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CREATING CONVINCING AND DRAMATIC LIGHT TRANSITIONS FOR COMPUTER ANIMATION

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CREATING CONVINCING AND DRAMATIC LIGHT TRANSITIONS FOR COMPUTER ANIMATION

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ABSTRACT

Lighting and atmospheric changes are complex phenomena that exist in nature; therefore replicating them using computer graphics can be quite challenging. Subtle changes in light conditions can greatly affect the mood or perception of the viewer and has been an important component of film making. With ever increasing technology and computing resources, filmmakers continue to strive to produce such complex effects that enhance their storytelling. Light transition (e.g.; day to night), continuously moving light sources, and dramatic change in seasons have been the focus of experimentation for many films. Most studios have therefore developed their own pipeline to create such effects. This thesis describes some simple and efficient observations and techniques to create such convincing lighting transitions.

ACKNOWLEDGEMENTS

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CHAPTER 1
INTRODUCTION

From the earliest time recorded in history, light has held a great importance in human culture and existence. Even today, light and darkness rule our lives, as most of us rise at dawn and go to bed after dark. We observe change in lighting conditions and color over the course of the day that greatly affects human behavior and mood. These natural lighting conditions have always been a field of study for all kinds of artists.

Along with movement, light is the primal element that makes cinema possible. A bulb inside the projector illuminates images on a filmstrip that are projected to a screen on the opposite side of the room, and through this magical process, we see movies. Many film artists have been fascinated with light itself, and have used it as a subject and a defining structural element of their films. Filmmakers have explored refracted sunrays, illuminated moth wings, flicker effects, and light reflecting in water. They have structured their films by movements of the sun, the light of fireflies, and digital light processes. They have even projected images through fog, making the projector's beam of light the star of the film [DITZ05].

With increasing resources and technology, filmmakers are demanding more and more dramatic sequences in their movies. Even in live action movies, the use of computer graphics is becoming a favorable option since filming lighting transitions can be quite difficult. Time and resources spent in filming such effects can be similar or even higher than producing the effect in 3D. Using computer graphics imagery, the filmmaker gains precise control over the artistic and technical aspect of the project. It also gives freedom to create and modify the entire ambience of the environment through color and atmospheric effects, as the story changes. Creating such lighting transitions has always been a challenging task for 3D artists, and it continues to grow harder as a directors demand more from their movies.

This thesis covers real life observations of light and light transitions in nature and movies, and our attempts to create similar effects in 3D. Chapter 2 describes the science of light, light transitions and atmospheric effects. We discuss the uses of light transitions and show some examples from movies and real life and discuss the technical elements for creating such effects in 3D. In Chapter 3, we discuss the implementation of light transition in our two test shots. Chapter 4 discusses results of both implementations. We discuss future work and conclusions in Chapter 5.

CHAPTER 2
BACKGROUND

This chapter discusses the nature of light and its scientific properties. Further, we discuss light transitions and review relevant case studies in movies and real life. We also try to introduce terminology used in the process.

2.1 The Science and Nature of Light

Light is everywhere. It carries information from the world to our eyes and brains. Our brains and eyes act together to make extraordinary things happen in perception. Seeing colors and shapes is second nature to us; yet light is a perplexing phenomenon when we study it more closely [LIGH07].

In general, vision occurs due to the stimulation of the optic nerves in the eye by light coming either directly from its source or indirectly after reflection from other objects. The amount and type of light emitted by a luminous body, such as the sun, another star, or a light bulb, or reflected by an illuminated body, such as the moon and most of the other objects one sees, causes change in lighting condition. Illuminated bodies not only reflect light, but sometimes also transmit it. Light reacts differently on a material depending upon its properties [COLU07]. Transparent objects, such as glass, air, and some liquids, allow light to pass through them. Translucent objects, such as tissue paper and certain types of glass, also allow light to pass through them, but scatter it in the process, so that an observer cannot see a clear image of whatever lies on the other side of the object.

Light rays scatter and change direction when they are passed through a small hole or close to an opaque surface. Light acts both like particles, or small light “bullets,” that stream from a source, explains and like waves, or ripples, in space.

Scientifically, light can be described as visible electromagnetic radiation. Of the entire electromagnetic spectrum, the human eye is sensitive to only a tiny part, called light. The wavelengths of visible light range from about 350 or 400 nm to about 750 or 800 nm. The colors of opaque objects are caused by the selective reflection of certain wavelengths and the absorption of others. Thus, some transparent and translucent objects allow only light of certain wavelengths to pass through them and thus appear colored.

2.2 Light Transitions and Atmospheric Effects

Over the course of the day, the light changes from a warm red at sunrise, to a cold blue at noon, and then back to a warm red or orange at sunset. These change in colors are caused by the scattering of light by fluctuations in the density of the Earth's atmosphere [BRIO07]. Thus, at noon colors appear clear and bright due to the scattering of blue light. But before and after midday, however, light from the sun is modified by the extra distance it travels through the earth’s atmosphere where some of the blue light is filtered out, leaving the light with a more reddish cast. This is clearly seen very early or late in the day when the light is often red-orange in tone. Sunrises and sunsets look more interesting due to objects in the foreground, such as the skyline, and their colors are further enhanced by atmospheric effects, such as sunrays streaming through gaps in clouds producing a diverging effect. These effects are generally caused by the dust, air molecules, water droplets, smoke, ice crystals, and smog produced by natural processes or human activity which scatter the rays and make the rays visible. The atmosphere produces a host of visual spectacles, like rainbows, halos, glories and coronas when light interacts with these elements [CURT06].

2.3 Lighting for Mood

Color can have a profound effect on our emotions. It influences mood and conveys meaning [STIN04]. Color inspires, energizes, soothes, and enlivens. For instance, blue, the color of the sky and the ocean, can look cold and depressing at times, but can also represent tranquility at other times. Similarly, green, often a symbol of nature provides a soothing feeling, but can also convey jealousy. Red, which is the warmest and most energetic color in spectrum, is normally associated with love, desire, speed, strength, but could also be used to show anger, violence and blood [JOHN06]. Thus humans tend to have emotional associations with certain colors and one need be clear about exactly which mood to convey: sunny, dreamy, scary, or any of a score of other emotional states while creating a scene in a movie

2.4 Case Studies and Observations

Here we review case studies related to light transitions. These examples include observing natural light transitions as well as transitions from a 3D animated movie, "Monster House."

2.4.1 "Monster House" – 3D Animated Movie

"Monster House" is a 3D animated movie created at Sony Pictures Imageworks. In one of the sequences from the movie, a quick transition was used to show the passage of time and change of mood. The scene progresses from a scary and noisy night shot to a bright sunny morning. Though the objects are still, the change in direction of lights and shadows, and changes in the color of the sky, make the shot look believable. Refer Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4 below and monsterHouse.wmv on the included CD.

Figure 2.1: Still from Monster house

Figure 2.2: Still from Monster house

Figure 2.3: Still from Monster house

Figure 2.4: Still from Monster house

2.4.2 "Moment" – Live Action Video Footage

"Moment," is a short movie created in Brisbane, Australia. Here the light transition shows the passage of time and the maturity of the person as time elapses. The silhouette of the city's skyline as it grows dark is an interesting phenomenon. One observes a slight tinge of pink in the clouds, which changes to blue and then dark blue. Finally, the blue color creates the ambience of night. Refer Figure 2.5 and Figure 2.6, below, and moment.wmv on the included CD.

Figure 2.5: Still from moment

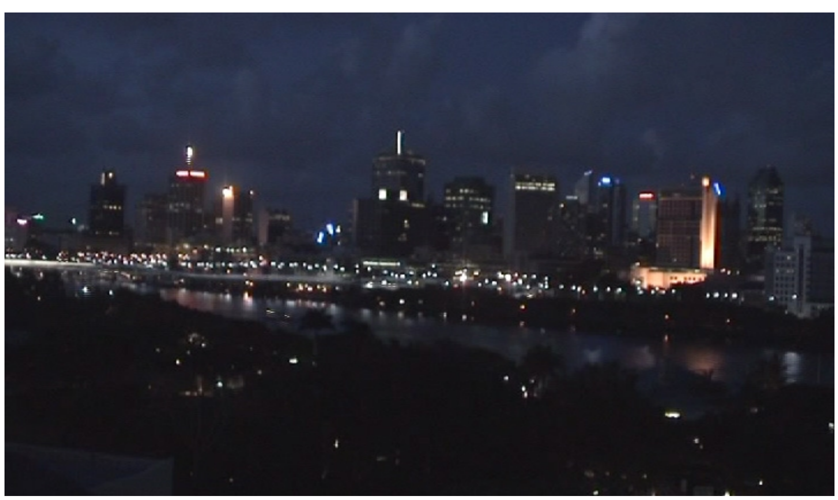

Figure 2.6: Still from moment

2.4.3 Change in Lighting on a Building Structure

In this case study, we took pictures of a building structure at regular time intervals. This helped us in observing closely how light direction changes as time passes. As one can see in Figure 2.7 through Figure 2.12, the long shadows at early noon change to short shadows as the sun moves to a position almost directly overhead. This movement can be seen by observing the shadows in the foreground grass, the shadow of the top pitch roof on the lower pitch roof, and the internal tree shadows in the center of the picture.

