

# Major Project Documentation

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## Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
<b>2</b>	<b>Pipeline Management</b>	<b>2</b>
2.1	Requirements . . . . .	2
2.2	Limitations . . . . .	2
2.3	Storage . . . . .	3
2.4	Asset Management . . . . .	4
2.5	Asset Pipeline . . . . .	4
<b>3</b>	<b>Character Rigging</b>	<b>4</b>
3.1	Requirements . . . . .	4
3.2	Solution . . . . .	5
<b>4</b>	<b>Groom</b>	<b>5</b>
4.1	Pipeline . . . . .	5
4.2	Results . . . . .	5
<b>5</b>	<b>Rendering</b>	<b>5</b>
5.1	Optimisation . . . . .	5
5.2	Distributed Rendering Tools . . . . .	6
<b>6</b>	<b>Compositing</b>	<b>6</b>

# 1 Introduction

This document serves to detail the work I was responsible for during the Final Major Project assignment, in which I helped create an animated short film as part of a four person team. As an aspiring software developer, my responsibilities for this project were mainly the technical aspects within production, such as pipeline management and character rigging.

## 2 Pipeline Management

### 2.1 Requirements

- Reliably store all of the project data in such a way that is accessible to all team members.
- Provide artists with a tool that manages assets, allowing them to update, reference,
- Provide artists with a simple method for releasing new versions of assets.
- Provide artists with a simple method for gathering assets, so that they can be referenced into a scene.
- Manage versioning of assets, accompanied by information regarding each versions release date, author, and description.
- Automatically update references to assets whenever an asset or one of it's dependencies has been updated.
- Provide an automated method for caching the entire scene, with the aim of 'packaging' the project to make it suitable for rendering on different machines.

### 2.2 Limitations

Prior to developing the pipeline and associated tools, it was important to address the limitations imposed by the environment in which we would be working. The most important of these were:

- Lack of unified storage amongst users. Due to the way the university network is set up, it isn't possible to have a single network location

for our shared data storage, without sacrificing one members allocated user storage.

- Lack of storage per user. The approximate storage limit per user is 50gb, which would quickly be hit in a complex production environment. It is therefore imperative that we are concious of the data that we keep hold of.
- Lack of storage space on the renderfarm. The approximate storage limit on the renderfarm is 30gb, meaning that all of the data required to render a scene or shot must fit well within this limit, as rendered frames are written to the same location.

### 2.3 Storage

For file storage we chose to use Resilio Sync, a peer-to-peer file synchronization service to store all of our working files. This ensured that each team member has their own local copy of the entire working directory, which is beneficial when creating backups. We chose Resilio Sync primarily because it is a free service that is compatible with the university computer network, however it does present us with some problems.

Due to being it peer-to-peer service, we often found that directories would fail to synchronize properly if not synchronized frequently with the other peers. This would not be a problem in a cloud hosted service as the directory state of the working directory would be reliably centralized, reducing the possibility of files becoming desynchronized, however these services are typically expensive and it was difficult to predict our exact storage requirements.

We also noticed a strange problem with Resilio Sync, in which the contents of files would be reduced to 0 bytes. Fortunately the data is usually not lost as it is sent to the 'Archive', which functions as a temporary recycle bin, though restoring these files manually each time it happened proved to become quite tedious. I decided to write a simple bash script to check through the working directory to identify any files with a size of 0 bytes, and to check if a matching file was present in the Archive. However, this wasn't particularly effective as often they would be missing from both the main working directory and the Archive, meaning I would have to search through backups to find the file to restore, which at times felt a bit like baby-sitting.

