Experimentation with Textures and Materials inspired by the Aesthetics of Two Dimensional Animation.

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Abstract

Creating a background/environment combining three dimensional computer graphics and two dimensional traditional animation. I want to create a style that has the realism of 3D but mimics the aesthetics of 2D animation.
To add a certain amount of visual interest experimenting with different materials, textures, colours, depth and perspective.

Introduction

Technology has advanced so rapidly in the past few decades- from the traditional cell animation to the highly technology based computer graphics. I want to study the link, the merging and amalgamation of these two techniques in today's day and age.
With the boom in 3D computer graphics I feel sometimes animators settle down to things that are readily available to them. Artists don't have to settle with the realms that they are subjected to, but also look for inspiration across wider fields. I want to use the tool of 3D computer graphics but mimic the aesthetics of 2D animation.

Three-Dimensional animation allows you to change your point of view within a given scenario, which makes 3d more 'realistic' or 'believable' when viewed in video or computer games.

2D on the other hand removes you from a scenario and presents the virtual environment as a layered stack of images. This could at some level relate the way you would see in a book.
Personally, I appreciate the combination of the two styles in order to maximize the artistic side, freedom of movement as well as the realism of 3D.

The bottom line being despite of the great advancement of 3D animation technologies, 2D will still have a place in the equation.

The reason I am researching the relevant techniques and skills associated with 3D computer graphics and the traditional 2D style is to build an environment which integrated the two styles. I will look what the technical side computer graphics has to offer and how I could implement them in my work.

Aims and Objectives

My aim is to create an environment in three dimensional incorporating the visual aesthetics of two dimensional aesthetics inspired by some Disney classics.

I want to explore use of different materials and textures available to me from a procedural front as well a traditional.
I believe to provide your audience with extra visual interest and add depth to the elements that are displayed onscreen the exploration of different techniques and materials is important.
I have never explored this side of computer graphics before. I wanted to get more involved in it as I feel this is where my strength lies.
The way I went about this process was looking at the history of traditional animation, painted backgrounds and then approaching the technology that we are faced with today and trying to combine the two to develop a technique I liked.

Environments in Cell Animation

In cell animation or hand-drawn cartoons backgrounds remain in a fixed two-dimensional style throughout the duration and do not mix with the mostly foreground elements such as the characters. Though later more experiment animations do mix the two.

The background artist's who is in charge of this would paint the sets over which the animation takes place on. These backgrounds were usually intricately painted in gouache or acrylic paint, water colour, oil paint or even crayon.
When it came to filming the backgrounds camera movements tend to be limited to lateral left to right pans across the backgrounds or up and down tilts.

The movement of the camera across a background plate can give the viewer an illusion of a change in perspective or an angle to facilitate a change an environment for the character.
The invention of cell animation made it easier for artists to make longer films. When the different techniques of the tradition ways are considered it makes us realise how beneficial the computer is to artists nowadays.

There are some animation backgrounds I was deeply inspired by while making my own environment.

i. Cinderella

In the classic Cinderella, the backgrounds are beautifully hand painted looking closely at key principles such as hue, tone and intensity. Red, yellow and blue are the basic hues from which all others on the chromatic scale can be made of. These three opaque pigments are the subtractive pigment primitives.

These backgrounds also are great examples of tonal progression, colour palette, depth, volume, perspective, brightness, saturation and texture.



Images from Walt Disney's Cinderella

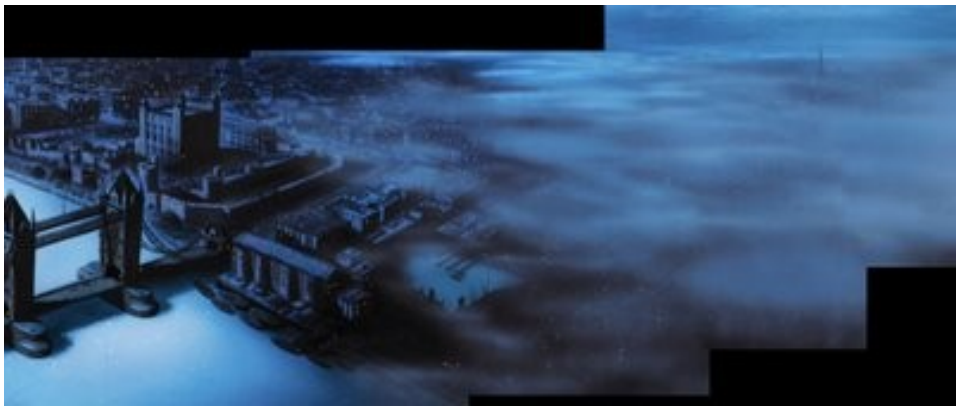
ii. Sleeping Beauty

The background art from Sleeping Beauty had Eyvind Earle's paintings as a major component of the look and feel of this Disney classic. Note the distinctive style and texture!
Even though it is a completely flat picture there is so much depth to it.

