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# LONGSHI

By

Pei-Cheng Lee

Submitted in Partial Fulfillment of the Requirements for the Degree

Master of Fine Arts

MFA Imaging Arts / Computer Animation

School of Film and Animation

Rochester Institute of Technology

Rochester, New York

March, 2009

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Professor Malcolm Spaul, Chair

School of Film and Animation

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Professor Tom Gasek

School of Film and Animation

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Professor Daniel Deluna

School of Design, Computer Graphic Design

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## 1. Abstract

LONGSHI is a Graduate Thesis film, a M.F.A Thesis at the Rochester Institute of Technology 2009, made by Pei-Cheng Lee.

LONGSHI is a story about a man in search of a legendary treasure which is very valuable in the historical record. The reality of this treasure is actually a trap set up by barbarians to attract the greeds.

The film is a 3D computer animation, created primarily using Autodesk MAYA 8.5 for production, Adobe Photoshop, After Effect, and Premiere for pre and post-production.

This film' s technical aspects focus on texturing, lighting and compositing to represent an illustration-style animation. The following paper will describe its techniques and aesthetic concept.

## 2. Concept and Pre Production

The story idea was adapted from an old Chinese fable about a man who survived in the desert because he was not greedy but kind. However, this story has been dramatized with a different outcome.

The idea first began with a man walking in the desert in search for the treasure jade, LONGSHI, that he has been looking for. During my meetings with the committee chair Malcolm Spaul, he constantly probed questions which allowed me to think about the storyline; to provide more colors and details.

First, The background story was about a legendary treasure called LONGSHI which gave the audience a reason why this man is walking in the desert for days. However, Malcolm asked the questions and reasons that would help build the story of the importance and value of the treasure. Questions about the rumor, its' significance in the story were the things I did not have answer for.

The story about the rumor was created to illustrate a connection between the hero and the barbarian's rapacity. For the man he faces a difficult decision to be in the desert with an empty kettle upon reaching the shake and finding a pump for water, as well as the treasure he is been searching for, he is in dilemma to choose either his life or fortune. The pump means water and his life, and the treasure means fortune and his greed. These two elements are conflict. I created another situation for him have the option, an option that would satisfy the man and the barbarian at the same time. I had no idea to get to this part of the story. I had several discussions with other committee members and friends. Everyone had different, big and creative ideas which were combined to portray the story that I have now. In the end, the solution was to make an

instruction painted on the wall that showed how the Longshi could start the pump. In the movie, the wall-painting illustrations were just basic geometric figures coming out from pump, for the audience to imagine the object that would be pumped out; water, gold coin or anything possible.

But, why barbarians want to collect the thing from people? Barbarians in the movie just like any creature in the world. They may have different treasure desire from people. Even under different culture, we may wondering why this thing will be enshrined, maybe honor or various interesting purpose force them to do that. No matter what kind of desires for them, all this cravings are related to the thing which lives on earth. Everything is related just like Butterfly Effect.

The theme of the movie depicts the real life situations where people make up rumors sometimes just for their own benefits, usually through greed or selfishness. The recent financial swindle perpetrated by Mr. Bernard Madoff on Wall Street shared similar lines with my story in that he was able to fool the whole world. Relying on his credentials on Wall Street, he used the public's trust and belief in him to steal huge sums money.

Because this movie has almost no dialogue, camera movement becomes a relatively significant element for visualizing from concept to screen. The most part, Malcolm and I didn't have too many different ideas except for how the barbarians should appear. Originally, I wanted the barbarians to show up after the man dies. Malcolm thought that was too sudden for the audience and urged me to build on the story. I then attempted to not let the audience know how barbarians looked like, to give them a hint that there is something watching the man in the dark. That way, audience will