## 2.4 Asset Management

## 2.5 Asset Pipeline

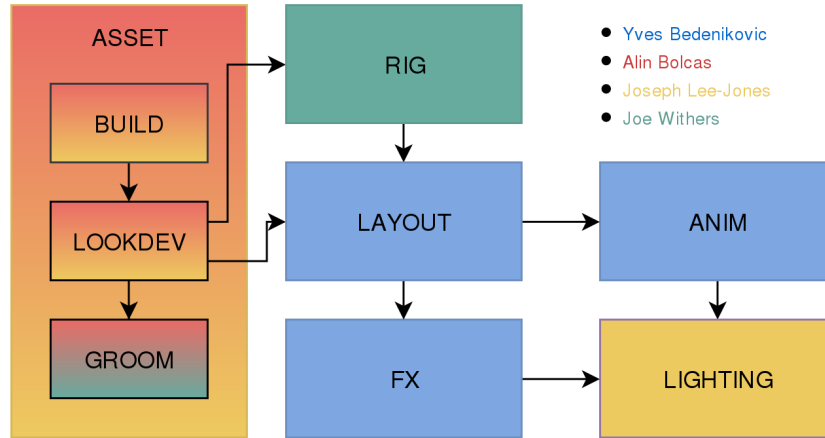


Figure 1: A Flowchart describing the asset pipeline, colours indicating the contributions of each group member.

## 3 Character Rigging

### 3.1 Requirements

For this project I was responsible for the rigging of both characters, as well as the rigging of any props that the characters interact with. Prior to working on the character rigs, it was important to outline features that would be required to achieve an appealing animation. This ranged from features that would allow the animator (Yves Bedenikovic) to work with them more efficiently, to features that would improve the overall aesthetic of the animation such as cloth and hair simulation. The following features were found to be of highest importance:

- Controls should be familiar to the animator to allow them to work intuitively with the rig. This can be achieved by using previous rigs that the animator has used as reference when setting up controllers.

- Rigs should be capable of achieving the desired facial expressions and poses as dictated by the story.
- Rigs should include the necessary geometry and nodes to allow for cloth simulation to be applied to clothes.

## 3.2 Solution

With these features in mind, I decided to use an automated rigging system to speed up the creation of the character rigs. This allowed me to focus primarily on the features listed above, and let a tool automate the creation of the basic bipedal rig.

I first looked at Kraken[3], a rigging system included within Fabric Engine. This appealed to me as it was easily extensible through its scripting language, which I thought I would find intuitive given that I had produced a basic automated rigging system for the specialism assignment in second year. Unfortunately, Fabric software went bankrupt at the beginning of the academic year so we were unable to get it working on the university computers.

I then found Advanced Skeleton 5[4], an extensive rigging tool for Autodesk Maya, which I found to be extremely capable and was more than adequate for my needs.

## 4 Groom

Xgen stuff

### 4.1 Pipeline

### 4.2 Results

## 5 Rendering

### 5.1 Optimisation

Due to storage limits imposed by the renderfarm, it was necessary to cache the scene geometry to remove the need for large assets to be stored as part of the project. Whilst it would have been possible to use the Alembic file format for this, I opted to use RenderMan's RIB archive format, as it is capable of storing shading networks and render attributes in addition to scene geometry. One downside of this approach is that shaders cannot easily

be changed after the cache has been made, however it eliminates the need for reassignment of shaders, which would be necessary in a comparable Alembic caching workflow.

## 5.2 Distributed Rendering Tools

[5] [1]

## 6 Compositing

In addition to being responsible for rendering, I took responsibility for compositing the shots, which was convenient as I was managing the storage of the raw renders and would be the first member of the team to get a chance to do any compositing. Being more technically inclined my compositing responsibilities mainly consisted of:

- Reconstructing the 'beauty' pass from the individual AOV passes. The AOVs we ended up using for reconstruction were direct diffuse, direct specular, indirect diffuse, indirect specular, subsurface, and transmissive, with the beauty pass being used for reference. The albedo pass was also used to generate a high pass filter for overall sharpening.
- Rotopainting out any visual errors if time did not permit re-rendering a shot. This primarily consisted of hiding any intersections between the shirt and the jacket, or intersections between the cornea and the eyelid when the eyes were closed.
- Removing Fireflies or any high variance visual noise from the individual passes, either through use of Nuke's denoiser or a third party 'Firefly Killer' gizmo found online [2].
- Setting the display colour space as ACES Filmic, and setting up a node to bake the colour space prior to writing.
- Adding depth of field to shots where depth of field wasn't calculated in RenderMan.