Images form Walt Disney's Sleeping Beauty

iii. Peter Pan

I studied the two opening shots from Peter Pan. The pan backgrounds are incredibly atmospheric. The clouds in both were animated in the forefront via the multi-plane camera. The third piece is an aerial view of the Darling house and neighborhood.



Opening pan shots from the beginning of Peter Pan

Fabrication – Looking at different Materials

Fabrication the term to me would directly be linked to materiality and as such the creation of a certain meta- reality which sometimes has the same property in the real world. The existence of materials of constructed objects and environments, natural forms, man made materials and substances which are taken for granted in everyday world.

Jan Svankmajer, says of this process:

“For me, objects are more alive than people, more permanent and more expressive. The memories they posses far exceed the memories of man. Objects conceal within themselves the events they’ve witnessed; that’s why I’ve surrounded myself with them and try to uncover those hidden events and experiences, and that relates to my belief that objects have their own passive lives

which they've soaked up, as I were, from the situations they've been in, and from the people who made them."[1]

Svankmajer's work serves the true importance of fabrication. Three-dimensional animation relies upon the complicity of the materials in the construction and representation of particular kinds of personal world.
Studying the different materials in reference to there colour and texture and bring such a strong contrast to an image or a three dimensional background.

An animation by Jan Svankmajer using al sorts of different materials

1.2 Environments in 3D Computer Graphics

'We know that that 2D makes things more beautiful but 3D is more real'. [2]
3D definitely brings in the reality to a final piece and 2D is the aesthetic appeal. The later definitely does have certain barriers which sometimes can hinder something not to look as believable. The true understanding comes when you watch films and great productions have used the two together.

[1] Well's P (1998) Understanding Animation
[2] www.beeijingportal.com.cn/7838/2004/06/30/2007@2137834.htm
3D Not a Child's Game

Many modern day productions make use of all techniques opened to them and by bringing techniques/knowledge together they are able to achieve far superior results which are not achievable with the use of only one material. I feel to keep the 2D elements alive in 3D brings a level of aesthetic and surrealism to a 3D environment.

Remakes of old classics are being made today with the help of new technology which wasn't available in the past, for example "The Beauty and the Beast" released in 1991. Its obvious how with the help of the advanced technology and high end software old classics such as that can be improved to look visually stunning.
The majority of the productions nowadays use 3D entirely, for the characters, vehicles, environments, props etc. The use of CGI produces a great level of realism in camera angles, lighting, depth which perhaps 2D animation was missing. 3D gives you a virtual plane, a space and depth which project's a believable environment. I feel that CGI is lending its skill and starting to produce more superior 2D work. Technology will carry on progressing but there will always be a place for the traditional hand drawn animation.

Environments and backgrounds are used in almost all aspects of animation – internal and external. Today there are several ways of creating an environment it's either a three- dimensional modeled or a projected matte painting. I want to create an environment which combines the two.

The use of different materials and textures, you provide your audience with extra visual interest and add depth to the elements that are displayed on screen. A film containing no colours or textures would create a visual experience that's far from interesting and exciting.
Not too long ago, computer generated graphics were restricted to a visual quality in which everything had a plastic, metal or glass look. However, now technology has evolved and simplified to the point that we have a variety of looks available to us. We can recreate what you see in the real world with the use of procedural textures and texture maps and can also experiment with graphic styles.

The Background for an environment

The presence or absence of elements in the background will create an abstract, real, fantastical scenario for your character to be in. A small number of background elements would contribute the audience's attention on the character. On the other hand, it also might create a feeling of loneliness or desolation if you have vast landscapes.
If you over clutter the background with loads of buildings, signs, traffic it may give an impression of chaos. A large number of objects can add detail and realism to your film, but if you over do it, it can complicate the production.
I also considered having living backgrounds. As seen in The Wizard of Oz, trees that actually throw apples not just simply sway in the wind and in Das Rad the rocks and building and trees don't remain static.

A Still from the film Das Rad

Background Plates/Matte Paintings

Background plates and Matte Paintings are often used to in computer graphics. You can model and render every object in your scene; however, background plates can be used to reduce render time and make things much easier.

A background plate is a pane that is connected to a camera and sits in the background behind the foreground elements. After which a painting or photograph is projected on it which would expand the depth of the scene.

