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Considerations for Creating a Believable Creature for the Short Film Li Fe

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CONSIDERATIONS FOR CREATING A BELIEVABLE CREATURE FOR THE SHORT FILM Li Fe

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Fine Arts
Digital Production Arts

by
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August 2012

Accepted by:
Dr. Timothy Davis, Committee Chair
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ABSTRACT

This thesis illuminates the specific methods undertaken to achieve of a realistic computer-animated creature that consumes light and dwells in a cave. The animation short, *Li Fe*, contains seven such creatures whose anatomy required various production techniques to achieve a believable appearance appealing to viewers in a strong way. In most animations all areas of production need to be optimized for fast rendering as well as easily adaptable to change. The modeling, texturing, shading and lighting methods for *Li Fe* underwent such optimization to achieve a truly believable creature. The look of the creatures was made possible by relying on the viewer’s real-world experiences with anatomy of both humans and animals. The modeling of the creature resulted in a highly detailed model, which was then optimized with a Zbrush plug-in for efficiency in future phases of the production. The texturing and shading of the creatures was implemented using a multi-layered process to achieve maximum detail and customization when desired. Lighting the creatures employed Maya and Nuke to achieve the controlled look of a light source glowing within. The end result of the methods used was a production that was easily able to adapt to change and a believable creature to which audiences will be able to better relate.
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CHAPTER I: INTRODUCTION

An essential component in producing a full-length feature film, or even a computer-animated short, is a good story. To relay the story effectively, the creators of the work must develop characters with which viewers will feel comfortable. The Li Fe story is loosely based on a popular allegory that has instructed for nearly 2,400 years. This simplified version of Plato’s “Allegory of the Cave” concerns the main character’s realization of a more real existence than what is already known. In Li Fe, those in the cave know only one existence, but the main character is able to escape and see the real world.

Many different directors have taken the basic idea behind the cave allegory to tell a unique story of escaping from a perceived reality to a true reality. Some of the best and most visually stirring examples include: Franklin J. Shaffner’s Planet of the Apes, Michael Anderson’s Logan’s Run, Peter Weir’s The Truman Show, Terry Gilliam’s Brazil, M. Night Shyamalan’s The Village, Kurt Wimmer’s Equilibrium, The Wachowski Brother’s The Matrix, Duncan Jones’s Moon and George Lucas’s THX 1183. Inspired by these films, Li Fe has taken a more literal approach to the narrative by centering the allegory on creatures that actually consume the light of the cave. Similarly to the other films mentioned, Li Fe introduces a new and specific universe of which little to no explanation is given in order for viewers to rely on their own experiences for interpretation.

Most successful computer animations use visual style to enhance the story, resulting in a better overall short. If the animation is not believable, the lighting implemented improperly, or the models stylized contrary to the art direction, the final result will be an uncomfortable and odd viewing experience, where the story and the visuals are disjointed. As a result, the viewer may feel disconnected and uninterested in the animation.
For these reasons, implementing the CG elements properly is the most important aspect of production after the narrative. Since a major component of a successful film is the viewing experience, the individual elements must be believable and complement the story. As evidenced in the films mentioned above, this approach is an effective means of ensuring a successful viewing experience and an overall goal of the Li Fe short.

Digital animation pioneer, John Lasseter, of Pixar and Disney Animation Studios, explains his view for the visual style of his films:

The real world out there, when you photograph it on camera, there’s so much detail and that’s what we are used to. That’s what tells us as an audience, this is a believable world. That level of complexity is so challenging to produce on a computer.

…Believable. I like to use the word believable because I never want to produce a world where the audience thinks it exists. I like to take a step back, use those photo-realistic tools and ability to make it look real, take a step back, produce a world that audience knows does not exist and then make it look as believable as possible. So the audience goes, “I know that’s not real, but boy it sure looks real.” [ROSE10]