We observe the addition of red to the light color as time progresses closer to evening. This can be seen at the outer boundaries of the trees in Figure 2.11 and Figure 2.12. Contrast in the images is less pronounced as time progresses from noon to evening.

Figure 2.7: Case study

Figure 2.8: Case study

Figure 2.9: Case study

Figure 2.10: Case study

Figure 2.11: Case study

Figure 2.12: Case study

2.5 Techniques and Terminology

Now we discuss some terms and techniques that will be used in Chapter 3. These basic terms help us in understanding our lighting transition test cases.

2.5.1 Three-Point Lighting

Three-point lighting is a simple starting point for lighting just about any subject. It is a standard method used in film, still photography and computer graphics imagery. As the name suggests, the technique uses three lights: key light, fill light and back light. Figure 2.13 shows a top-view of a basic three-point lighting setup.

The key light is the main source of illumination, but if used alone it produces shadows. Another light is therefore required to fill in areas of darkness and to soften the shadows the key light has cast. This light is known as the fill light, a secondary light source of slightly less intensity than the key light, which is placed at eye level. Even this combination of key and fill lights, however, must be supplemented further if a director is seeking to create a sense of depth. The third light source that provides the necessary depth is known as the back light, as it is placed above and behind the subject. Used on its own, the back light creates a silhouette of the subject.

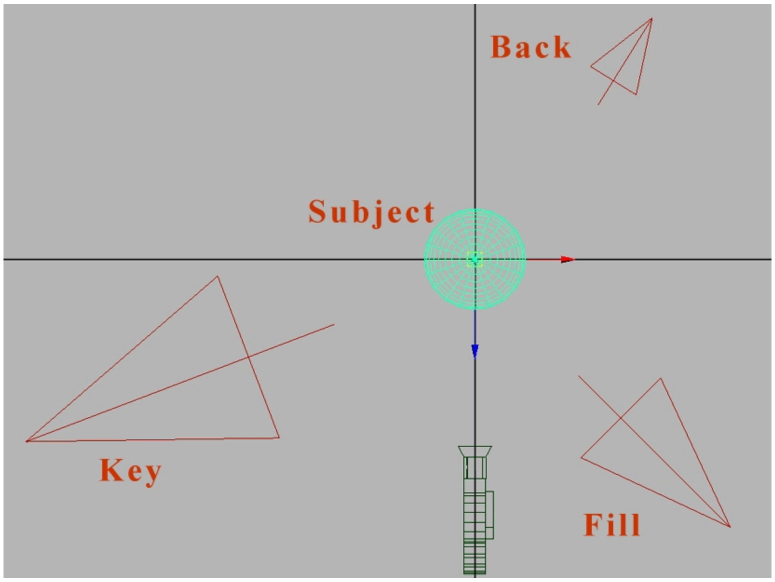

Figure 2.13: Top-view showing a three-point lighting setup

2.5.2 High-Key & Low-Key Lighting

Some lighting techniques can be divided into high-key and low-key categories. A low contrast ratio of key and fill light will result in an image of almost uniform brightness. This is termed high-key lighting, and is a standard, conventional lighting scheme employed in Hollywood genres such as musicals and comedies.

A high contrast ratio of key and fill light will result in low-key lighting, producing dark shadows and a night-time effect. Faces will often appear bleached white against a black background. Genres such as horror and film noir employ low-key lighting for its atmospheric shadows and intense contrast of light and darkness [COLU07].

2.5.3 Different Lights in Maya

In the real world, the surfaces of objects are illuminated by light rays emitted from various light sources (for example, light bulbs, flashlights, the sun, fire, and so on). Similarly in Maya, by setting the properties of a light source, one can simulate many of the different types of real-world light sources [GIBB06]. Kinds of light objects available in Maya are discussed below.

Ambient light

Ambient light can be described as a pervasive background light source with no particular source location or direction. Ambient light is typically used to control the overall brightness and color of a scene.

Area light

Area light is a type of light source that emits light from a two-dimensional area. A larger area light has a stronger intensity.

Directional light

Rays of directional light are parallel to each other. The use of directional light is to simulate a very distant point light source (for example, the sun).

Point light

A point light is a light that illuminates in all directions, radiating from a point in space. For example, a point light can simulate an incandescent light bulb.

Spot light

A spot light is a light that shines evenly within a narrow range of directions (defined by a cone) from the light's location.

2.5.4 Render Passes in Maya

Render passes help to break up the rendering of a scene into parts, to create multiple images for each frame, or to organize output for easier import to compositing software. This also helps to speed up and simplify the workflow and decrease render time dramatically. We can segment any scene using render passes depending upon the complexity of the shot [BIRN06]. All these layers are then composited together with different blend modes to create the final image.

Render passes normally used in Maya are listed below.

Diffuse

Only diffuse shading is performed (that is, no shadow or specular information).

Specular

Only specular shading is performed. The specular component is modulated differently depending on the type of material associated with the object.

Shadow

This render produces only the shadow component of the image in the alpha channel. No color information is produced.

Occlusion

This passes use the mental ray renderer to produce an open sky-type render. It helps to create inter-diffuse reflections on the object.

Luminance Depth:

This pass produces a grayscale render based upon the depth (distance) from the camera. This results in an antialiased grayscale image for use in determining depth priority in a compositing application.

2.5.5 Blue Screen Removal

Blue screen removal or chroma key color transition can help bridge the gap between reality and illusion. Not only can one superimpose videos of a person against a backdrop, but also can one it to remove or add objects inside a video. The first step is deciding the color of the screen, followed by shooting the subject standing in front of it, and finally removing the screen digitally using compositing program like Apple's Shake. If aiming for perfection, the subject needs to have a well-defined outline. Lighting of the background should be uniform to prevent unwanted shadows.

2.5.6 Matchmoving

Matchmoving is a special effects technology that allows the insertion of virtual objects into real footage with the correct position, scale, orientation and motion in relation to the photographed objects in the scene. Matchmoving is primarily used to track the movement of a camera through a shot so that a virtual camera can reproduce the movement inside the computer. The intent is that when the virtual and real scenes are composited together, they will represent the same perspective and appear seamless. To aid in this process, the filmmakers often place reference markers in the scene. They then use these markers to track the motion of the camera through the scene. This allows virtual objects to be added to complicated camera movements or even hand-held shots. The reference marks are later digitally removed from the final shot.

2.5.7 MEL

Maya Embedded Language, or MEL, is a scripting language used to simplify tasks in Alias' Maya. Most tasks that can be achieved through Maya's GUI can be achieved with MEL, along with certain tasks that are not available from the GUI. MEL offers a method of speeding up complicated or repetitive tasks, as well as allowing users to share or distribute a specific script that others may find useful. MEL is syntactically similar to Perl and offers direct access to functions specific to Maya [WILK05].

We have now covered the terminology and techniques that are used in implementing light transitions in our test shots. The next chapter will cover our method of implementing such transitions in two test shots.

CHAPTER 3
IMPLEMENTATIONS

In this chapter, we discuss two implementations as our test cases. Both our implementations focus on creating effective transitions using Maya and Shake.

3.1 Implementation-I : Transition from Natural Light Sources

This section focuses on transitions from natural light sources showing a passage of time. We further shoot and composite a live action figure in our 3D scene to enhance the results.

3.1.1 Explanation of sequence

A photograph of an adobe house from New Mexico (Figure 3.1) was chosen as a structure for our 3D scene. The passage of time is shown using a light transition from night to a bright sunny day. The sequence starts with an artificial lamp inside the house with a dark blue sky in the backdrop giving the feeling of a cold night. As the night passes, the lamp turns off and the scene changes to a bright sunny day, affecting the color and visibility of the objects in the scene. During this time we observe change in the color of the objects according to the environment changes. Warm colors, like red, orange and yellow, help the foreground objects stand out, while blue keeps other parts of the environment toned down. The transition finally leads into a bright sunny day with a clear sky, shining snow and dark shadows. We then have an actor shot against blue screen composited in our shot, opening the window and enjoying this beautiful scene.