The background plate images are most useful for distant elements that would be difficult to model such as clouds, cityscapes, or a large number of objects.
A few mountains in the distance in a foggy landscape will surely create a sense of depth and distance. Background plates of images of above the clouds would certainly give the feeling of the character flying or floating about the ground. A background plate of a single hue would probably make an environment look less specific.

Also another main advantage of matte paintings I feel, are that they don’t significantly increase file sizes.

The main disadvantage of background plates is that camera moves can often break the perspective illusion. The further the background plates are the more freedom you have with the camera.

Case Study 1

Beauty and the Beast

'Beauty and the Beast', the classic French fairytale released in 1991 by Walt Disney was a true master piece. It was the first and only animated film which was nominated for Best Picture Academy Award.

Beauty and the Beast was a major stepping stone for Disney into the world of 3D computer Graphics. The incorporation of 3D beautifully with 2D truly was a great achievement. Pixar, a relatively small and unknown company at that time created the rendering software that was used in the film.

The film incorporated traditional 2D animation and some 3D animation together to create exquisite new visuals. The ballroom sequence was the most remembered scene with captured much attention.
Jim Hillin, CGI artistic supervisor said, "The ballroom sequence features the first computer – generated colour background to be both animated and fully dimensional"[3]
This allowed the animators to literally animate the background, which allowed camera angles and shots that would have never been possible.

The ball room sequence was the defining moment of the film, where the two protagonists of the film get together. The acceptance of new technology helped the makers to heighten effects that would not have achieved with traditional media. The freedom to play with a virtual space can exaggerate emotions and also show of the ballroom interiors which is surely not possible with the flat piece of art work.
The acceptance of new technologies in the correct way would help enhance the traditional industry. It helps convey messages more potentially and enhance the audience's experience.

In the ballroom sequence, the beauty and the Beast are dancing within a rotating room. The animation artists had to work with in

[3] www.digitalmediafx.com/Beauty/Features/originalbeauty.html

a 3D frame. Even though the 3D input was great and parts of it looked photorealistic and 3- dimensional, the fine skills of people such as Glen Keane who has been with Disney since the 1970's brought in a 'painterly' look to it.

The dimensions of the ballroom helped creating the final look. 72-foot high ceilings, 184 feet from door to door with a width of 126 feet, a 86x126 foot dome[4] with a mural that way hand painted then applied as a texture map and 28 wall window sections. The camera became the eyes of the scene enabling audiences to have a look around the room. The lighting was done in such a way that it produced theatrical effects, with one hundred and fifty eight light sources. The innumerous number of candles illuminated the entire room in a very unique way.

The integration of 2D and 3D elements evoked a certain emotion and drama to the film. The 3D elements really boosted the 2D traditional way of animation and pushed all its boundaries.

This case study illustrated to me that to achieve the kind of results you are looking for in your planned vision, you need to en corporate a whole lot of techniques, soft ware, technology, and traditional methods.

[4] http://www.digitalmediafx.com/Beauty/Features/originalbeauty.html
An inside look at the original Beauty and the Beast

Images of the famous Ballroom sequence

Case Study 2

Eni Oken

Eni Oken, is a freelance 3D Artist from Brazil who is based in Los Angeles, California.
I liked her artistic style. It was very exaggerated from my likings but I definitely was exspired by some aspects. It was colourful, fantasy like and very ornamental

A render of “Little Village Far, Far Away” by Eni Oken

Her render “Little Village Far, Far Away” is purely her need to fulfill her vision, it was her way to express an opinion. It wasn’t a client or commercial project, breaking away from the commercial style.
It was created on 3D Studio Max, Nendo, Photoshop. It consists of visual effects such as glows and fire. The scene only containing 380,000 polygons which is very surprising as the image is so detailed.
Another very striking aspect of her work was her choice of colour palette.

“One must understand the psychological power of colour.”[5]

The image also has a great deal of depth and contrast. The distance blur enhances the tonal regression making the foreground detached and enhanced from the background. The lighting she used doesn’t look particularly realistic. There were 28 lights in this scene, approximately three lights around each important object and a blue backlight behind each, perhaps giving an effect of the reflection of the sky.

Material Types in 3D Graphics - Maya

Lambert- This is the best when it comes to conveying dry, unpolished matte surfaces. This material is capable of diffusion but it has absolutely no specular quality.

Phong- This type of material is to depict sleek and extremely well polished surfaces such as varnished wood or plastic.

Blinn – This type of shading casts specular highlights. The Blinn shader works well for metallic highlights , such as brass, aluminum etc.