Optimizing the overall pipeline is especially important when attempting to create a realistic creature since many potentially time-consuming details must be included. This approach requires recognition that each part of the production will affect the next. Texturing, modeling, shading, and lighting are important methods of achieving believability, and all require specific technical detail and attention. Texturing in Li Fe drew from actual creatures that live in the most deserted and inhospitable places. Eyes, often described as the gateway to the soul, were created in many separate layers so that they could be altered and specifically art-directed. Modeling the creatures also relied on examples from life to achieve an effective model for both production and narrative purposes. Shading and lighting were also important since eyeballs needed to appear wet and alive, while the belly needed to emanate a glow. Each of these elements required separate render passes, which caused render times to increase dramatically.
Several different elements were required to produce and fully realize the *Li Fe* short. First, the background of Plato’s “Allegory of the Cave” and its application to the story of the light feeders will be presented. Next, the artistic direction of digital art techniques and composition will be explained along with their benefits to the short. Finally, technical aspects used in shading, lighting and rendering will be fully detailed with production images and rendered frames.
CHAPTER II: BACKGROUND

“The Republic,” written by the Greek philosopher, Plato, contains an illustration known as “The Allegory of the Cave” [PLAT80]. In his allegory, Plato attempts to illustrate the difference between perceived reality and true reality. The concept explained by Plato is the fundamental basis for Li Fe.

In the allegory, a dialogue exists between Socrates and Glaucon, where Socrates describes a group of prisoners who have been chained to a cave wall their entire lives. They are bound so that they are unable to move their arms, legs or even their heads. They face the opposing wall constantly, while behind them people pass on a raised walkway in front of a fire, carrying various objects above their heads. Since the chained prisoners can only watch the projected shadows of those who walk above them day and night, their knowledge includes only the shadows on the wall and the echoes of sounds above them. The prisoners only know the reality of the shadows and sounds, not the truth behind them. Their society and existence are based purely on the cave’s illustration of life.

One of the prisoners is then freed and shown the objects that create the shadows on the wall. At first the prisoner, still clinging to the only reality he has known, does not believe them to be real. The prisoner is then forced to look at the fire, but again refuses to believe it as truth and tries to look back at the shadows. Eventually, the prisoner emerges from of the cave into the blinding sunlight. After regaining his sight and seeing the true physical world, he realizes the ultimate truth and reality around him (see Figure 2.1).
Similarly, *Li Fe* attempts to portray the consciousness of true reality. The story is about exploring beyond the boundaries of one’s comfort zone and discovering life is more than what is normally seen. Beyond this basic theme, other interpretations could be formed from a viewing. For instance, the way the feeders focus completely on the light and react violently when the light is taken away is similar to the behavior of a drug addict. The main feeder breaks away from this addiction and is then able to see a fuller and richer existence than his former one. Another interpretation might be that the main feeder has a greater calling in life and divine intervention freed him from his mundane existence. Several other interpretations of the main story are possible, as viewers rely on their own experiences to inform a view of the narrative.
The title of the short is *Li Fe*. The “Li” and “Fe” stand for the first two letters of “light feeder.” When read literally, the title is the word “life,” which allows for broad interpretation of the story. Multiple interpretations of the title hopefully ensure that viewers will think about the story and apply their own conclusions in the end.

The light feeder creature originated from a simple sketch created in the mid to late 1990’s that involved combining different parts of various creatures to make a single disturbing beast. The light feeder sketch was executed more quickly than others and was much simpler in design, but the idea was present: a small, unpleasant, creature whose existence was solely based on surviving by consuming light. The creature in the sketch had no arms or legs, but simply a belly with small nubs where feet should be, and an extendable neck with a giant single eye on the top, with large eyelids.

For the story of *Li Fe* to be realized, many different programs and applications were used: Adobe Photoshop, Adobe Premiere Pro, Adobe Sound Booth, Pixologic ZBrush, Autodesk Maya and The Foundry’s Nuke. Each of these programs was able to implement specific tasks related to the production without which the production would not have been possible. The details of implementing the story of *Li Fe* will be discussed in Chapter 3.
CHAPTER III: IMPLEMENTATION

The story of cave-dwelling creatures that consume light required a vast amount of research to make the visuals and narrative appear to be based on reality. The physical appearance of the creatures, with their human eyes and frog-like skin required intense investigation into biology. This research led to a time-consuming technical journey into ways to make the biology of the creatures appear believable, through means of the computer.

3.1 Designing a Light Feeder

Snakes, newts and centipedes are only some of the many different types of creatures that dwell in caves and live under rocks void of any human contact. The appearance, movement and feel of these types of creatures served as inspiration to the story of the light feeders. The texture and skin of a toad helped to bring the bump and specular maps of the feeders to life. The quick rapid movements of a newt gave the light feeders their reactions when starved of light. Even though most people avoid these types of creatures, they are relatable on a certain level, which can help to create a deep and almost unconscious connection to the creatures.