Figure 3.1: Reference photograph for adobe house

3.1.2 Modeling and Texturing

Camera matching was achieved using the reference picture (Figure 3.1) as a background image in Maya. The picture was then traced in 3D using polygon modeling. The challenging aspect of modeling was to create a feel of an adobe house, which was achieved by generating uneven surfaces and round edges on the facade. Vertices were arranged manually and lattices were used on groups of vertices to add unevenness at specific spots. The overall model has been kept light, but also retains all the fine details and smooth edges. A few stones were modeled and then duplicated and randomized using a MEL script. Figure 3.2 shows a wire-frame of the 3D scene.

For texturing, UV's were arranged and exported using the UV Layout Editor in Maya. Photoshop was then used to paint various layers for base texture (Refer Figure 3.3), wet adobe (Figure 3.4), normal adobe, and bumps and scratches (Figure 3.5). These layers were finally arranged in Maya using a layered shader to create the desired effect (Figure 3.6 and Figure 3.7).

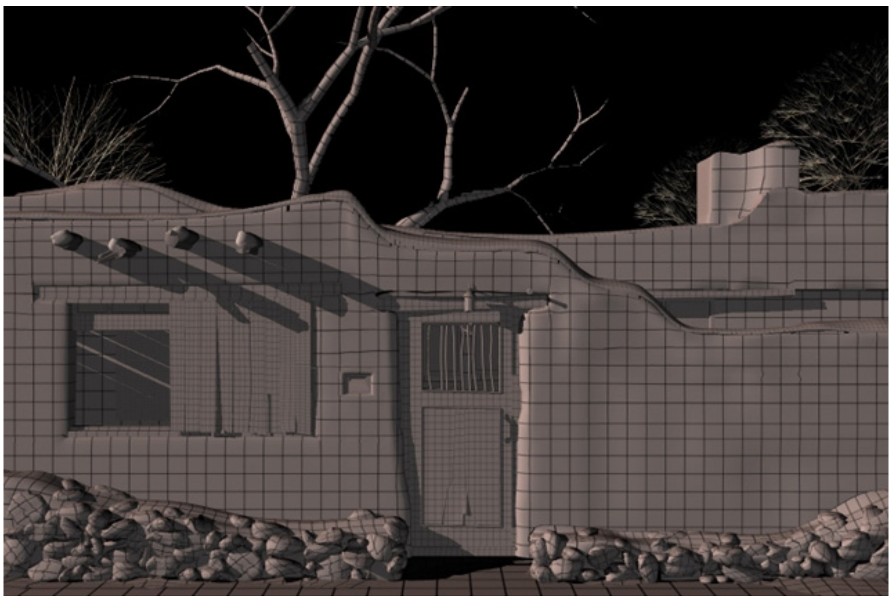

Figure 3.2: Wire-frame of adobe house

Figure 3.3: Base mud texture for adobe house

Figure 3.4: Wet mud texture for adobe house

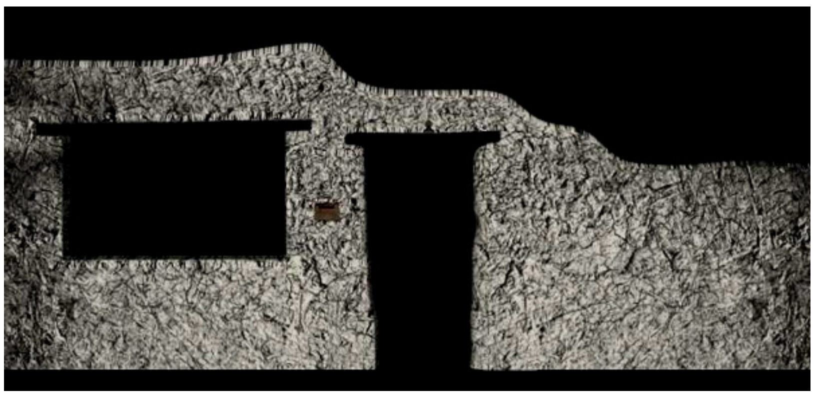

Figure 3.5: Texture for bumps and scratches for adobe house

Figure 3.6: Final textured model – with default light

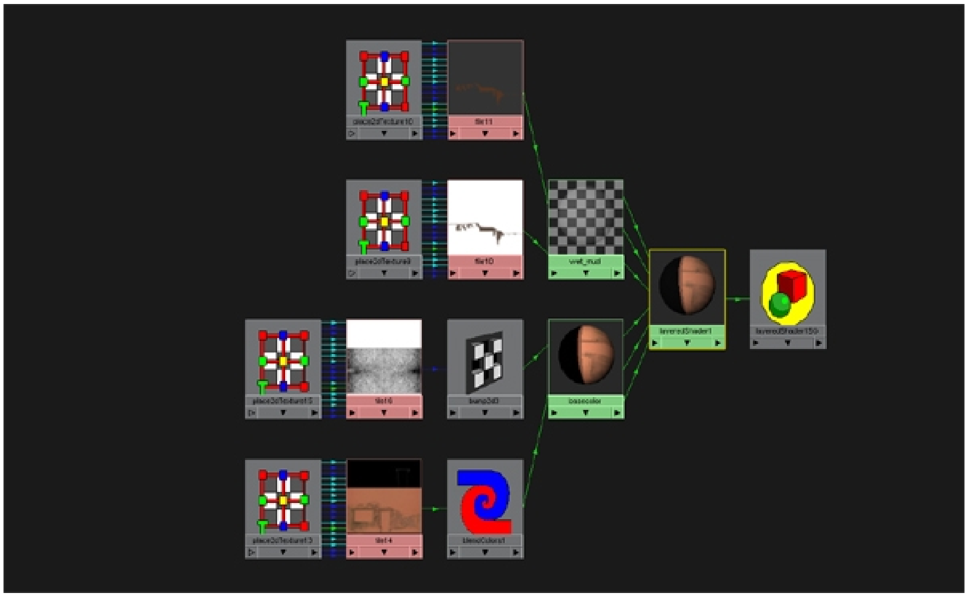

Figure 3.7: Final shader network

A snow shader was created by adjusting the parameters in specular shading, including roll off and eccentricity, and adding noise in bump mapping to get a rough texture. The same noise texture was added to incandescence and specular to make the snow look fresh. Adding fractal noise in the color remap field added glitter to the snow.

3.1.3 Lighting Techniques

Lighting is one of the primary elements that adds realism to a scene. The process becomes complicated when digital effects are integrated with live action footage. For lighting our test scene, many factors involved that required limitation. For instance, the change of shadows to reflect the change in time, the change in properties of objects for day and night, and light reflections from other surrounding objects onto the house.

For our 3D scene, a simple lighting rig was created with key, fill and rim lights. This combination, helped us separate the subject from its environment and created a sense of depth.

For night time, we created a set of lights, including a moon light casting shadows and fill lights illuminating the entire environment. Accordingly, a high key lighting setup was created for the night scene. Animating the window glow in the shader network parameters adds contrast when everything is otherwise still while we wait to see the scene change to bright sunny day. We created a different set of lights for the sun, with high intensity and strong contrast. This low key setup helps us in the visual transition and provides a strong contrast. The intensity and positions of lights were animated to match the time and mood.

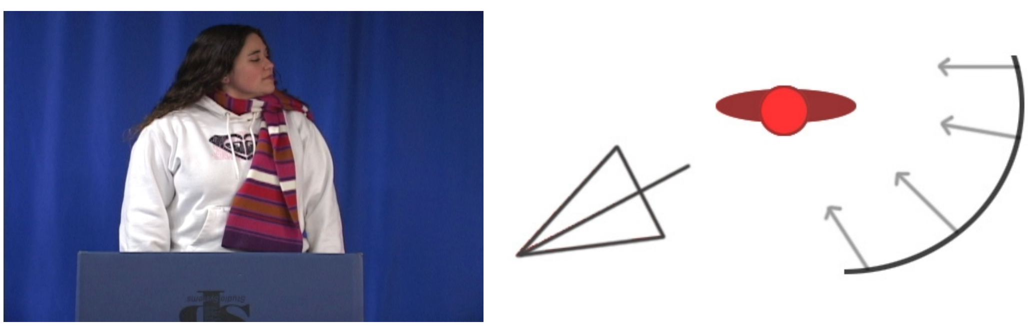

Figure 3.8: Blue screen shot with lighting setup

Matching live action footage with computer-generated images is challenging. While shooting the footage of the actor against a blue screen, care was taken that the background was uniformly lit. Additionally, if the blue screen shot were too brightly lit, then some light would reflect off the background producing circles. A bright light was positioned from one side so that the light direction matched our 3D scene (Figure 3.8). The focus was completely on the actor to prevent the character from appearing blurry in the final footage. Care was taken that no small parts of the clothing or hair hung loose so that we could get a sharp separation from the background. The actor was made to stand away from the blue screen to avoid shadows on the screen.