Material Attributes

The meaning behind each material attribute helped me a great deal to understand what they did and achieve what I had in mind.

Colour – The colour attribute results from the combination of hue, value and saturation. In the real world, colour is not a

[5] http://www.raph.com/3dartists/interviews/i-i141.html - An interview with Eni Oken.

property that an object inherits, but a property of light. In computer graphics colour is calculated from a system that interpolates between primary hues combined with saturation values.

Ambient Colour – This attribute can be described as the effect of a light source that is inherited to the material itself.

Diffusion- This attribute determines the way light spreads and gets distributed over a surface.

Specularity- This attribute measures the degree in which materials can reflect light in the form of bright highly concentrated highlight. It is usually used in depicting shinny surfaces.

Translucence- this property determines the way light can filter and gets diffused through the surface of the object. This could be used to depict leaves, human skin etc.

Refraction -The natural phenomenon of light when a ray of light makes a trajectory at a slanted angle from one medium into another of different density.

Incandescence- This attribute makes a material appear as if light is emanating from it. It could also make a material glow.

Texturing

Once your surfaces have been assigned materials in which case they will react to lighting in the scene, textures and used to dress up the geometry so that they look more believable. Texturing is the stage after the material assignment they add depth and definition to objects. It also provides you with the opportunity to add your personal touch to your work.
With your art direction in mind I began the the process of obtaining my textures.

i)Traditional Mediums

You can use traditional mediums such as water colours, acrylics, pastels, oil paints, airbrushes which you can scan and create a variety of textures with.
This creates a strong artistic style for a project.
Doug Aberle's animated short, Fluffy, used the technique of painted textures with traditional medium before being transformed onto the digital models.
Fluffy was an energetic dog who sees life as a challenge to be conquered, even if he doesn't understand it. The story is being told from a dogs point of view where they don't understand what the humans are trying to say to them.

A still from L'Enfant de la Haute Mer by Laetitia Gabrielli, Pierre Marteel, Mathieu Renoux, and Max Touret

ii) <u>Real World digitalized textures</u>

The world around us is a massive source for a huge variety of textures. Taking photographs and scanning in materials from real life and then transferring them to the 3d models would really give a feeling of the reality.

I often carry my camera along with me to collect textures that I've photographed and used.

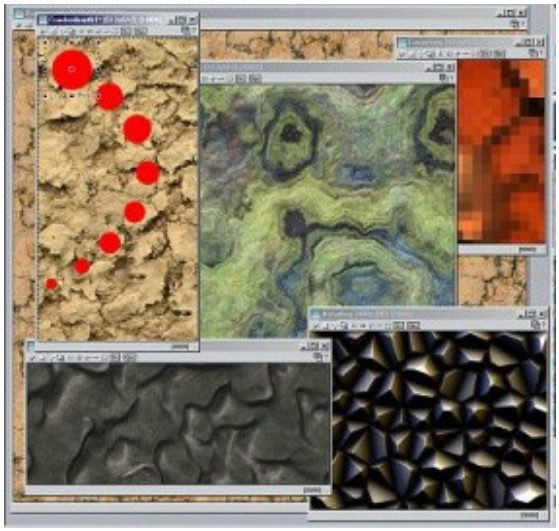
Images I collected of real world textures

iii) Two-Dimensional Painted Textures

Another viable way to generate textures is to paint them using digital software such as Photoshop, Corel draw, Gimp, which provides us a wide rang of tools and utilities to add detail to your texture painting.

iv) 3D Painted Textures

There are also 3D paint programs available such as Right Hemisphere's Deep Paint and Mazon’s Body Paint 3D. These programs are helpful when you are adding finishing touches to a surface that has already been textured by other methods.



A Snap Shot of Right Hemisphere's Deep Paint

v) Procedural Textures

I wanted to learn about procedural textures because I’ve always had a pre-conceived notion that procedural textures look plastic and generic 3D. I wanted to experiment with them and see how I could incorporate them into my personal style.

Instead of manually creating all the textures you can generate textures procedurally. Procedural texturing uses numerical algorithms that stimulate natural patterns such as wood, marble, rock, textiles, animal skins, skies etc. There are numerous numbers of permutations and combinations you can have of the colour combination, variation in patterns, so it takes a fair number of trial and error to finally reach your desired look. The advantage of procedural textures is that they don’t have a fixed

resolution limit so you can zoom in or out without losing any detail. There are two types of procedural textures two dimensional and three dimensional.
3D influences the geometry whereas 2D procedural textures are applied like texture maps. Most 3D packages ago come with default settings for a particular procedural texture.
Whilst experimenting with procedural textures I found the advantages to method being,

- They look more natural as they are no seems caused by texture wrapping.
- They have finite resolution.
- They have a good amount of control over the material definition.
- One procedurally generated texture can be used to create a range of similar materials.
- I felt the rendering time was also much faster.