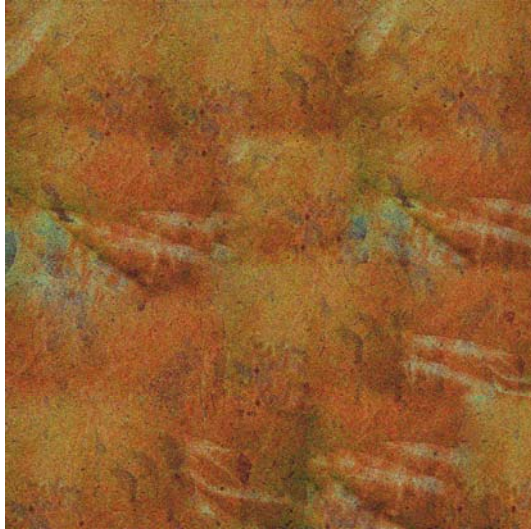
give more attention to what will happen later. This was an idea that I did not think of before, but it works. I always want to surprise the audience, but without giving a little clue, the surprise would come too sudden like a random act instead of a premeditated plot. To do this, I used a POV shot of the barbarian watching the man walking in the desert a cactus. It was not very obvious but enough to prompt the audience. But Malcolm thought that was not enough. After several meeting, I added another POV shot of a barbarian blinking his eyes right before the appearance. I was very satisfied with the scenes captured of camera moving in the end. It conveyed more dramatic scenes to help the audience become more wary of the story.

For the movie style I started thinking about combining two kinds of animation's advantages together. Traditional hand drawing animation is more unpredictable with more interesting results than CG. However CG is more flexible to give camera movements and angles in animation. For the character and environment designs, I consulted with European's animations such as: "The Triplets of Belleville", Folimage Valence Production's work as well as a 3d animation adapted from an illustration novel from Taiwan called A Fish With a Smile. Both are illustration style, meaning all the texture are done with hand drawing stroke, exaggeration and irregular appearance.

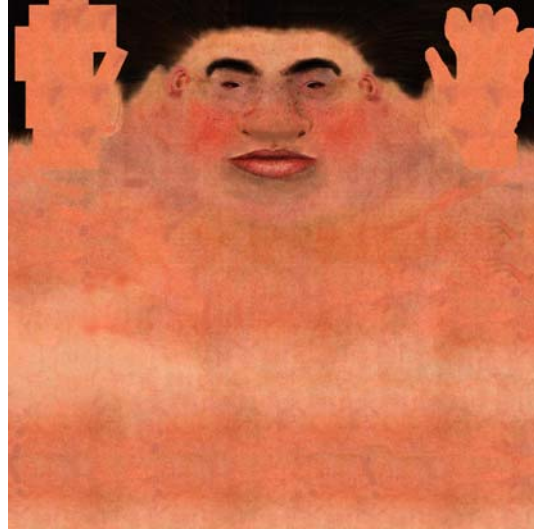
### **3. Production and Post Production**

During production of the model, I prolonged the main character's body, and shortened the barbarian's body to make it look more dramatic. For the environment, at the beginning, I created a realistic model of a house, then modified it with deformer in order to get rid of symmetrical shape and straight lines. I attempted to make a lot of

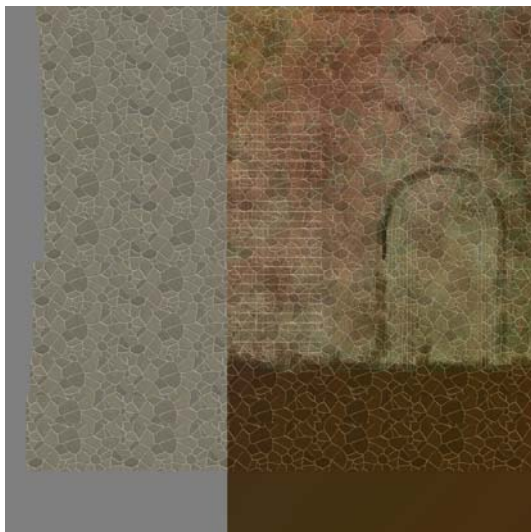
details and always broke the straight lines. For the texture, I obtained from real object texture, but also used Photoshop and Painter with wacom to make them more hand drawn like. For example:



Map painting of desert



Map painting UV of Main character



Map painting UV of wall in the city

After all the designs and models were ready, the next step was to rig the characters. Because I know this is not my focus, I used Set up Machine to help me with the rigging. However paint weight was not so easy, the attributes the program did automatically for me was not meet my expectation. I spent a lot of time to add more attributes to control the rig, such as making an attribute of five fingers holding together ...

Facial expression is the key to let the audience understand the feeling of the characters.

In my past two films, I never tried to make blender shape into one control panel. I wanted to push myself to learn more on how to rig the face. It needed a little bit of programming support. I don't have too much programming background, so Stop Starring was the perfect book to teach an entry learner to do facial rig. In the end, I am pretty satisfied with what I did in the panel. That panel is more logical and convenient to help me do facial animation.