3.1.4 Using Render Layers and Passes

We need to use a layered approach workflow to handle digital sets efficiently. Sets are usually done in various layers and passes, which gives more flexibility in producing the final output. Before breaking down the layers and passes, there should be a good amount of forethought put in to the process to alleviate stress in the end.

In our implementation, the idea was to make the image look as realistically lighted as possible, while also providing choices for color correction in the final output. As well, it should be easy to change multiple images for a variety of looks. It is not easy to change the animation inside a 3D program and re-render the entire scene multiple times to check the final animation. It may prove to be an inefficient method of doing such tasks, especially when complicated scenes with huge render times are involved. Each render passes (diffuse, specular, shadow, occlusion and reflection) contributes to the realistic lighting of the image. In Maya this is accomplished by using render layers and render passes in the layers section. These layers and passes are then composited carefully inside Shake.

Figure 3.9 shows an image of the background. A ramp node in Shake was used to create a base for the sky. This will save time in the end as we can animate the colors of the sky easily as compared to a 3D program, where we first have to animate the colors and wait for the final renders to see the effect.

Figure 3.10 shows the tree layers in a single image. Two sets of tree layers were rendered so that a depth of field effect could be added during the compositing stage. Animated diffuse (Figure 3.11) and specular passes (Figure 3.12) for each object in the scene were rendered. The front wall, back wall, front window, back windows, door, snow, stones and floor objects were rendered separately. Shadows for the moon and sun (Figure 3.13) were rendered for each frame of the animation. All these elements gave us extra control to tweak colors and to increase or decrease shininess on a per object basis. Finally an ambient occlusion layer (Figure 3.14) was created to give an effect of inter-diffuse lighting. Since the objects were static with no camera movement, we used one single image for this layer. This saved a lot of time while still providing an extra layer of realism.

3.1.5 Compositing

Compositing is the final hurdle in combining all the rendered elements together. If planned properly compositing can give many options for the final image. Live action footage will be combined here with computer-generated background.

A Key light node was used to remove the blue screen from behind the actor. Blue spill on the character made some areas disappear during blue screen removal. This was fixed by adding a few quick shape nodes and color correcting the original video. The actor was shot with a blue box in front so that her hand could appear to interact with foreground elements. While shooting the scene, no markers were placed on the actor's hand; thereafter, we had to manually move the window to match her hand movement.

Figure 3.9: Sky layer

Figure 3.10: Combined tree layer

Figure 3.11: Combined diffuse layer

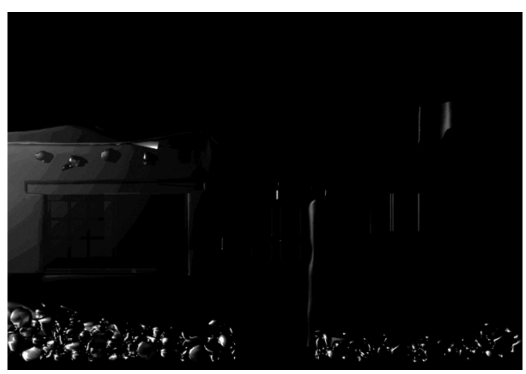

Figure 3.12: Combined specular layer

Figure 3.13: Shadow layer for sun

Figure 3.14: Ambient occlusion layer

As shown in Figure 3.16, specular layers of each object were composited with diffuse layers using an add node. We used the multiply mode to multiply the background layer with shadow layer, as we do not want the underlying layer to be affected in the white areas (Figure 3.17). Here we are actually lowering the color value of the background image only at the shadow areas, which the white areas remain unaffected. Similarly, The ambient occlusion pass for inter-diffuse shading was multiplied with the background [HANS05].

Figure 3.18 shows the final shake tree using all the layers and passes. The final composited image is shown in Figure 3.15.

Figure 3.15: Final composited image

All the rendered images were stored in a image format that supports an alpha channel. This helped us to layer multiple images on top of each other.

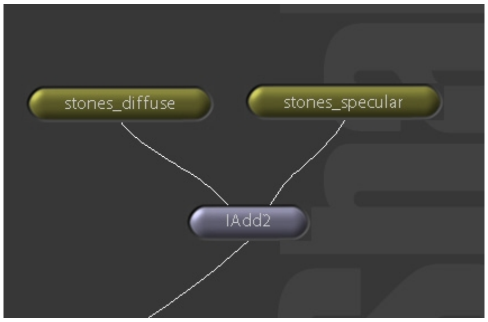

Figure 3.16: Add node for specular

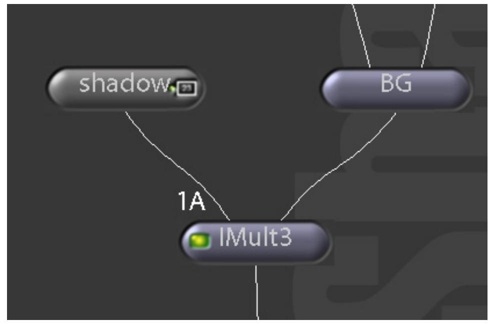

Figure 3.17: Mult node for shadow

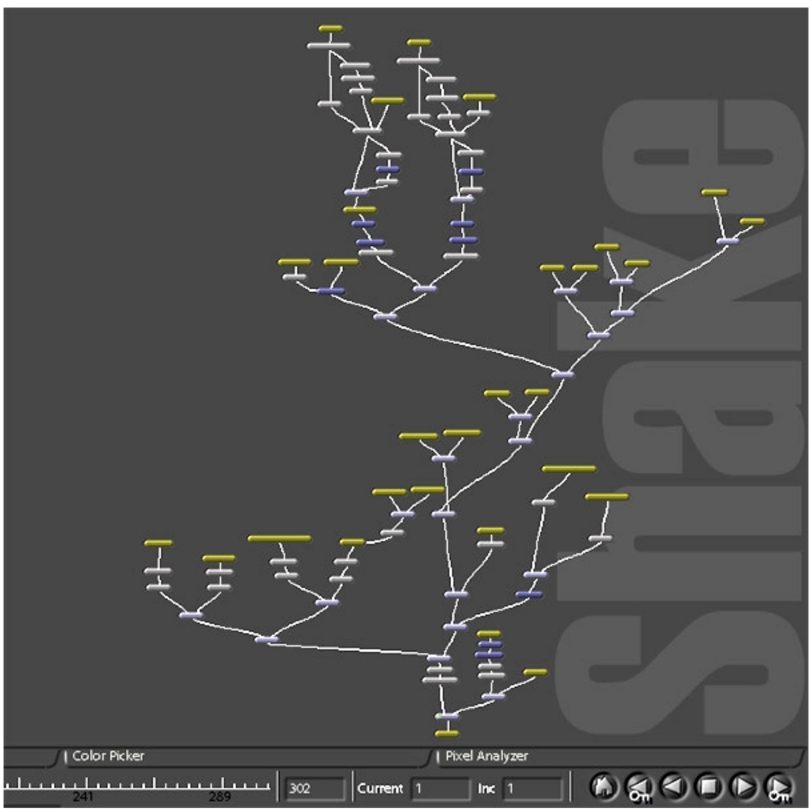

Figure 3.18: Final shake tree

3.2 Implementation-II: Transition from Artificial Light Sources

This section focuses on transitions from artificial light sources. Three different kinds of lighting rigs were created and we propose a straightforward way to handle transitions like these.