3D procedural Textures

3D procedural textures work in a way that when they are applied to a surface it produces a different pattern for each axis. There is no need for the specification of materials for the top and sides of the object as may be required with standard texture maps.

2D procedural Textures

Each 2D procedural texture has its own specific setting as well, to control various aspects of its appearance.

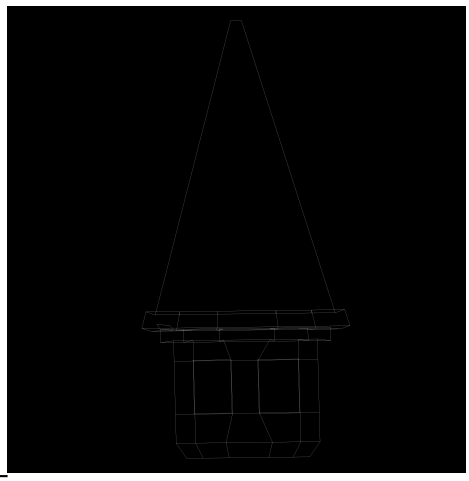
Procedural Textures provide us an alternative to the choice of image based textures. The difference between them would be the memory cost and execution time. Graphic architectures that are equipped with the ability to display image textures typically have large amounts of memory and with a handful of fast processors.

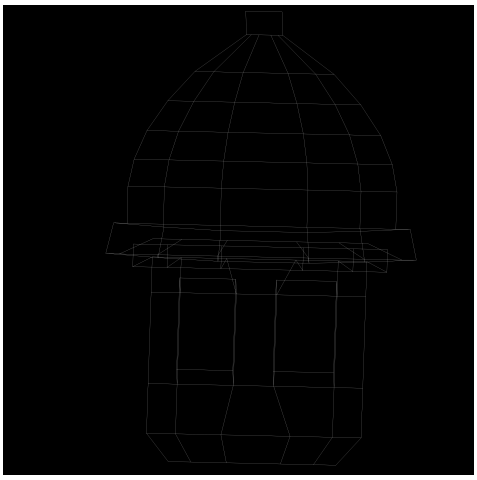
Texture Mapping

Texture Mapping allows you to increase the detail on your model without increasing the detail on the model. Once, you've created the texture maps you have to apply them properly on your digital models. The texture maps are attached to the geometry of CG models through the influence of a coordinate system. The 2D image file is based on XY coordinates textures are applied to digital models based on the U(horizontal) and V(vertical) coordinates. The way you apply a texture map varies depends on the surface type. NURBS surface have implicit UV coordinate structure, so the texture can be fitted to the geometry based on the parameterization of the surface. Polygons, on the other hand need actual creation of a UV coordinate system for the surface.

Sometimes to be able to achieve a desired look a single texture map isn't enough. Creating texture layers can help us give attention to different details independently.