Speaking of animation, it is always my weakest part. My committee member, Tom Gasek gave me a lot interesting animation suggestions and ideas. I tried to do my best but I know I was not focused on animation for the thesis and even for my future career. I opted for more time to compositing to make the images look better.

Compositing was the last step for images, the most important stage. No matter how the render image is, good compositing can always turn a sequence better. There will be a completed explanation of compositing working process in the next section.

For music and sound effects, this is the only part which I could not handle myself. I started to look for a composer just two months before the screening. I thought that I needed to finish the animatic and also give the composer final composited frames first. For this reason, I knew it would be easy to convey my concept. For the previous two movies I made, I always gathered music from different movies and published albums. The point is the music can not follow the plot of the story perfectly. This time I wanted to look for a professional musician to help me produce a proper background music. I am very lucky that I had two very professional composers to help me. One is a friend and the other is Alexander Tartter, a music school student in Genesee Collage. We discussed my concept a lot through email. The composer asked me for some

images of my film first, because those images would be a good starting point to imagine the music from color and modeling. During every conversation with the composer, he mentioned a lot of aspects in which I never had thought of before. In the end, I had two versions of the music. At first, I chose the version that my friend did for me, because it was mild. Then I showed that version to Malcolm, and he thought that one was too insipid. Frankly speaking, I didn't like the second version in the beginning. But after listening repeatedly to both versions, I agreed with Malcolm's opinion.

#### **4. Techniques**

The main aim of LONGSHI was to focus more on texturing and lighting. For my past two films of academic years, I tried a lot of different techniques to deal with depth of field. However, even the final picture results on both films were not too different from one another. The time saved and easy to adjust attributes became relatively important. I will explain next.

For the first movie I made for one quarter, I utilized render image of RLA file. This file included final render and Z-depth data. Z depth is good for dealing with the depth of field, because it is not easy to treat the focal lens of camera in MAYA. Most people would like to control depth of field in post production program like AE and Combustion. However, RLA render is too time-consuming to render. For example, if one regular frame needs 2 minutes to render, usually the RLA file needs at least two times of render time than usual. In other words, it contains too much data that the user doesn't need. Nevertheless, RLA is still very useful for a movie which integrates animation with live action. For those kinds of films, it needs more data to calculate precisely the distance from each subject in the camera to represent a more realistic

environment. For a whole 3d animation, there is no need to know the precise physical distance in an image, as long as it is reasonable for the sense of sight.

For the second movie I made, in order to break away from rendering RLA, I decided to separate every subject in the scene to foreground, medium ground and back ground, this is a good technique for a not too complex movie that does not have too many elements in the scene, where shadow situation will cause a lot of problems. This is a traditional way of depth of field in hand drawing animation. Each frame may vary in foreground, medium ground, and background. However, in the 3d program, once you set up the elements in foreground or back ground, even when the camera moves around, the objects are still in the same layer of each ground. For instance, there is an apple, an orange and a banana arranged in order on a non visible line, and the camera is at the very front. It is very easy to know that the apple is foreground, the orange is middle ground and the banana is the background. If the camera moves around -135 degree, then every thing will change. The Apple is the background, the orange is middle ground and the banana becomes the foreground. Because of this situation, using layers to deal with depth of field in 3d program becomes unpractical. However, this technique still has one benefit. If one of the subjects were rendered incorrectly, the user only needs to render the ground layer which it belongs to. Using this could save some time.

Due to previous experiences, I searched a lot for better methods to handle the depth of field. From what I know, the pre-set render layer (EX. Luminance Depth, Occlusion, Normal Map etc.....) have existed since version Maya 7, but seldom in lectures do they bring up this topic to the class. Maybe render layers still have lots of shortcomings, but I believe as the version updates, it will continue to be more reliable

and a perfect tool to have. I am now going to introduce the process which I used for thesis.

### Techniques were used to achieve

First of all, I needed to understand what these preset render layers meant,

#### Luminance Depth

Luminance Depth Layer Image creates a range from black to white flat shape for each subject from the scene. Render engine considers white which means it will be more close to the camera. On the other hand, more black means further away from the camera.

