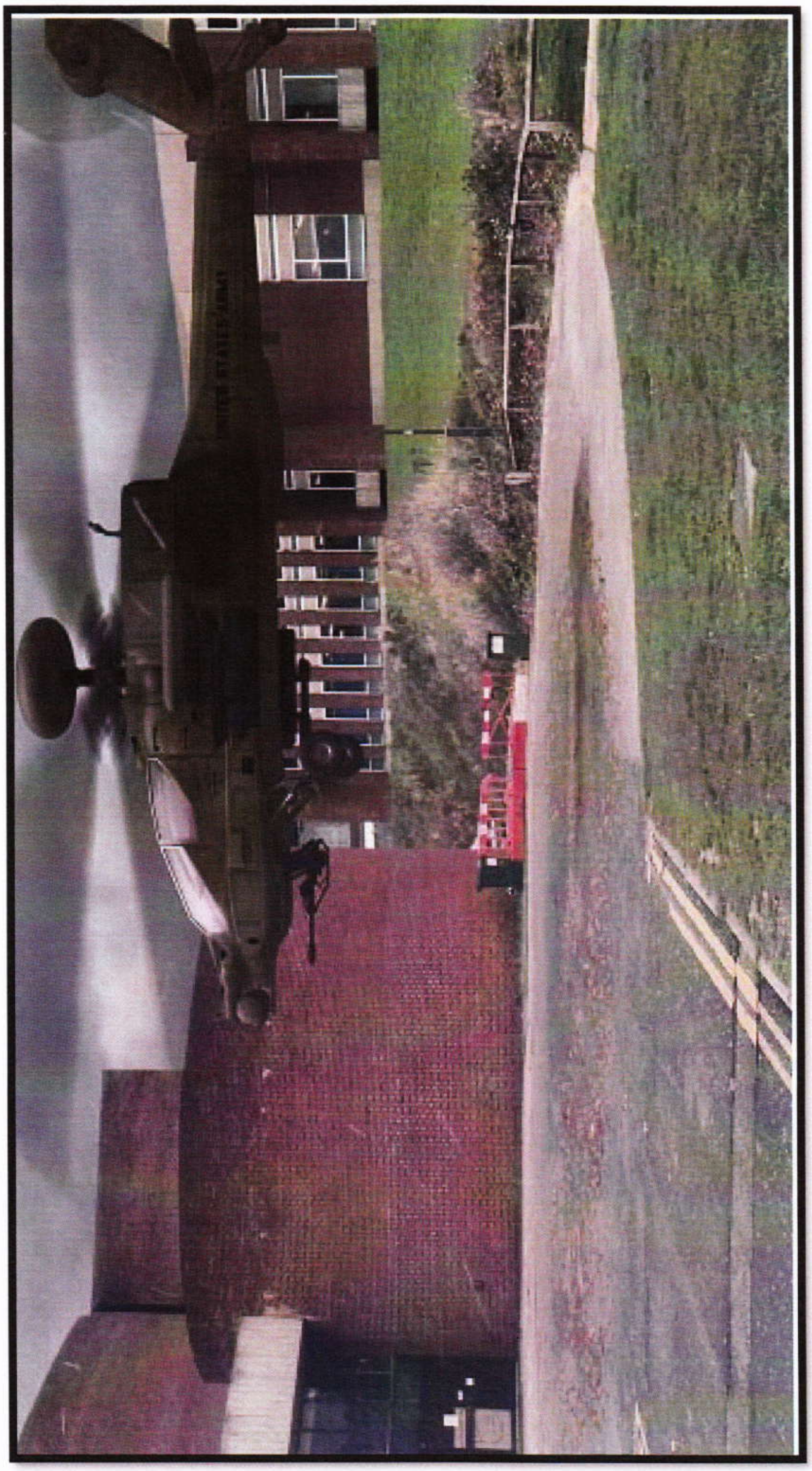


Figure 8.11.29 - *Shot 1 – Final Composite*

Figure 8.11.30 - *Shot 3 – Final Composite*

Figure 8.11.31 – Shot 4 – Final Composite

TESTING - 10

Technical testing was done as the project was being produced Such as checking the model animates as expected, making sure the camera track holds its position and checking all the masks and alpha channels work correctly in After Effects.