The appearance of the light feeder creature was modeled after an original sketch; however, some modifications were introduced to allow the creature to serve its purpose and perform technically and visually for the animation. While the original sketch portrayed a short, fat, stubby little creature with little to no mobility, the newer concept drawing of the creature incorporated the ideas of motion and story, as shown in Figure 3.1. As a result, the nubs that helped the feeder “stand” were made larger, so that in the animation the creature could hop or move around more easily. Additionally, the feeder’s neck was elongated for better range of movement, thus allowing the feeder to better reach for light. As for the eye itself, a human type of eye was used so that viewers would better relate to the feeder, despite the rest of its appearance.
After the basic creature design was finalized, storyboards were started, which caused a few more changes in the feeder’s design. The storyboards revealed that the feeder, at times, had a phallic appearance and motion. This result was unacceptable as it may have distracted viewers from the story and focused more on an unintended result of the feeder’s design. A solution to this issue involved shrinking the bellies of the feeders, resulting in a thinner overall appearance.

The next design change involved enlarging the emotive brow areas around the eye. Adjusting the brow helped the top of the feeder to appear more oval-shaped and less phallic overall. The feeder’s brow motions and reactions were taken into consideration later during animation. At the end of this process, the feeder appeared more like an unseen creature that would clearly and visually enhanced the story without distracting the viewer.

3.2 The Human Eye

The next step in the creation of the light feeder involved the most important of its physical aspects, the eye. Every viewer, consciously or not, is aware of the small intricacies of the human eye. The movement, reaction to light, coloring and depth of the
eye, as well as the emotion and thought it reveals, are all elements that viewers instantly recognize as real or manufactured, which motivated the feeder’s giant light-eating eye’s careful and precise execution. To achieve believability, certain aspects of the eye were taken into consideration: depth, texturing, wet appearance and reaction to light.

The first step in creating the eye was to study the different aspects of the human eye, particularly the way it works and the features that determine its appearance. The human eye is comprised of many different parts (see Figure 3.2) but the only elements considered were those that were visible: the sclera, cornea, iris and pupil. The sclera includes the outer white area of the eye and helps give the eye its overall shape. The clear part of the sclera that allows light to enter into the eye is the cornea. The iris comprises the light-responsive muscular tissue and gives the eye its blue, green and brown colors. The center opening of the iris is the pupil and grows larger or smaller depending on its reaction to surrounding light.

![Diagram of human eye](ERIC11)

Figure 3.2: Diagram of human eye [ERIC11]

Many methods exist for modeling eyes for production purposes, but most of these methods do not provide an adequate level of detail for the light feeders animation. Typically, eyes are modeled procedurally in Maya since viewers may only see them from far away with little detail. The light feeder’s eyes are viewed with extreme detail in many
scenes; therefore, a combination of modeling methods was required to achieve the believability and depth of a human-like eye.

3.3 Modeling the Feeder’s Eye

The eye model for one feeder was separated into four parts of one complete eyeball group, as shown in Figure 3.3. The cornea consists of a NURBS sphere with a small, extended section pulled forward where the iris begins. This extended section helps to imitate the appearance of a human eye when viewed from the side. The sclera is a duplicate of the cornea model scaled .99. The extended sclera faces were deleted to allow the iris model to fit properly. The iris is a subdivided torus shaped into a disc, with the center pushed back farther than the outer edge to enhance iris depth. The pupil is a halved polygon sphere that is elongated to a bowl shape. When the four separate eye models are properly aligned and grouped, they form a complete eye, as shown in Figure 3.4. The next steps in creating a realistic eye are texturing and shading.

Figure 3.3: Breakdown of eyeball models from left to right: iris, pupil, sclera and cornea
3.4 Texturing and Shading the Iris

A simple way to texture the iris and sclera is to use real photographs of human eyes. Photographic images ensure realism with minimal digital painting, but leave little flexibility for art direction and customization. The *Li Fe* production therefore used a method of digitally painting all elements of the eye, similar to the technique described in [Kris05]. Digitally hand painting enables complete art direction and allows for each feeder to assume a unique eye color with individualized depth.
The iris texture map was created in Photoshop with an Intuous pen tablet pad. The final texture file consisted of 24 separate customizable layers, as depicted in Figure 3.5. The different layers ensured that each of the seven feeders could be assigned an eye unique from the others. A simple way to customize the eyes was to adjust the color, opacity and rotation of specific layers, as shown in Figure 3.6. This method was not only a time-saving approach to texturing multiple eyes at once, but it also ensured that at any time during production, modification could be made rapidly and easily.
3.5 Texturing and Shading the Eyeball