#### Occlusion

Occlusion Layer Image mainly utilizes mental ray to render a gray level image which is similar to the sky light effect. The key function is giving an adjustable attribute to integrate the effect of shadow.

Here are the main compositing layers I used for this thesis and I am going to explain how these layers work in After Effect.

First, these are three layers rendered and ready to composite.



Final gather render (Mental ray)



Occlusion render

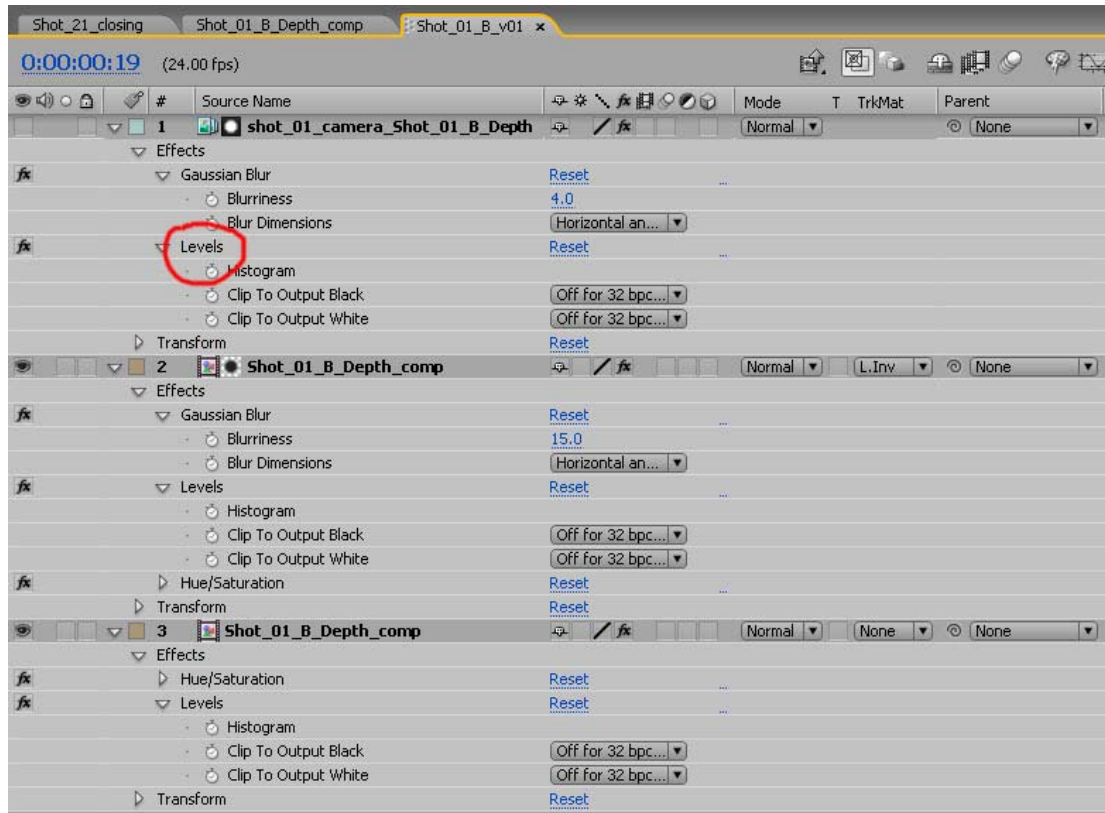


Luminance Depth render

In the After Effect, I created a composition where I integrated “Final Gather” and “Occlusion”. In doing that, it allowed me to give the image more sense of perspective.



The final step is to use depth layer to separate foreground and background. The composition should look like the following.