Technically, the project is completely sound and it work as expected and as planned. The main test for this project however is to show the final product to viewers and take a record of their opinion. This was done by showing the completed footage to a group of viewers and getting them to fill out a questionnaire. The questionnaire is shown overleaf.

good

William towle – Final Year Project Evaluation Questionnaire

Q1. Was the shot believable? Please circle a number 1-10 (1 = Not at all, 10 = Very)

1 2 3 4 5 6 7 8 9 10

Why a 10 point Likert scale?

Q2. Was there anything that struck you as wrong or out of place in the shot? Please circle Yes or No.

Yes No

If your answer was Yes, please describe the problem below:

____

____

____

Q3. Was the editing suitable for the shot? Please circle Yes or No.

Yes No

If your answer was No, please describe the problem below:

____

____

____

Q4. What did you like best about the shot?

____

____

____

Q5. What was your least favourite aspect of the shot?

____

____

____

Q6. Overall, how would you rate the shot out of 10? Please circle a number 1-10 (1 = Not at all, 10 = Very)

1 2 3 4 5 6 7 8 9 10

Thank you for taking part in this questionnaire.

The results of the questionnaire were collated and will be evaluated in the evaluation section.

EVALUATION - 11

After analysing the results of question one, 10/10 people thought the shot was between 7 and 10/10 in believability. Two people rated it 7/10, three people 8/10, four people 9/10 and one person 10/10.

This proves the shot was believable, with 80% of the viewers rating it 8/10 or higher. These results are shown in figure 11.1.

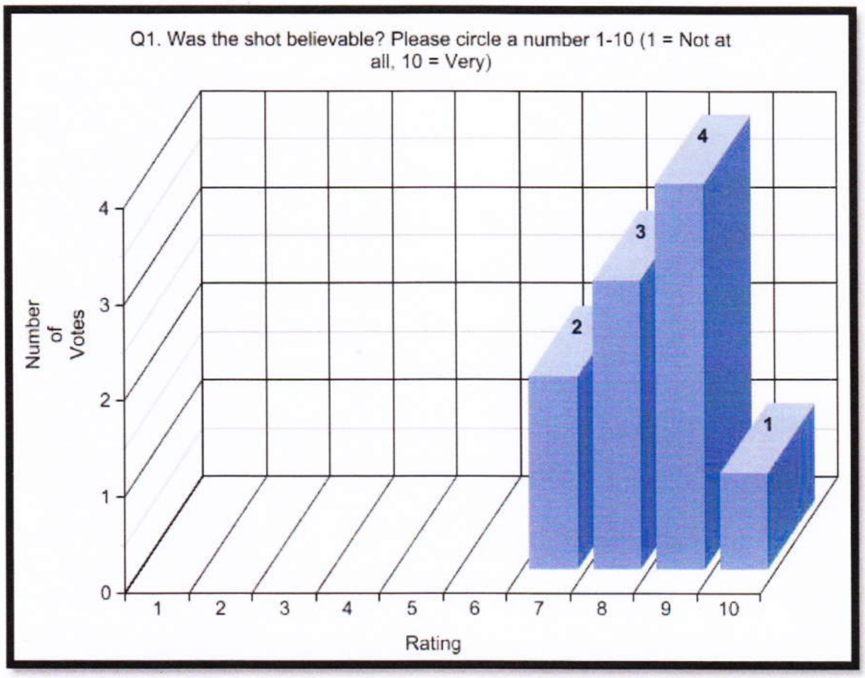


Figure 11.1 - *Results of question one*

Question two asked if there was anything that looked out of place or like it did not belong in the scene. 8/10 people said there was nothing that looked out of place and 2/10 said there was something wrong.

Both the viewers who answered yes pointed out that the colour of the helicopter changed slightly between shot 1 and the following close-up shot. After viewing the footage, the helicopter was further colour corrected to compensate. After the changes, the viewers were shown the new footage and 10/10 people said there was nothing out of place. The first set of results are shown in figure 11.2.