Unlike the iris, which used a basic Blinn shader, the sclera needed a Sub-Surface Scattering (SSS) shader to emulate the way the human sclera absorbs light. While a Blinn shader can be adjusted for transparency and light reflection, attributes desirable for imitating a human iris, a SSS shader absorbs light and scatters it between different texture and color layers, allowing the light to penetrate a specified depth. These qualities help to imitate the different layers of color, muscle and blood vessels seen in the sclera.
Since many texture layers can be used and adjusted for specific amounts of depth, the texturing of the sclera was designed with the SSS shader in mind. The diffuse color layer, which represents the diffuse color of the sclera, contains the outer blood vessels and the appearance of various eye muscles, as shown in Figure 3.7. The Front SSS Color represents the color and weight for surface scattering on the outer surface. This texture layer contains additional blood vessels and allows adjustments in appearance, which can imitate a bloodshot eye, as seen in Figure 3.8. The Back SSS Color contains the color and weight of surface scattering for the backside of the model. When viewed from the side, light from the opposite side of the eye will pass through the eye to reveal the color of this layer, which was set to a muted red color to imitate the liquid inside the eye.
After the iris and sclera were textured, the pupil and cornea needed only shaders to achieve believability. The pupil uses a Blinn shader with a dark red specular and reflected color to achieve a “red-eye” appearance when the eye is shown at specific camera angles. The cornea employs a Mia Material X shader with many different presets that can be chosen to imitate glass, metals, plastics and rubber. The thin glass preset was chosen and its refraction adjusted to achieve the desire appearance of the iris.
3.6 Eyeball Bumps

Figure 3.9: Mia_roundcorners1 added to Standard Bump in the SSS attribute editor

Figure 3.10: Cornea bump map

Another advantage of the eye is that different types of bump maps can be applied (Figure 3.9). The Overall Bump map is taken from the sclera’s diffuse map, which was desaturated and inverted (Figure 3.10). The presence of this map helps the blood vessels appear to possess a slight thickness. The next bump map, the Standard Bump, allows an extra element of refinement to be added. The mia_roundcorners node causes the shader to produce a rounded edge when any other geometry touches it. This rounded edge can be manipulated artistically by setting the radius in the
mia_roundcorners attributes. This node, when set appropriately, causes the eye to appear as if liquid is pooling at the edge of the touching eyelid, as in a human eye (Figure 3.11). This small bit of detail, while discrete, helps with the subtle believability of the eye.

![Figure 3.11: Top: without mia_roundcorners node; Bottom: with mia_roundcorners node](image)

After all of these elements were combined and adjusted, the eye appears more realistic. Further, it absorbs light, which is essential for the feeder’s survival. Other types of eyes, such as those of animals, are sometimes harder to achieve artistically and cause the viewer to study the eye more closely to determine the type of animal eye depicted.
3.7 Modeling the Feeder’s Body

The next logical step in the creation of the light feeders was modeling the feeder’s body based on the concept art, as depicted in Figure 3.12. All of the feeder’s body modeling was performed in one step since the creature has no separate body parts and is essentially nude. The perfect program for ease of sculpting for the level of detail needed was Zbrush.

Modeling the body in Zbrush began with Zspheres. These primitives provide a simple way to achieve a basic shape since they can be moved and adjusted within a shape or form, and previewed in polygonal form with the push of a button. Further, the simplicity of Zspheres was helpful in viewing the alignment of the polygons on the model during creation.

After the rough shape was created, the Zsphere model was converted to a workable Zbrush model, which enables the digital sculptor to manipulate its form. The
most efficient way to sculpt the model is to move and shape it using various brushes and then to subdivide the faces. A helpful feature in Zbrush is the ability to move backward and forward across levels of division, which makes the sculpting easier and oftentimes faster (see Figure 3.13).