As these tasks were common to all shots, I created a template Nuke script which configures everything for me. Unfortunately, when reading multichannel EXRs generated by Renderman, Nuke would swap the alpha channel with the red channel from the direct specular. However this was easily fixed using a pair of copy nodes.

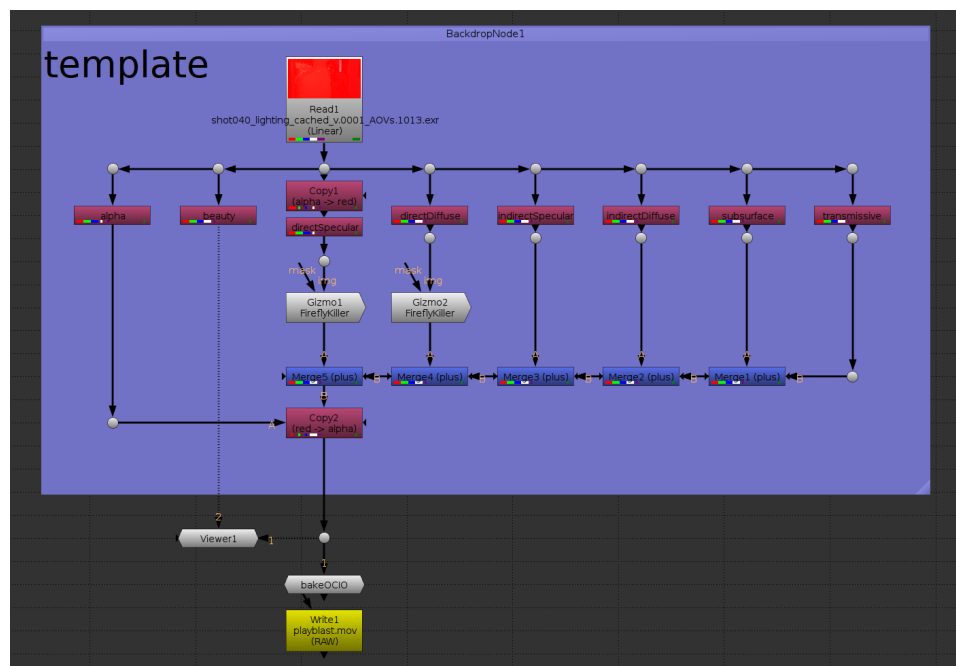


Figure 2: The template Nuke script which was used as the basis for all shots.

For the opening shot, a more complex Nuke script was necessary as we needed to integrate FX elements, all of which were rendered separately. We also chose to render the foreground and background separately so that we could make adjustments to them independently.

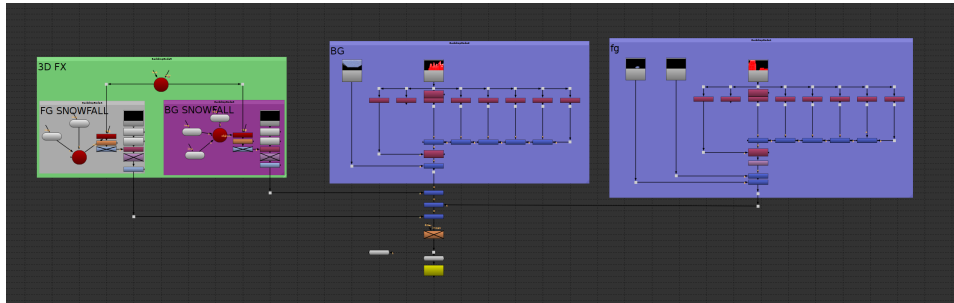


Figure 3: The Nuke script which was used for the opening shot.

## References

- [1] Ben Martin. Parallel ssh execution and a single shell to control them all, 2008.
- [2] Stefan Muller. Firefly removal, Feb 2015. Accessed 16 May 2018.
- [3] Fabric Software. Kraken - rigging framework, 2015. Accessed 23 December 2017.
- [4] Animation Studios. Advanced skeleton, 2016. Accessed 23 December 2017.
- [5] [www.parallelssh.org](http://www.parallelssh.org). Parallelssh - asynchronous parallel ssh client library., 2014. Accessed 8 October 2017.