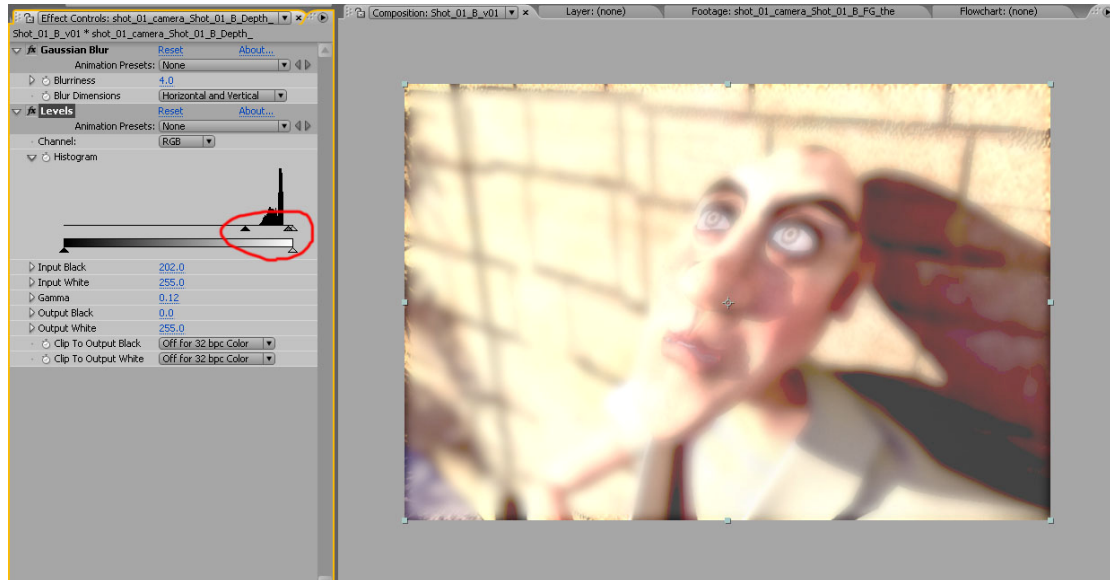


Layer 1 is the sequence of depth render. Layer 2 and 3 are the compositions which we



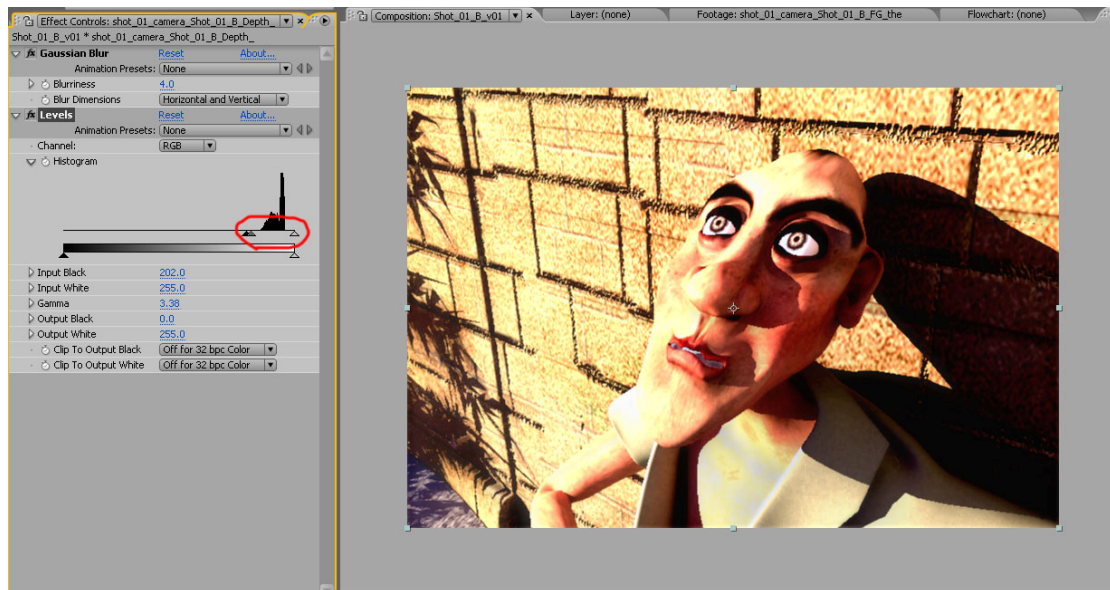
created before. I used layer 1 that is the depth sequence to tell what is in the foreground and what is in the background. White means near and black means far.

Here is the difference if I adjust the level of layer1.