![Subdivision levels - Left: Level 1: 3,362 polygons; Right: Level 6: 688,128 polygons](image)

After rough modeling, details were added to bring the feeder to life. In Zbrush, a modeler can import an image and “stamp” it onto the model. The image is first desaturated to grayscale in an image processing application. In this way the image can be used by Zbrush to determine depth, with white representing the closest point and black the farthest point. This image can then be imported into Zbrush as an alpha map and applied as a brush to the model, as shown in Figure 3.14. The higher the number of divisions in the model, the higher the precision of the brush. Many images of real human
and animal skin were used to model the skin texture and wrinkles of the feeder in Zbrush.

![Figure 3.14: Four different skin alphas created in Photoshop for use in Zbrush](image)

At the end of modeling, the feeder was composed of several million polygons in Zbrush, which resulted in an amazing level of detail, but was unusable for practical production purposes (see Figure 3.15). While a certain level of detail was needed in the model, the polygon count was reduced greatly to facilitate production. The solution to this issue was a special plug-in for Zbrush called Decimation Master, which can reduce a high-poly-count model by a specified percentage while retaining a majority of the detail. This plug-in optimizes the faces of the model for detail at the highest division level. When using Decimation Master, all of the division levels are merged into one as the final step before exporting the model to Maya.
3.8 Texturing and Shading the Body

The next steps in the process were texturing and shading. These two steps were performed simultaneously to produce the proper look and feel of the skin. Based on the character research and the concept art, the feeder possessed the look and feel of an amphibian type of creature. The skin needed to appear discolored and cold-blooded, scaly and thin with underlying veins showing through the surface (see Figure 3.16).

The amphibian appearance of the skin will undoubtedly evoke a response from the viewer. Most viewers will probably have handled a frog or seen a small creature quickly slither from underneath a rock. Whether the viewer is repulsed or intrigued, he or she will rely on personal experience to transition the viewing process to a more tangible experience, which is the type of connection desired for the short.
As with the texturing of the iris and sclera, texturing the skin was completed in many layers while taking the shader into consideration. The Sub-Surface Scattering shader, misss_fast_shader_x_passes, was combined with a misss_skin_specular shader, as seen in Figure 3.17. Combining two shaders in this manner allows for a greater range of specular control for the skin on the body and around the eye.
The shader dictated the need for separate epidermal, subdermal, backscatter, bump, and primary and secondary specular texture layers. Each of the textures was composed of separate layers as well. Like the eyeball, all of the texturing and digital painting was performed in Photoshop using a variety of methods to achieve the final result.
The epidermal layer, or top layer of skin, represented the feeder’s protection from the outside world. The feeder’s contact with the environment was shown on this texture map in the form of dirt where the feeder touches the cave floor, as seen in Figure 3.18. This layer also depicts blood vessels and veins that are closer to the surface of the skin. Topical skin imperfections were included on this texture map as well.
Another map that added to the perception of depth in the feeders’ skin was the backscatter map, as shown in Figure 3.19. This map determines the amount of light passing through the feeder when a light source is opposite the camera. If too much light passes through, the feeder will appear plastic and thick. If too little light passes through, the feeder will appear rubbery and synthetic. This map adds another small level of detail.
While most skin texturing was painted by hand, the bump maps and one of the two specular maps were produced with an image of a flattened frog skin, as seen in Figure 3.20. This image contained a large amount of scanned detail and required only a small amount of touch-up painting to extend edges and cover seams. The image was then desaturated so that Maya could properly read the image values for bump and specular. Similarly to Zbrush, Maya interprets this type of image with lighter values signifying higher depth, while darker values are lower or deeper. For specular lighting, Maya thus assigns higher specular values to lighter parts of the image and little to no specular value to darker areas. The frog skin added an extra level of tangible texture, while also providing several texture maps for different elements of the final shading.

The second specular map was hand-painted and specifically used around the eyelid area of the feeder. This map added to the wet look of the eyelid, which could be
completely controlled through the specific misss_skin_specular shader. These small but important shading details and modifications were needed to produce a creature more realistic in appearance.

The most important aspect in the texture of the lightfeeder’s skin was the appearance of depth. The skin needed to appear as if veins and blood vessels were pulsing and pumping underneath it (see Figure 3.21). The SSS shader therefore needed to scatter light in a way that the viewer could believe, which could be achieved by adjusting the scatter weight in the attributes menu of the shader.