3.2.1 Explanation of Sequence

The picture below (Figure 3.19) was used as a reference image to study light and shadows. It conveys a time of dusk. The sun has set and we see shades of blue in the sky. We observe that this scene is primarily lit by three light sources:

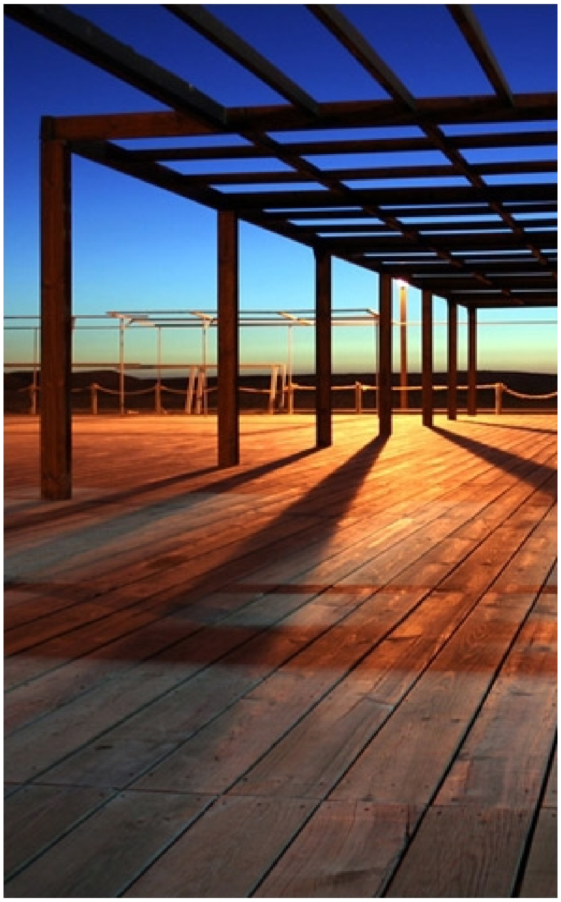

Figure 3.19: Reference picture for Implementation-II

Artificial light 1:

This light seems to come from the left side of the picture with an orange tint and low intensity, casting light shadows.

Artificial light 2:

This light source is the brightest light in the picture and is located on light pole in center of the image. This light is casting high-density shadows.

Natural light:

This natural light refers to the ambient contribution of the environment and does not change during the entire sequence.

There is no time passage shown in this sequence. The artificial lights are being turned on and off. Here, we experiment with the techniques of creating such transitions. Since the natural light from the ambient sky remains constant throughout the sequence, we concentrate mainly on artificial light sources.

3.2.2 Modeling and Texturing

All the elements in the scene were modeled using polygons as seen in Figure 3.20. Most of the objects are 3D primitives with modified vertices to match our requirements.

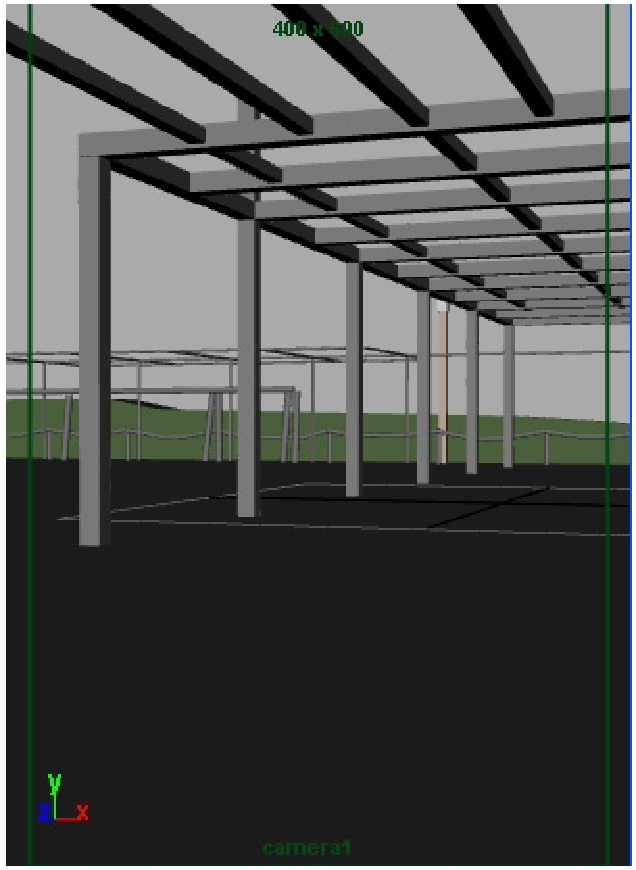

Figure 3.20: Scene modeling

UV's were laid out for the wooden planks, making it easier to handle textures on them. All the other textures were procedurally created inside Maya. A glow was added in the shader to the lamp-post light to make it look more dramatic.

3.2.3 Lighting

Spot lights were widely used as we have more control over where and how light is cast in the scene. Parameters like the cone angle, penumbra angle, and barn doors give more flexibility when using such lights.

We create three lighting rigs for the different kinds of lights discussed in section 3.2.1. Our main focus here is to create three differently lit scenes each of which will portray a unique mood. Eleven spotlights were used for creating a lighting rig for artificial lighting-1, which shows light coming from the left side of the picture (Figure 3.19). Figure 3.21 shows the lighting rig for the same. Similarly, Figure 3.22 shows a lighting rig for artificial lighting-2 and Figure 3.23 shows a lighting rig for moon light.