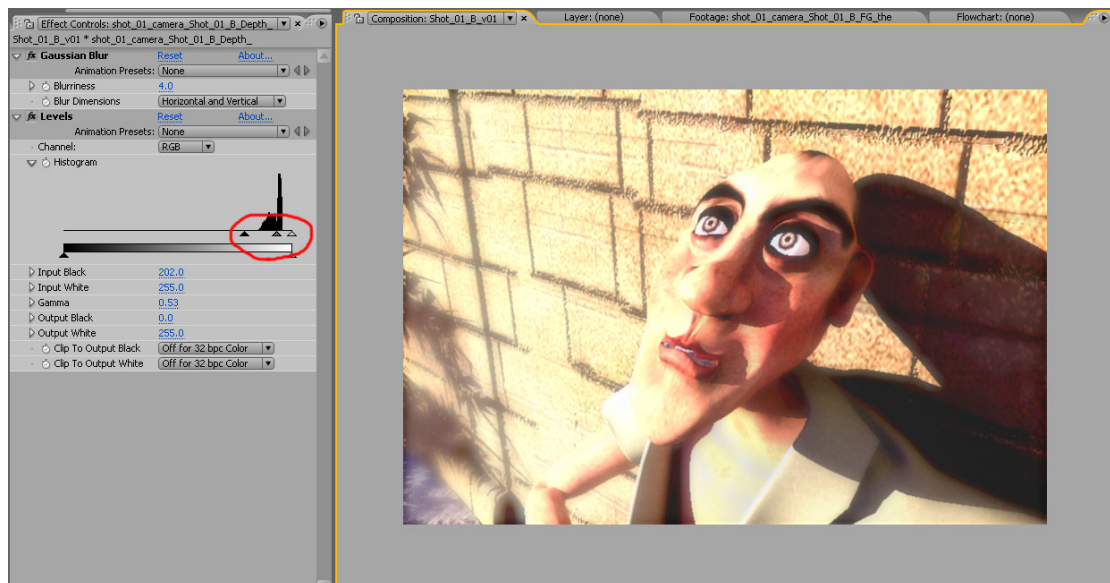


To use this on the background.

I added more effect to the background, a little bit lustrous, unsaturated color, and blurry.



To use this on the foreground



Final adjustment



#### Final compositing

For foreground, I maintained the saturate color which higher in contrast/brightness. It depends on how the user wants the picture to represent. In short, this is a time efficient and easy way to deal with the depth of field. Besides that, the image would become softer by using this way to compose.

In conclusion, there are other ways to do field of lens as well. However I still love to use two layers to deal with background and foreground separately. From the esthetic angle, clear in the front and blurry in the back would not the only aspects that would change in an image. It should be also altered with hue, brightness and saturation. This compositing way which I used is easy to take care of different aspects of depth of field individually.

## Challenges

Because I expected my thesis to be an illustration and use a little bit hand drawing brush style, I put a lot of efforts to draw texture with WACOM. In MAYA, I used Photoshop network directly connecting to shader ball. I kept this Photoshop network in order to update the texture easily. However, it caused a huge problem to render. During rendering, I used render farm, but some frames were always be dropped. Even to render locally, Maya always gave the “Run Time Error”, and proceeded to shut down. I was stuck with this situation for weeks. The render was way behind my schedule at that time.

Dan Deluna, one of the committee members provided me with a lot of solutions. I tried turning down the resolution of geometry, highering the memory limit in Maya, turning off the scanline and even chosen preview quality to render. All of these tricks showed the same result “Run time error.”

Since the reference files like environment and character rigging scenes are close to final, they would not be changed. I proceeded to import the whole reference file in the shot scenes that had render problem which meant if I update the environment or rigging, it would not update the reference file anymore. Even though this method took risks, reference files did cause some problems like this. Nonetheless, even though the reference files are still very useful for production pipeline.

Importing reference files fixed part of the problem. At least, there was no run time error anymore, but the shader missing took it over. This made me think of the fact that I used PSD network directly to shader. Because the computer needs to calculate and merge whole layers from Photoshop first then put it to Maya to render again, that cost a lot of

memory. I assumed that because of this error, so I merged layers and saved it out as a single TARGA file for color, bump mapping....

Finally, the problem was fixed, and it proved that my assumption was correct. In conclusion, users should alleviate the work of memory as much as they can.

While I did rendering, I sent it to render farm which is always the most efficient. Somehow, the depth layers couldn't render by render farm. Generally speaking, depth layer should be the fastest to render, because it uses software render engine. Ferris Webby, supervisor of Render Farm, helped me solve a lot of Render Farm error. However, depth layer just could not be rendered by render farm. After all the testing, I decided to render locally. Thankfully, local render of depth layer was not too much chaotic because one frame only needed a couple of seconds. In the end, I finally got all of the render ready.