![Figure 3.21: Cumulative layer build-up for subdermal texture map](image)
When the texturing was complete, the feeder’s body contained a high level of detail and depth that enhanced its realism, as seen in Figure 3.22. Each of the various maps added an element needed to bring the body to life. Once the body was fully textured, the eyeball was put in place.

3.9 Adding Subtlety

One area of the body that required additional detail was the area where the eyeball and eyelid meet. All humans have fleshy, muscular tissue surrounding this area, called the caruncle, which contains sweat glands. Two caruncles were therefore modeled to imitate a small organic nodule. After the caruncle was created for one side of the eye, it was duplicated, flipped and slightly modified to fit the opposite side of the eye. Both models were textured with the same multi-layered technique discussed previously, with subsurface scattering shaders included to allow a small amount of light penetration. The mia_roundcorners node was also added to each to provide a uniform wet appearance across the eye (Figure 3.23).
3.10 Rigging the Iris

After the modeling and texturing were completed, the next step was rigging, which involves creating an adjustable skeleton for the model to facilitate animation. The entire light feeder required a fairly complex rig to achieve the desired movement. The iris rigging was completed independently of the body rigging.

Since most eye models in CG are shown from a distance, the eye usually does not include rigging of the iris; however, the close-up shots of the feeders required such rigging for animation. In order for an iris to “react” to light, it needs to dilate and contract. One method for achieving this movement involves selecting each vertex of the iris model and assigning it a unique weight. By default, each vertex has an assigned weight of 1.0, which corresponds to a 100% effect on that vertex. If a vertex were assigned a .55 weight, the vertex would only be affected 55% when animated.
Since each vertex on the iris model was assigned to a single ring, each ring simply received a unique weight, with the inner rings allowing more fine-tuned adjustment and the outer rings less. The next step was to cluster all of the vertices together so that a set-driven key could adjust the dilation and contraction of the iris. With a range of -10 to 10 for the set-driven key, the -10 completely closes the iris and deforms the texture in an unusable way. Similarly the 10 setting completely opens the iris to its widest, which again unnaturally deforms the texture. The middle range more closely mimics the appearance of a real eye; therefore, the iris could be easily animated in this range based on the lighting in the scene (Figure 3.24).

3.11 Body Animation

The next step in bringing the feeder to life was the animation. The movement of the feeders was specific for each scene, but since they do not exist in the physical world, their animation had to be planned carefully to mimic actions comparable to real-life creatures. Some scenes required little animation while others demanded more detailed work.

The first few scenes, where the feeders are virtually motionless while consuming the light, needed slight subtle movement of the creatures. Without subtle movement, the feeders appear lifeless, similar to a single still image. In the natural world when a person tries to stand perfectly still, a small amount of back and forth sway occurs anyway due to
natural processes. This sway is the perfect type of subtle movement to add to the feeders to enhance their realism.

The animation of shot seven, where the feeders lose their night light source, also needed real-life movement; however, these actions were more difficult to achieve due to the anatomy of the light feeders. Without arms, legs or an emotive face, the feeders could show only a limited range of emotion. As a result the body movements were exaggerated to enhance expression.

When the light is initially blocked, the feeders remain in their light trance state shortly thereafter; however, they begin to swing their heads up and down and from left to right rapidly, which reveals their confusion and anger. These movements were based on the way a lizard reacts when picked up by the tail. The animation of the basic vertical movements was made for one feeder and then copied and pasted to the other feeders with staggered timing. The other head-shaking motions and blinking elements were individually keyed by hand, so that each feeder would display more individuality (see Figure 3.25).

![Figure 3.25: Feeder emerging from light trance](image)

All of the other movements of the light feeders were animated by hand and, as before, were based on various types of real-life movement. The animation of scene twenty-five, where the feeder falls through the crack in the cave floor, was based on the motion of a long tube-shaped balloon filled with water when thrown down a flight of
stairs. The movements of the feeder pushing himself to stand after falling forward were modeled after the movements of a person trying to stand up from a kneeling position with his hands bound behind his back. This type of motion and movement research added to the realism of the feeders by giving them more accurate weight and gravity.

3.12 Eyebrow Emotion

After the body movements were animated to match expressions of emotion, the eye area was animated to be emotive as well. Since the eye would be shown in full frame, the brow surrounding the upper part of the eye was the key element that added this extra bit of emotion. Many expression sheets were created in the preproduction process with this goal in mind (as shown in Figure 3.26), which helped to animate the feeder’s “facial expressions.”