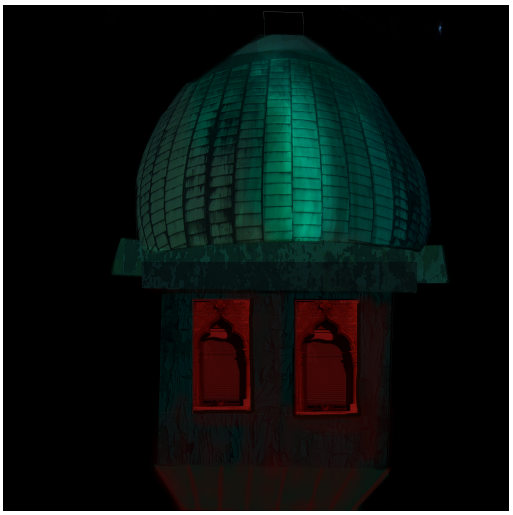
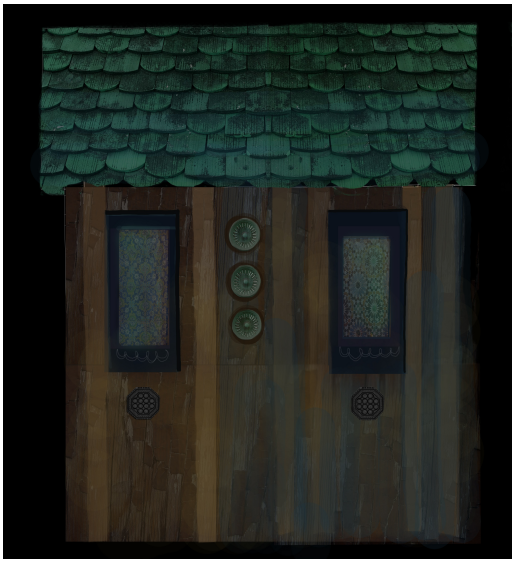
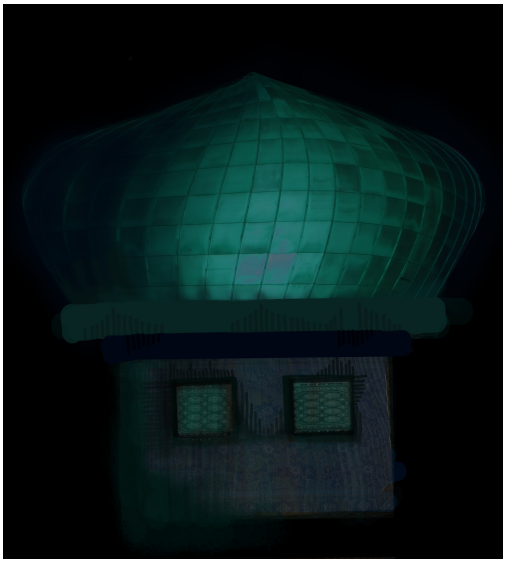
Materials and textures can add extra detail, definition and visual interest to your digital scene. I want to create an environment that combines procedurally generated texture maps, hand painted traditional texture maps, the use of traditional media, photographs, colours, reflectivity, specularity, translucency, glow etc. and develop a style based on my own art direction preferences.

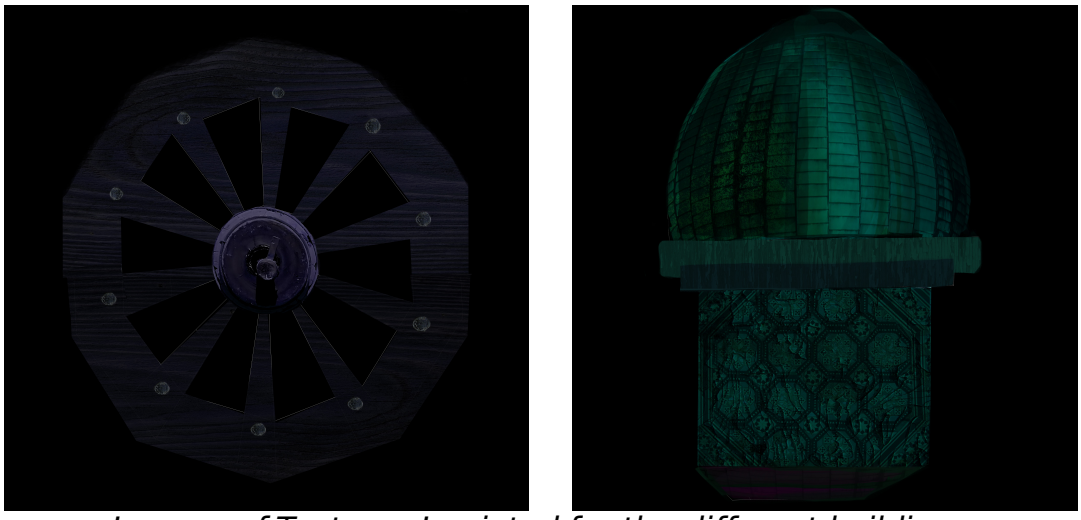




Snap Shots of the building's UV's unwrapped

I started off by unwrapping the UV coordinates of all my geometry. Once I had the UV's laid out I could take them into Photoshop and could begin creating my textures.
I collected lots of textures some of which I photographed myself over the past couple of months.



Images of Textures I painted for the different buildings

Projections

'A 3d Projections is a mathematical transformation used to project three dimensional points onto a two dimensional plane'[6]

I want to project 2d images of buildings on a three dimensional object. 'The concept of the mechanics of projection involves treating the 2D projection as being viewed through a camera's viewfinder. The camera's position, orientation, and field of view control the behavior of the projection transformation.

An image that I created, to combine, with the 3D elements for the environment.