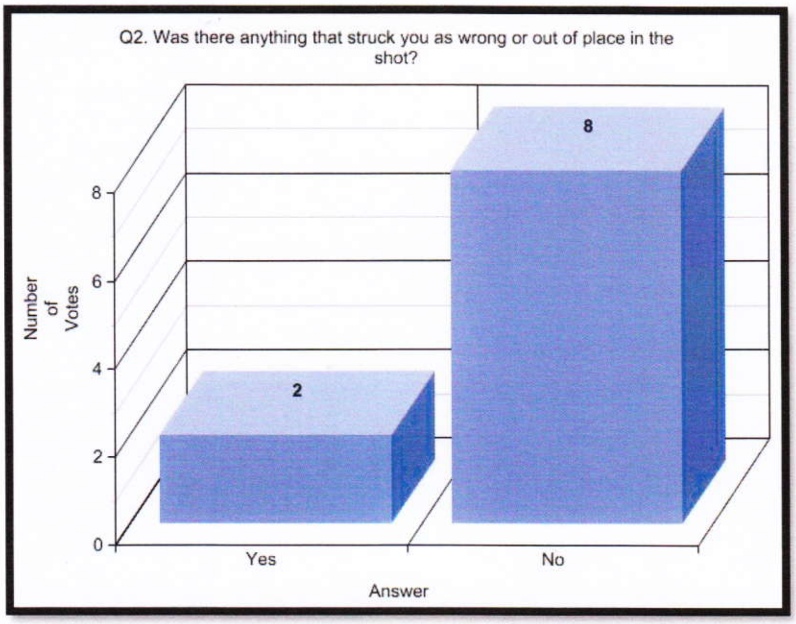


Figure 11.2 - *Results of question two*

Question three asked if the editing was suitable for the shot, meaning the cuts between the three scenes. 8/10 people said there was no problem with the cuts, but 2/10 people said there was. The two users both said the problem was with the cut between the first and second scene. The second shot was thought to be too short and hard to see what's going on because it is on screen for such a short amount of time. After this feedback, shot 2 was extended by roughly half a second in an attempt to solve this problem.

After the alteration, the footage was shown to the viewers again and they agreed the extension helped but the camera cut is still not perfect. Unfortunately there is nothing that can be done in post production to fixed a camera cut, but 80% of the test subjects said there were no editing problems and that is a huge majority so it can still be stated that the editing was a success.

Question four asked what the viewers liked best about the video. The majority of the viewers said their favourite section was the first shot as the helicopter comes in and especially when the cockpit opens and the actor jumps out of the helicopter.

It was stated that the first shot was very atmospheric and captivating and the following two shots rounded off the scene well.

Question five asked the viewers what their least favourite aspect of the scene was. The two areas which were focused on in this section were the camera cut mentioned in question three and one person noted that the camera shake in the second shot may be slightly too vigorous.

The camera cut was dealt with as much as possible using the methods stated in question three and after speaking to the user who pointed out the camera shake it became apparent he thought the shake was intended to co-inside with the pilot hitting the ground, which would not shake the camera as much as it was shaking. In actual fact the camera shake was supposed to create the effect of wind and turbulence underneath the rotor blades and, since only 1/10 people misunderstood the shake, it was not altered.

Question six asked the users to give the overall project a mark out of 10. Four users gave the footage 8/10 and six gave it 9/10.

This is an extremely positive outcome for the project with it not being marked below 80% by the viewers. Because this project was aimed at viewers the fact they have rated it so highly leads me to believe this project was a success.

Figure 11.3 displays the results for question six.

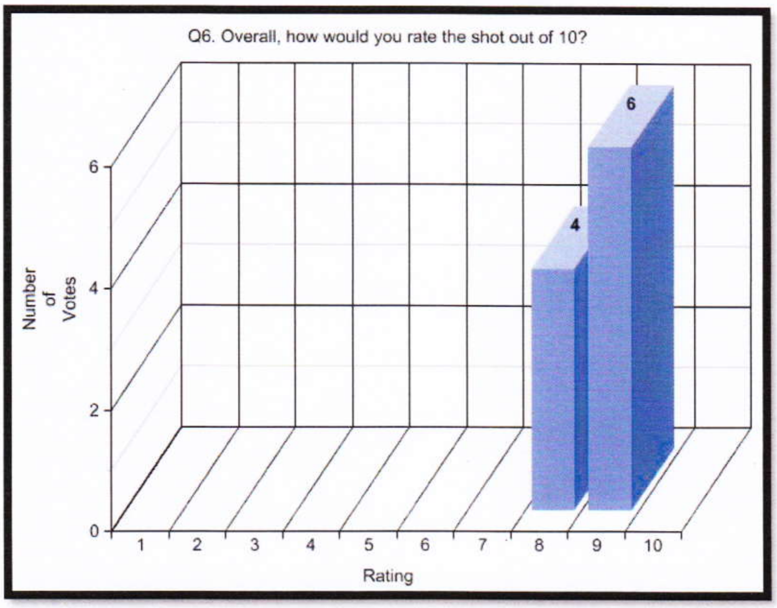


Figure 11.3 - *Question six results*

CONCLUSION AND FURTHER WORK– 12

This project was conceived with the intention of creating a believable video effects shot of a helicopter landing on the University campus. To meet these requirements Autodesk Maya, 2d3's Boujou, Adobe Photoshop, After Effects and Adobe Premier were utilized.