![Image of expression sheet for feeder]

Figure 3.26: Expression sheet for feeder

The upper brow was created to act as a functioning eyelid that would open and close, but also to posses some of the emotive properties of two human eyebrows combined into one. Each side could move up and down together or separately to form various arch shapes. Since most viewers are able to draw a conclusion about the
emotions of a character based entirely on facial expressions, adding a familiar emotive feature to the “face” of the feeder was important to relay expression in a fairly simple face consisting of a single eye. The emotive brow feature was used only by the main feeder in the story, which helped set him apart from the other entranced characters in the animation.

3.13 Belly Glow with Ambience

The lighting elements of the *Li Fe* short were important but challenging aspects of the production. One of the unique lighting challenges was the glowing belly of the feeders. When the light feeders consume light, it builds up inside their bellies and slowly pulses. This pulse is an important visual to show the life force of each feeder, while also serving as another emotive tool. When the feeders are calm, the pulse is slow and steady, but when they are frantic, the pulse becomes rapid and erratic.

![Figure 3.27: Ambience texture map for feeder’s belly: Left: Day, Right: Night](image)

The first method for implementing the belly glow was by means of texturing using an ambience map, as shown in Figure 3.27. This type of map can cause the brighter parts of the map to emit an ambient glow on the model to which it is applied. Both sunlight and moonlight ambience maps were created to fit the shape of the belly.
Unfortunately once these maps were applied, the belly did not appear as if it were glowing from the inside (Figure 3.28). Instead, the belly appeared extremely discolored and splotchy. In addition to the odd look of the skin, the pulsing life-force effect could not be easily controlled or changed if needed.

Figure 3.28: Left: feeder with day ambience map; Right: feeder with night ambience map

3.14 Belly Glow with External Lights

The next method involved shining a light from the outside of the feeder onto its belly. The light could be more easily controlled by rendering it as a separate layer, but the look of the light was still odd. The light did not have the appearance of originating inside the belly and glowing through the skin. The moonlight also caused the feeder to take on a greenish-blue color, which gave it the appearance of being both alive and dead. The placement of the lights outside of the feeder could also be problematic during
production when the feeders are moving close together due to a small amount of rim glow cast on the ground (Figure 3.29). As a result, the moonlight belly glow and the outer lighting techniques were discarded.

3.15 Belly Glow with Internal Lights

The technique that worked best involved lighting the belly from the inside. The SSS skin shader allows light to pass through two sides of a model. In order for light to pass through the “skin” of the feeder, a section of the feeder’s belly was duplicated, extracted and pushed back into the stomach (Figure 3.30). This solution did not work at first due to the way normals function within a SSS shader.
The glow of the feeder’s belly simulated the way light from a flashlight travels through an organic translucent surface, such as an ear or the tip of a finger. This intense but soft glow is an effective way of showing the feeder’s life-source. The SSS look was already working well for the feeder’s “feet,” but it was not working for the belly. When the section of the belly was inserted into the body wrap and parented to the rest of the feeder, the normals were still pointing to the outside of the model. The inner belly section was then selected, the normals were reversed and the belly then glowed as desired from the inside. Of course, this glow did not produce light that would shine on objects in the cave; therefore, a small spotlight was parented to the inner belly light and placed outside of the belly to imitate the inner glow.
After the initial belly glow was accomplished, the glowing pulse needed to be implemented. The intensity of the lights could be keyed in Maya, but if changes in the speed of the pulse were desired, the lights would need to be completely re-rendered, which would consume a considerable amount of time. Instead the pulse needed to be easily controlled and directed without re-rendering. Creating a separate render layer for each belly light would achieve that specified control. Bellies lights would be the only lights in each of the layers. The layers could then be rendered and screened over the beauty render pass in Nuke, as shown in Figure 3.31. They could then be keyed to fade in and pulse as fast or as slow as needed. This method resulted in longer render times because of the seven separate layers for each feeder, but the control achieved outweighed these render time issues.

With belly lighting implemented, the final element to bringing the feeders to life was completed. The models, combined with the many texture layers and shaders, all work together to create a living and light-eating creature. The remaining elements for the *Li Fe* film was to animate, light, render and composite to create the final film.
CHAPTER IV: RESULTS

Once the modeling, shading, texturing, rigging and animation of the feeders were complete, the final look of the feeder emerged, as shown in Figure 4.1. All of the details of the texturing and shading are seen in every shot of the *Li Fe* animated short. The feeder’s skin absorbs and scatters light properly and the eyes appear to react to the light in a fashion similar to a human’s eye, as demonstrated in Figure 4.2.