[6] http://en.wikipedia.org/wiki/Projection

An image of a 2d building I drew to project onto simple geometry

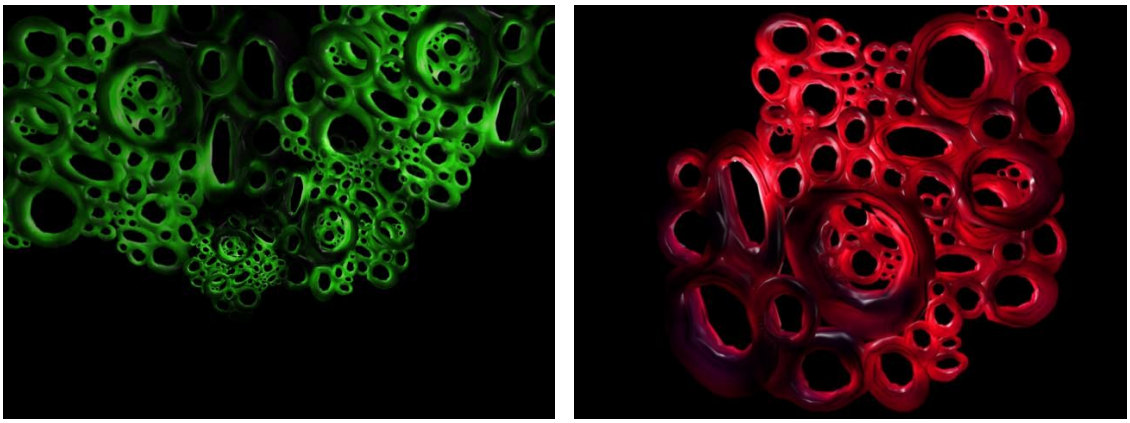
Sub-Surface Scattering

Sub Surface Scattering is something I looked into in my second year and also wanted to use it in the third year in some form.
This term used in 3D graphics describes the effect we see when the real world light enters a surface to some degree and then scatters about, bounces around a bit and then either it gets absorbed by the surface or gets reflected back out again.
This effect is mostly used in organic/real objects that have the qualities of being translucent such as human skin, wax, grapes.

It's quite a complex phenomenon and its different attributes need to be understood in order to achieve exactly what you want.
I found a very interesting paper which combined subsurface scattering and texture mapping. This is exactly how I wanted my

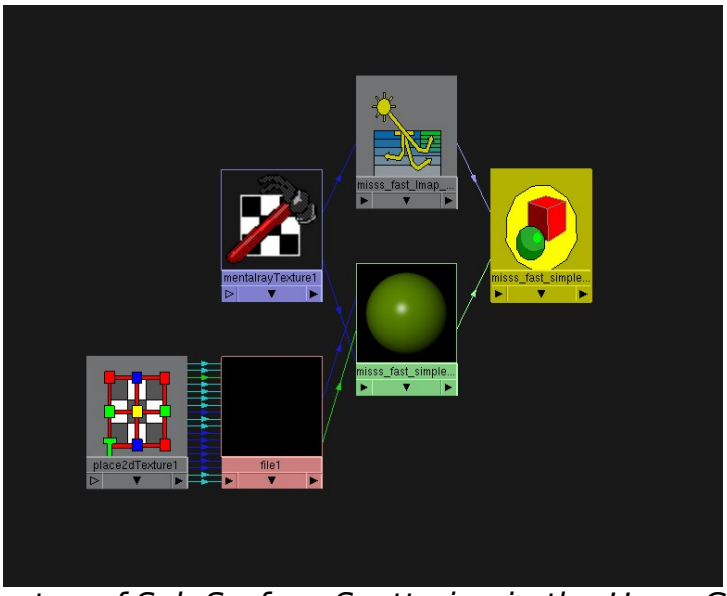
environment to look. I wanted it to have to have a translucent wax like look but still have a texture to them.

Tests that I carried out to see the result.



Snap Shots of tests I carried out to see the effect of SSS plus textures

I had looked into texture mapping quite extensively and mental rays subsurface scattering as separate techniques but I wanted to combine the two.
One has to study concept of relief texture mapping (Policarpo et al. 2005). However instead of representing the surface details, you represent the inner structure of the object. The layers of the material are described by one or more simple 2D textures where each of the textures encode the thickness of the layer.