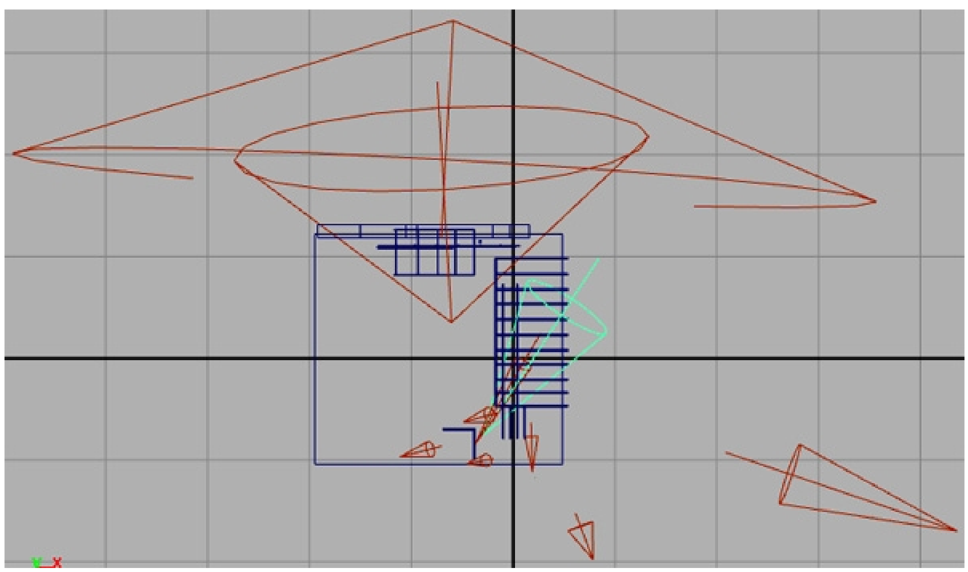

Figure 3.21: Lighting rig for artificial light source-1

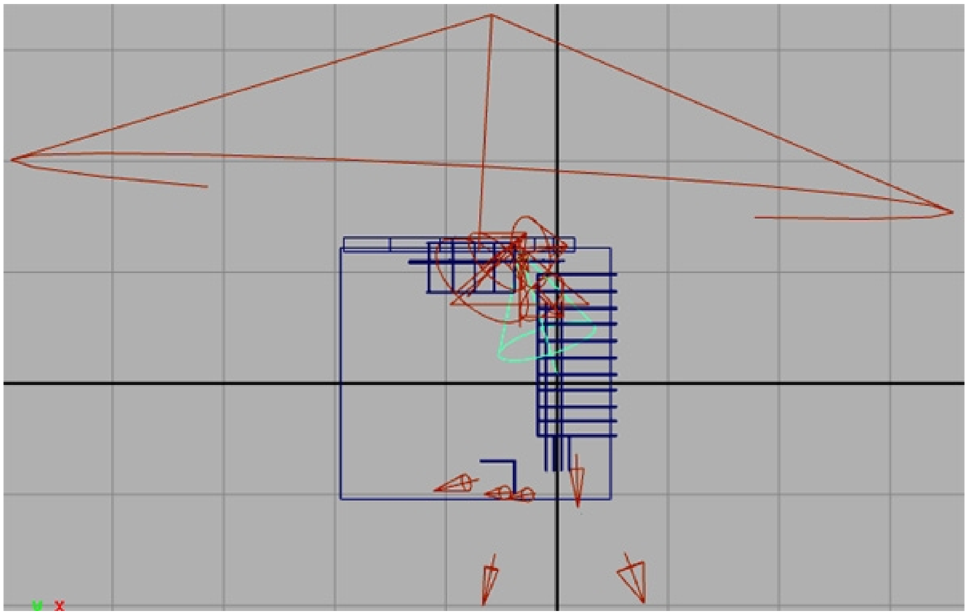

Figure 3.22: Lighting rig for artificial light source-2

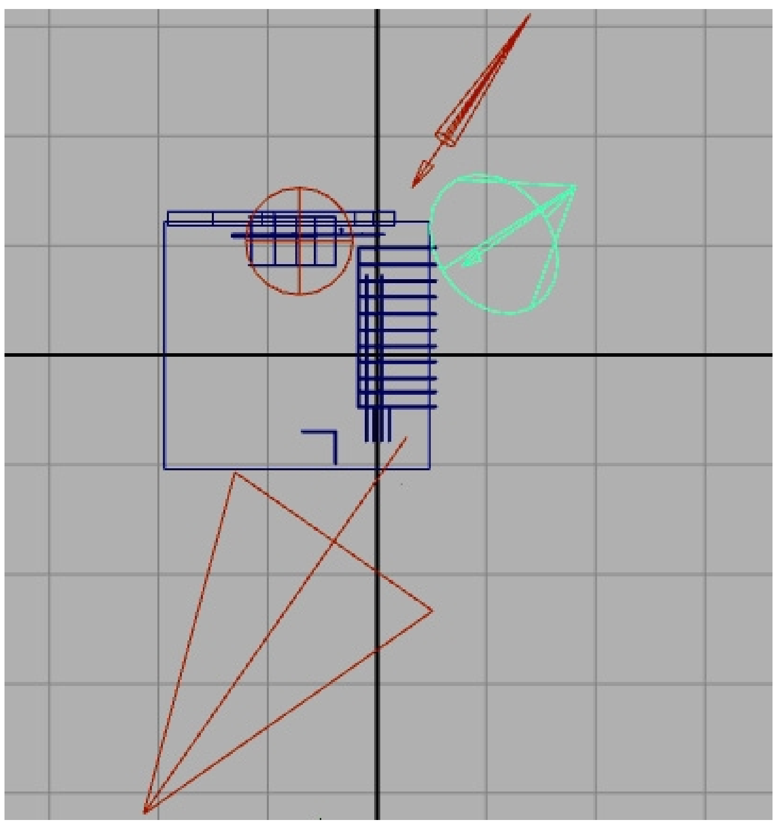

Figure 3.23: Lighting rig for moonlight

A MEL script was created (Figure 3.25) to aid in the process of producing these three distinctive looks effectively. The GUI for this lighting rig is shown in Figure 3.24. The user must select a light rig node and run the script. The GUI generated will have all the lights and its controls for the selected rig. This makes it easy to handle all the lights together for creating a specific look.

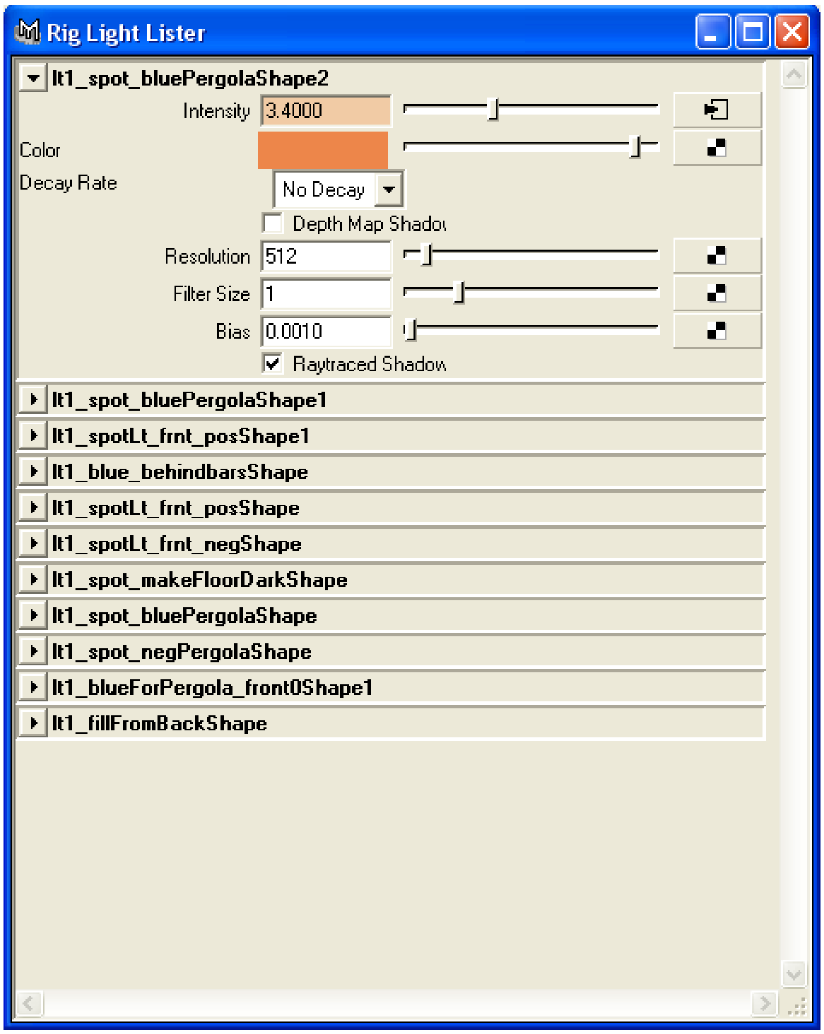

Figure 3.24: GUI for rig light lister

```
global proc lightLister() {
   if (`window -q -exists lightListerWin`) deleteUI lightListerWin;
   window -width 400 -title "Rig Light Lister" lightListerWin;
   scrollLayout;
   columnLayout -adjustableColumn true;

   //select lights in the selected rig
   string $sel[] = eval("ls -dag -shapes -sl");

   for($i=0;$i<size($sel);$i++) {
      if (`gmatch $sel[$i] "*|*"`) {
      }
      else {
            frameLayout -label $sel[$i] -cll true;
            columnLayout;
            attrFieldSliderGrp -label "Intensity" -at ($sel[$i] + ".intensity");
            attrColorSliderGrp -label "Color" -at ($sel[$i] + ".color");
            attrControlGrp -label "Decay Rate" -attribute ($sel[$i] + ".decayRate");
            attrControlGrp -label "Depth Map Shadows" -attribute ($sel[$i] +
".useDepthMapShadows");
            attrFieldSliderGrp -label "Resolution" -at ($sel[$i] + ".dmapResolution");
            attrFieldSliderGrp -label "Filter Size" -at ($sel[$i] + ".dmapFilterSize");
            attrFieldSliderGrp -label "Bias" -at ($sel[$i] + ".dmapBias");
            attrControlGrp -label "Raytraced Shadows" -attribute ($sel[$i] +
".useRayTraceShadows");
            setParent ..; setParent ..;
            }
   }
   showWindow lightListerWin;
}
```

Figure 3.25: MEL script for rig light lister

After tweaking and finalizing the three lighting rigs, we created another MEL script (Figure 3.27) to add keyframes to the intensities of all the lights in one rig at a time. Figure 3.26 shows the GUI generated from this script. If the user wants to produce the maximum effect from rig-1, he or she should click on max button (or normal button) for this rig and min button (or zero button) for the other rigs. The script has been hard-coded to contain the light intensities. Using this method we can animate the intensity of lights easily. Further, the timing of the animation can be easily changed per the director's vision.