Figure 4.1: Front, side and back views of the main light feeder
Figure 4.2: Final render: Close-up a feeder’s eye

The feeder’s posture and body movements portray a creature that relies entirely on the light shining through cracks in the cave walls. This convincing result was achieved with both modeling and rigging. Three different camera and lighting situations required varying posing and placements of the creatures, as depicted in Figures 4.3, 4.4 and 4.5.
Figure 4.3: Final render: Full body view of feeders

Figure 4.4: Final render: View of all the feeders
Texturing and shading techniques used on the skin resulted in rich, subtle detail. The final belly lighting method, combined with compositing, provided a rendering set-up that was easy to control and change if needed. In the final renders, the belly light originated from the inside of the model, as if the feeders were actually feeding on light, as shown in Figure 4.6.
The final renders for *Li Fe* show a creature that lives entirely on light. The feeders have realistic eyes and skin, which behave in a similar fashion to humans. They are odd and unique creatures that exist only in the world of animation, but are brought to life by the time and effort put into their creation (Figure 4.7).
CHAPTER V: CONCLUSION AND FUTURE WORK

Only through the application of the methods and tools used to create the light feeder creature was the final production made possible. Using Zbrush to model the body of the light feeder creature proved to be an efficient way to achieve a high-detail model. The ability to create custom brushes based on any image ensured a unique look that was limited only by the functional capabilities of ZBrush. As stated previously, the primary issue in developing a model with millions of polygons is that it can slow down other aspects of production.

Such a model can be extremely difficult to animate and render due to massive computational requirements. Zbrush’s Decimation Master plug-in was an effective solution for this problem. Reducing the light feeder model from millions of polygons to only a few thousand resulted in much faster animation and rendering, while retaining most of the model’s detail. This plug-in would be useful for future productions, especially those where even more detail is desired. One direction that was not used in the Li Fe short relies on displacement and normal maps to increase detail while retaining efficiency.

After a model has been sculpted in Zbrush and the UVs organized with the UV Master plug-in, various maps can be exported from Zbrush for use in most 3D programs. Two such maps include a displacement map and a normal map. Displacement mapping is a method that uses a texture or height map to displace the actual geometry, unlike a bump map, which gives the illusion of displacement without actually modifying geometry [ERIC11]. A normal map consists of RGB components that correspond to the X, Y, and Z coordinates of a model. When applied to surfaces, normal maps affect lighting and give the illusion of detail without adding more polygons. These maps can actually be
produced from the original model under a higher level of subdivision. Once the maps are exported from this higher subdivision, a switch to a lower subdivision is necessary in order to export the model in OBJ format for use in Maya. Once the OBJ file is imported in Maya, the displacement and normal maps can be applied to the model and adjusted to achieve the amount of detail created in Zbrush at the higher subdivision level. Using this method provides the model with the level of detail created in Zbrush, but will not produce issues in animating and rendering.

The methods used for texturing the light feeder creature were effective in addressing the needs of the production. Using a multi-layered approach proved to be an advantage in assigning each feeder a unique eyeball. Allocating 24 layers for the iris allowed simple selection of any of the layers to adjust the color or hue. Rotating or deactivating certain layers aided in the creation of a completely new texture map with little extra work or effort. This approach was efficient for the Li Fe production because the iris map for the main feeder otherwise required more than five hours to paint. Texturing with this method may work well for future productions if many similar textures need to be customized.

Lighting the belly of the feeder proved to be a difficult task, but the result ultimately achieved the look desired. The glow emitting from the inside of the belly allowed rendering in separate layers, which facilitated light adjustments in Nuke. This method of rendering is currently used for many productions since adjustments can be made easily.

Ultimately, the production required a tremendous amount of time to render, primarily due to the numerous render layers and the reflections and refractions of the eyes. If the short had not been rendered in multiple layers, the feeder’s skin would not appear as realistic, the eyes would not display a great amount of depth, and control of the belly lights would not be possible. Optimizing each area of production, from modeling
to lighting, helped to accomplish a believable look that could be easily art directed and modified with minimal rerendering.
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