This conclusion will assess the success of this project based on it meeting the project requirements. Also, possible improvements to the footage will be discussed as well as potential future work.

CHALLENGES ENCOUNTERED DURING PROJECT – 12.1

During this project, many challenges were faced to complete the project to the expected quality and in the time scale. Some of these challenges were taken into consideration before the project had begun, but some proved much harder than expected during planning.

This section describes the challenges which were encountered during the project.

LEARNING AUTODESK MAYA – 12.1.1

Learning Autodesk Maya was much harder than expected. Having a background in Autodesk 3DS Max, it was presumed that the learning curve for Maya would be much the same. It turned out to have a much steeper learning curve than Max. New

Although both programs essentially have the same function, being used to the Max workflow proved to be extremely frustrating when trying to model and texture the helicopter in Maya. Maya has a far more complex texturing workflow and, although the modelling workflow is similar, the fact the GUI (Graphical User Interface) differs so much from Max and all the functions are named differently meant becoming accustomed to the new environment was wearisome and tedious. well done

However, on reflection, Maya was still the best choice for the task and after the basics had been learnt, working in Maya was an enjoyable and productive experience.

LEARNING 2D3'S BOUJOU – 12.1.2

Having never used tracking software before, stepping into using Boujou was a jump into the unknown. After familiarising myself with the interface and the basic workflow using tutorials the track for the project was attempted. The track for the project took between nine and ten attempts before a track was produced which was to an acceptable standard. New

The tracking took longer than expected but the extra time put into producing a good track was worth it for the end result. Without a good track the shot would not have been believable. good

LEARNING ADOBE AFTER EFFECTS – 12.1.3

Adobe After Effects was another program which had to be learnt from scratch. After Effects was heavily used in the production of the project and had to be mastered quickly if the project was to be a success.

From knowing nothing of the program, advanced features had to be learnt including feature tracking, time-remapping and the colour correction workflow.

ANIMATING THE HELICOPTER – 12.1.4

Animating the helicopter was a long and tedious process. The animation was done in Maya and, as previously stated; Maya had to be learnt from scratch. Adding the small detailed movement to make the helicopter move realistically took a long time and many test animations were produced to assess the animation before the final animation was produced.

THE FINAL PROJECT – 12.2

The final project presents a video effects shot which combines 3D Modelling, animation and compositing to create the illusion of an Apache helicopter landing on campus, the pilot jumping out, hitting the ground and walking off screen.

In the creation of this project a variety of professional software solutions were utilized to produce the end result. In the construction of the project such programs as Autodesk Maya, Adobe Photoshop, Adobe After Effects and 2d3's Boujou were used and an insight was gained into the workflow and production of a visual effects for film or television.

As shown in the evaluation section, the majority of the end users voted that the project fulfilled its requirements of making a believable video effects shot of a helicopter landing on campus

In conclusion, with all of the users voting the project above 7/10 for believability, it can be classed as a success.

FUTURE WORK – 12.3

ANIMATION – 12.3.1

Given more time and to developing the project further, the animation could be further refined to match that of an Apache Helicopter. Although none of the viewers commented on the animation being wrong or out of place, as personal preference added animation detail would add to the scene realism.

This could be implemented using the animation techniques discussed in this project.

TEXTURING – 12.3.2

For further future development, the helicopter could be further textured adding more grime and dirt, making it look old and worn. In some frames of the project the helicopter looks a bit too clean and extra dirt would help add believability and realism.

The dirt or grime layer would be made in Photoshop using the same techniques as the original texturing process.

SOUND – 12.3.3

Sound was possible addition functionality for the project time permitting. Unfortunately, there was not enough time left at the end of the project to implement sound.

Sound would be added to the footage using Adobe Premier or Final Cut Pro. Sound would provide an extra dimension of realism immerse the user further into the project.