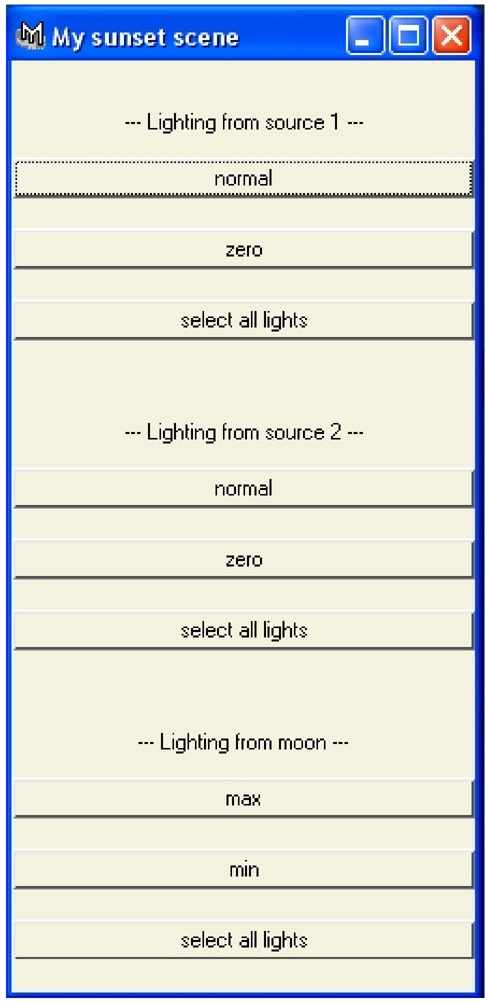

Figure 3.26: GUI for sunset scene

```
global proc sunset() {

   if (`window -q -exists sunsetScene`) deleteUI sunsetScene;
   window -w 300 -h 500 -title "My sunset scene" sunsetScene; sunsetScene_UI(); showWindow
sunsetScene;
}

global proc sunsetScene_UI() {
   columnLayout -adjustableColumn true;
   text -l "--- Lighting from source 1 ---\n"; button -l "normal" -c "lighting1_normal()";
   button -label "zero" -command "lighting1_zero()"; button - l "select all lights" -c "select_lighting1()";
   text -l "--- Lighting from source 2 ---\n";  button -l "normal" -c "lighting2_normal()";
   button -l "zero" -c "lighting2_zero()"; button - l "select all lights" -c "select_lighting2()";
   text -l "--- Lighting from moon ---\n";  . . . . . . . . . . . . . . . . . .
}

// Lighting 1 -----------------------------------------------------
global proc lighting1_normal() {
   setAttr "lt1_spot_bluePergolaShape2.intensity" 3.4; setKeyframe "lt1_spot_bluePergolaShape2.in";
   setAttr "lt1_spot_bluePergolaShape1.intensity" 0.4; setKeyframe "lt1_spot_bluePergolaShape1.in";
   . . . . . . . . . . . . . . . . . .
}
global proc lighting1_zero() {
   setAttr "lt1_spot_bluePergolaShape2.intensity" 0; setKeyframe "lt1_spot_bluePergolaShape2.in";
   . . . . . . . . . . . . . . . . . .
}
global proc select_lighting1() {
   select lt1_spot_bluePergola2 lt1_spot_bluePergola1 lt1_spotLt_frnt_pos1 . . . . . . . . . . . . . . .
}


// Lighting 2 -----------------------------------------------------
global proc lighting2_normal() {
    . . . . . . . . . . . . . . . . . .
}
global proc lighting2_zero() {
   . . . . . . . . . . . . . . . . . .
}
global proc select_lighting2() {
   . . . . . . . . . . . . . . . . . .
}


// Lighting moon -----------------------------------------------------
global proc lightingMoon_max() {
   . . . . . . . . . . . . . . . . . .
}
global proc lightingMoon_min() {
   . . . . . . . . . . . . . . . . . .
}
global proc select_lightingMoon() {
   . . . . . . . . . . . . . . . . . .
}
```

Figure 3.27: MEL script for sunset scene

CHAPTER 4
RESULTS

In this chapter we show the results of two implementations from chapter 3.

4.1 Implementation-I

After final compositing and color correcting all the elements in the sequence, we generated a final version of the sequence. Figure 4.1 through Figure 4.5 show some frames from the final movie. Refer to video Implementation-1.wmv on the included CD.

Figure 4.1: Snapshot from Implementation-I

Figure 4.2: Snapshot from Implementation-I

Figure 4.3: Snapshot from Implementation-I

Figure 4.4: Snapshot from Implementation-I

Figure 4.5: Snapshot from Implementation-I

4.2 Implementation-II

After testing the three lighting conditions, we generated a final version of the sequence. Figure 4.6 through Figure 4.8 show some frames from the final rendered movie. Refer to video Implementation-II.wmv on the included CD.