### **Screenings and Future**

After finishing and screening my film, I can say I have learned a lot over the past few years – from the original proposal to the finished screening. From conceiving a story, designing the character and environment, to drawing up a timeline and pipeline, production and screening, all of those processes were dependent on time management. I also firmly believed that CG animation should not be perfectly done by one person. It needs all kinds of specialized field to work together. I am very glad that I decided to take on an aspect that I am really good at instead of trying to take care of everything and not being able to perfect it. I did my best in texturing, lighting, and compositing. The responses from the audience were very positive. One unfortunate thing is that I couldn't find an animator to help with animation. After all, animation is also one of the important

parts in film that also takes time. It was not easy to get someone to help me out with animation. But without design and composition, the movie is still like a blemish in an otherwise perfect thing. No matter what, I believe that thesis will not be the last movie I make, but I will try to gather everyone's professional specialty to make a better one. Next is always better than this.



## 5. Appendix A

### a. Treatment

#### TREATMENT

Working Title : LONGSHI

Producer : Pei-Cheng Lee

Start Date: April 2007

Budget : \$2343.74 USD

Running Time : 5 min

Adviser : Malcolm Spaul

End Date : May 2008

Release Format : DVD

#### Story:

A man is looking for the gem (Longshi) in a desert.

#### Synopsis:

<< Longshi has disappeared out of history for last hundred years. Some people out there say they have seen Longshi before, but no one really knows who those people are. Some of those people who have seen Longshi are never coming back again because of the curse. However, there are still a lot of adventurers still looking for Longshi... >>

There is a man who is lost, and has been walking in the desert for several days. The water in his canteen has run out, with only his weak two legs, and a thin and walking stick to support him. He takes out a roll paper from his backpack, which is a hand-drawn illustration of Longshi (See pic-1). He looks at the paper for a while than puts it back into the backpack. He keeps walking and it seems the distance never ends; he is dehydrated and after a while he finally sees a shack ahead of him. He shakes his head a little bit, and he doesn't believe his eyes, thinking it maybe is another mirage. He continues walking. However, as he gets closer he gradually believes that it could be real, so he drags his weary body towards the shack's door with the last ounce of his strength.

The man enters and swiftly looks around the inside of the shack. The shack is empty and seems like it has been abandoned for quite some time. He can almost hear his own heart beating when suddenly he sees what is in the shack: a water pump! The water pump has a pipe going down through the floor, perhaps tapping a source of water deep underground. He begins to work on the pump, but no water comes out of the well. He tries to see the bottom of the well. There is only endless black and a hollow echo. He goes back and keeps pumping and still nothing happens. Finally he gives up from exhaustion and frustration, and throws up his hands in despair. It looks as if he is going to die after all. Then the man notices a thing in one corner of the shack, which is exactly the thing he is looking for. He climbs to Longshi with all his might. He crawls on the floor to Longshi and cups it in his hand. He can't believe that this is the thing he has been looking for his whole life, and is now in front of him. Suddenly, he notices that there is some kind of mural on the corner of the wall. He pushes aside the dust and cobwebs in order to see the mural more clearly (Pic-2). It looks like it could be directions for the water

pump, and so he turns around to look at the disabled pump. He notices that there is a dent on the pump just right to fit to Longshi's shape. He can't help but imagine what would come gushing from the pump. He imagines first is lots of water, but it seems that he will get more than just water, maybe a lot of gold coins.

He picks up the Longshi, and walks towards the pump. However, he hesitates to put Longshi into that dent because that is the thing he has been looking for his whole life. In the end, he decides to put Longshi into the dent. The man's ears perk up and he holds his breath. In that moment, time seems to stand still and silent. He works on the pump again wishing something will come out, something beyond his imagination. Suddenly, an earthquake happens. He looks worriedly around to see if there is anything coming out from pump. However, there is nothing, only a drop of water. At that moment, he wants Longshi back now. He tries very hard to pull Longshi out, and suddenly a large rock comes crashing down from the air and smashes him on the head (Black).