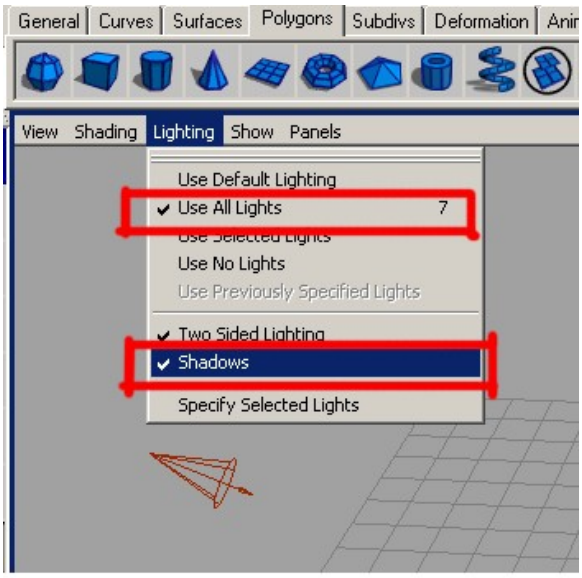


The setup of Sub Surface Scattering in the HyperGraph

Baking Textures and Light

When I combined sub surface scattering with textures in a scene with a lot of geometry I noticed the scene becoming extremely heavy and look very long to render each frame. This was probably due to Sub Surface Scattering being a complex phenomenon.
If I was going to have animated textures inputting into the diffuse layer of the SSS and also have the geometry animate as a whole as well I had to think of making this process more efficient and less time consuming.

What is baking?
Baking the Surface shader on to the object would take the shader and texture information and “bake” it into single texture maps for the objects combining the shader and the texture.



I could also bake the light in my scene. The whole point being if I rendered lights and shadows at every frame it would take a lot of time.

I did some tests using subsurface scattering and baking it to save time.

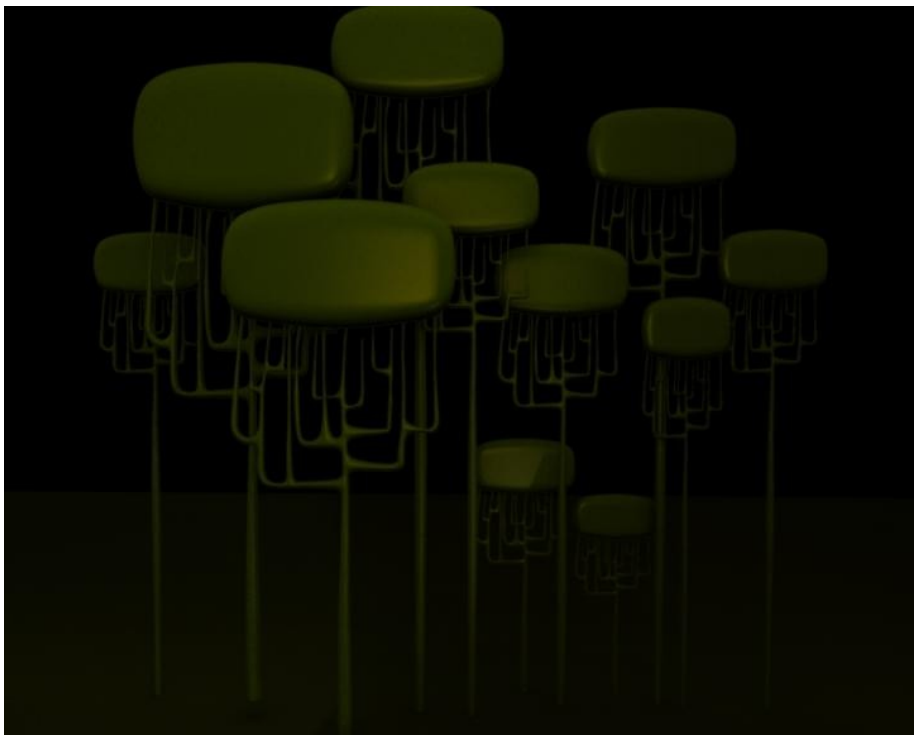


image of trees I rendered out using SSS and baking

textured building 1

textured building 2

textured building 3

Shot from the final rendered image sequence

Shot from the final rendered image sequence

Conclusion and Critical Analysis.

I feel I have worked on my strengths and tried to derive the maximum from it. I wanted to incorporate the realism of three dimensional animation and the aesthetic appeal of two dimension animation.

The final sequence that I delivered I feel was lacking a certain level of contrast. I wanted there to be more depth in it. I also want to hand draw more over the rendered image to give it a more 2D feel.

Regarding texturing I feel the most important thing to do is to research your surface. Two surfaces are never the same. There is no way a procedural texture would ever aesthetically represent an object as a hand drawn texture could.
In industry today nearing to the deadlines texture artists are forced to use procedurally generated textures.

This innovations project has been a huge learnig for me personally. When I began I had very little knowledge of texturing, Uv's, the Hypershade.
There is undoublty huge amouts of mathematics behind the algorithms of each node in the hypergraph. I would like to understand these algorithms in more detail so that I have more freedom with them.

In the animation industry there has always been a steady transition of styles. At the dawn of 3D computer graphics It was said that 3D and 2D are completely separate entities though now the merging of them seems natural.

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