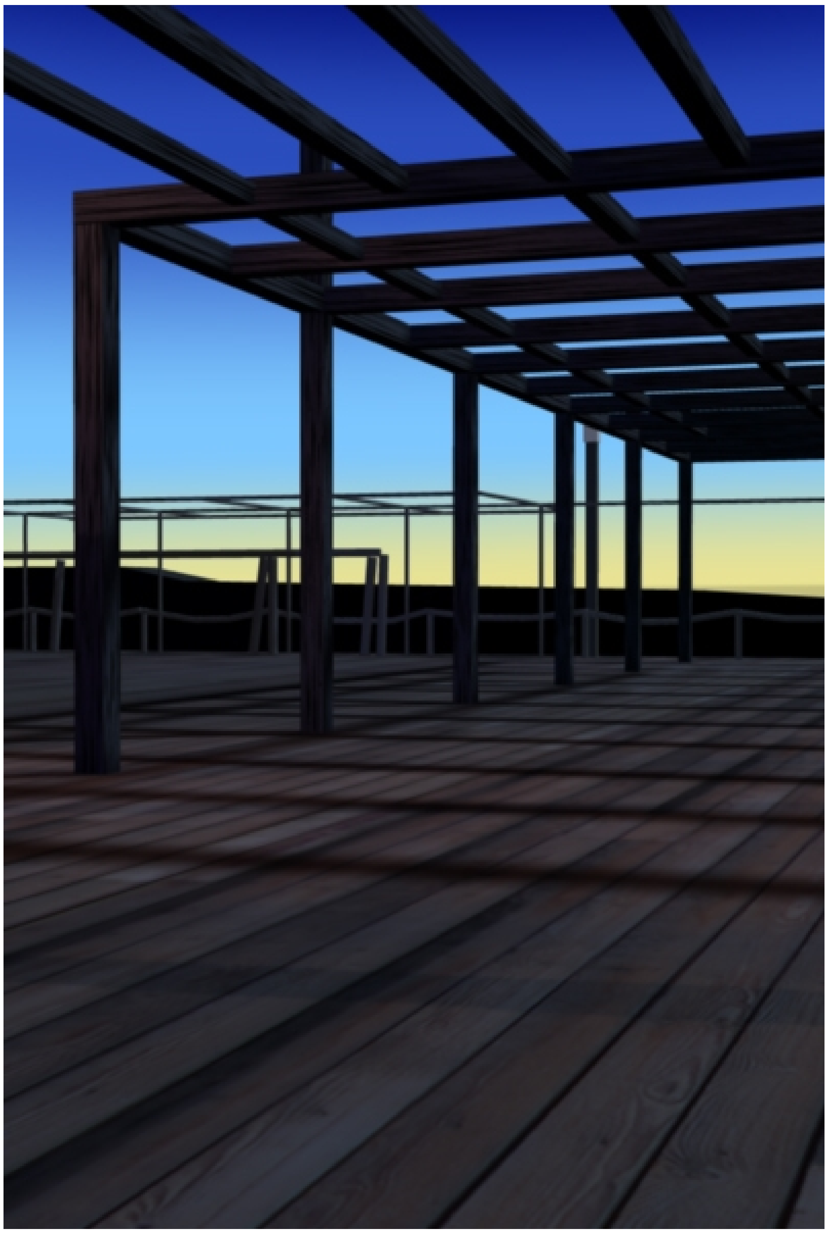

Figure 4.6: Snapshot from Implementation-II

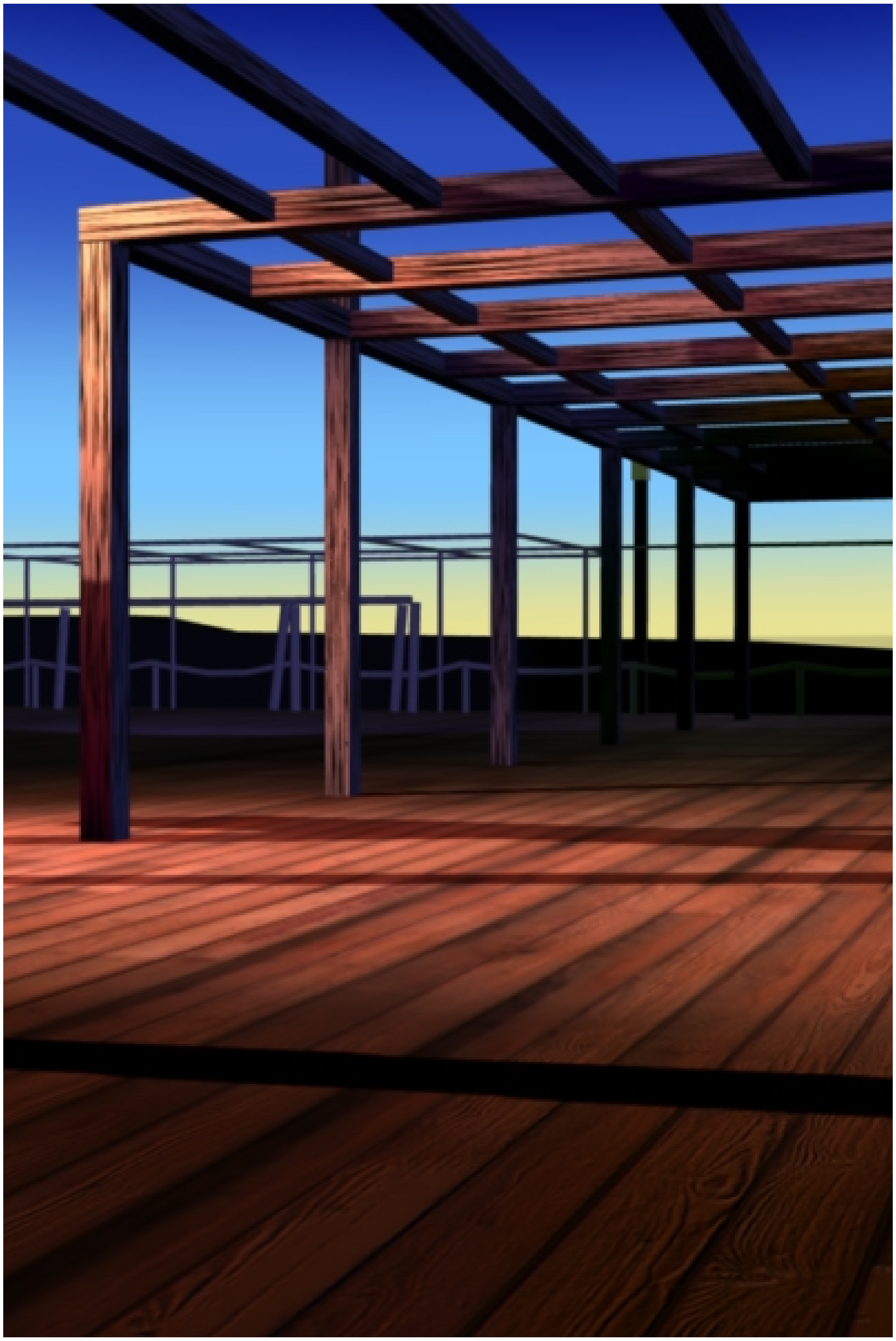

Figure 4.7: Snapshot from Implementation-II

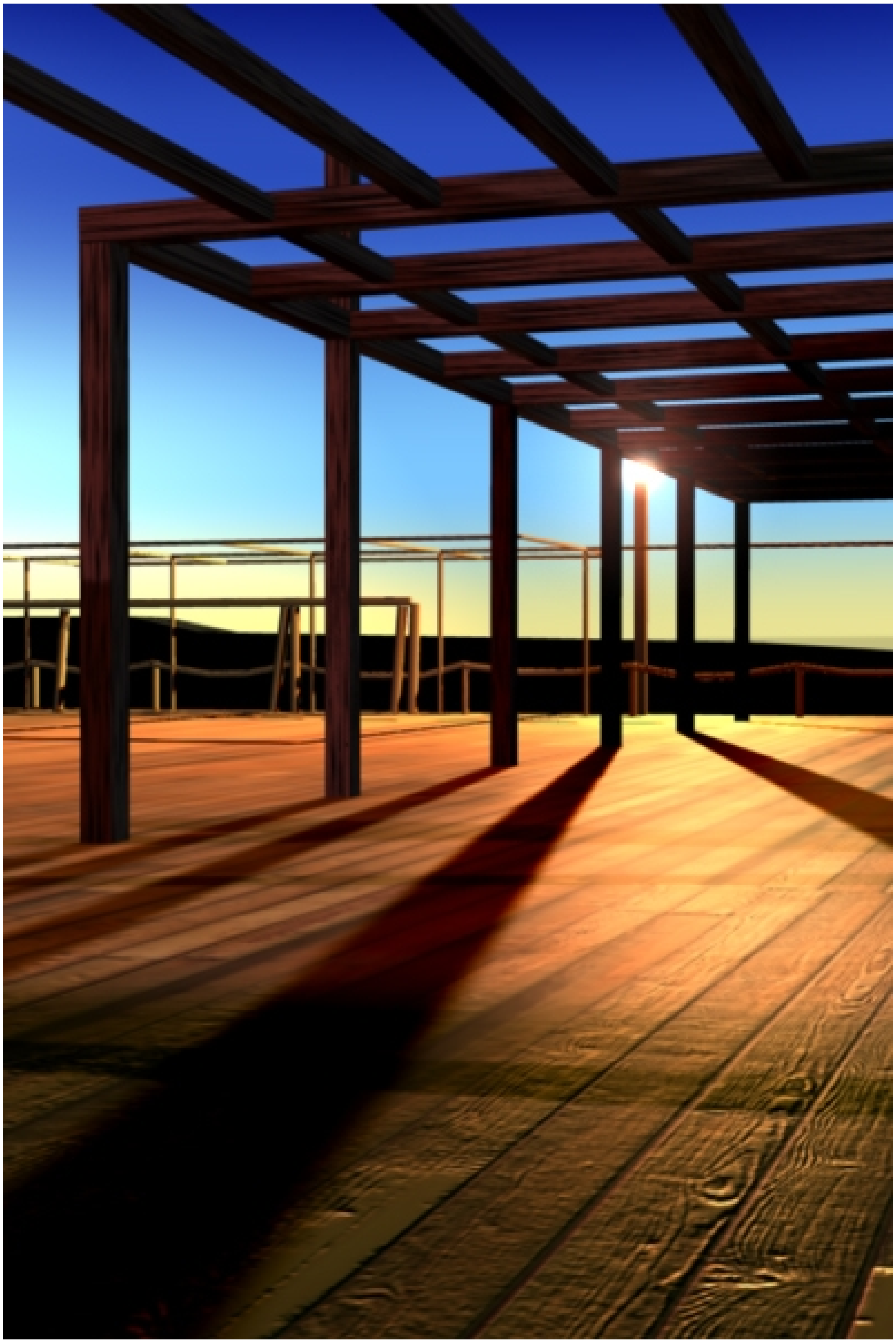

Figure 4.8: Snapshot from Implementation-II

CHAPTER 5
FUTURE DIRECTIONS AND CONCLUSIONS

This project has described a few techniques that can create light transitions similar to the ones presented in the case studies. Similar settings can be used for any project that needs to create light transitions. Additionally, this project has described methods to create a digital environment that in some cases eliminates the need of onsite shooting.

Time is a big factor when working on projects having visual complexity and there is always a room for further development. The same is true for this project. The final renderings are satisfactory in many aspects, but further development is possible in some areas.

A great deal of effort was put in to achieving realistic light transitions. Atmospheric effects such as clouds, fog, and dewdrops, would have further enhanced the overall outcome. We drastically move from low-key to high-key in all of our implementations, which makes our scenes more dramatic to audiences.

Resolution is a big issue when compositing several different elements for the shoot. While still images are rendered in high resolution, live footage was captured with a Sony DV-Cam with resolution of 700 X 486. To match this resolution, other computer generated elements were scaled down resulting in some loss of image quality.

There are some things we could have done differently. In Implementation-I, we manually move the window with the actor's hand. A good way of handling such a case would be to put markers on the actor's hand while shooting. This way we could track the movement of the markers and create a tracking node to move our window. This would eliminate the need of manually moving the window.

Also, the actor was wearing white clothes, which resulted in a lot of blue spill on her clothes. This made our blue screen removal difficult and the final result somewhat unsatisfactory. Darker clothing (other than blue) would have been more favorable in cases like these.

In Implementation-II, the rig light lister MEL script (Figure 3.25) is very useful in handling multiple lights in one light rig. One can handle all the lights under a single user-interface. The MEL script for light transition, however has been hard coded (Figure 3.27). If we want to make a small change in the lighting rig, the script needs to be changed every time Hence, this may not be the best method. Automating this process and eliminating hard-coded values would have been a better solution for a large production. For example, another MEL script can be written in which one can modify the light-rig as many times as desired before clicking on the bake button in the rig light lister. This bake button can modify the values in our sunset scene script so there will be no need of hard-coding [WILK05].

This thesis has presented a few methods of handling light transitions in computer graphics. We achieved very convincing transitions using our methods. We primarily relied on artistic imagination to create our shots, and were pleased with the final results. As more and more studios are using complex technologies and directors are looking for huge groundbreaking shots, lighting transitions are more important than ever.

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