All of the sudden, a group of small barbarians emerge from a back corner. They creep slowly towards the man to check if he is still alive, and they noticed that the man is still holding Longshi in his arms. They laugh menacingly at the dead man and say "^^&#S%^....." which means "Haaaaaaa, another moron again" (Subtitle) One barbarian takes Longshi away from the man's arms and puts it back where it used to be. The other two barbarians are hovering over the dead body, and pull out a tool which looks like tongs. As they are trying to open the dead man's mouth, the barbarian, who is the oldest one, and who refilled the bottle shouts: "^^&#S%^....."(Stop.....). The other two barbarians jump aside. Then the oldest slowly comes towards the dead man. He takes the tool and extracts the only gold tooth in the dead man's mouth. He looks at that the tooth evilly, and lifts up a thick layer of fat under his jaw. There is a necklace of teeth strung on his neck. The oldest barbarian is forced to extend his neck in order to show off his new collection. At the same time the other two are fighting behind him for other teeth off of the dead man. (Blake) They bind the dead man onto a stick like a pig in a spit. On their way out, before lifting the dead man up on their shoulders, the oldest barbarian drew another triangle on the wall. (see pic-2)

#### Approach :

This movie will be produced in 3D computer animation, and primarily using the following programs MAYA, Photoshop, After Effect, Audition, Premiere, and Quicktime. The whole movie and characters will be stylized, and cartoonic-looking. I will be looking for a professional background music director to edit the musical part.



## b. Timeline

### Timeline

Working Title: The Water Pump  
 Producer: Pei-Cheng Lee  
 Start Date: April 2007  
 Budget: \$2343.74 USD

Running Time: 5 min  
 Adviser: Malcolm Spaul  
 End Date: May 2008  
 Release Format: DVD

Thesis : The Water Pump	Timeline	2007					2008								
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Pre production		PER PRODUCTION													
	script & budget														
	Storyboard														
	Character design														
	Environment design														
	Sound Record														
Production	Animatic														
		PRODUCTION													
	Modeling														
	Rigging														
	Texture/Lighting														
	Animation														
Post Production		POST PRODUCTION													
	Rendering														
	Sound-Mix														
	Compositing/Specail effect														
	Editing														

## c. Budget

### Budget

Working Title : LONGSHI

Running Time : 5 min

Producer : Pei-Cheng Lee

Adviser : Malcolm Spaul

Start Date: April 2007

End Date : May 2008

Budget : \$2343.74 USD

Release Format : DVD

	Qty	Actual Cost	Total
<b>A. Pre-Production</b>			
A-1 Director	1	In-kind	\$0.00
A-2 Producer	1	In-kind	\$0.00
A-3 Script	1	In-kind	\$0.00
A-4 Paper/Pens & Pencils	1	\$15.00/In-kind	\$15.00
A-5 Design Setting	1	In-kind	\$0.00
A-6 Reference Books	2	\$60.00	\$120.00
A-7 Research films	3 month	\$10.00	\$30.00
		<b>Subtotal</b>	<b>\$165.00</b>
<b>B. Production</b>			
B-1 Modeling	1	In-kind	\$0.00
B-2 Rigging	1	In-kind	\$0.00
B-3 Texture/Lighting	1	In-kind	\$0.00
B-4 Animator	1	In-kind	\$0.00
B-5 Computer software/hardware	1	In-kind	\$0.00
B-6 Graphic card	1	\$879.99	\$879.99
		<b>Subtotal</b>	<b>\$879.99</b>
<b>C. Post-Production</b>			
C-1 Render farm	1	In-kind	\$0.00
C-2 Composor	1	\$500.00	\$500.00
C-3 Editor	1	In-kind	\$0.00
C-4 DVD	3	\$2.00	\$6.00
C-5 DV Cam	3	\$8.00	\$24.00
		<b>Subtotal</b>	<b>\$530.00</b>
		<b>All subtotal</b>	<b>\$1592.99</b>
		<b>25% Contingency</b>	<b>\$398.24</b>
		<b>Grand Total</b>	<b>\$1991.23</b>

## 6. Appendix B

### a. Storyboard



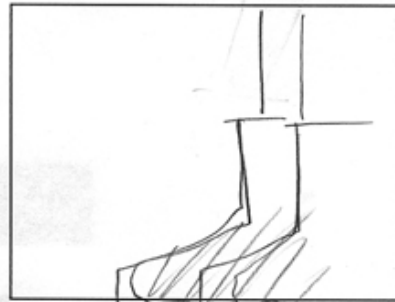
shot-04-B



happily feet  
close up

↓ dissolve

shot-05-A  
tired feet

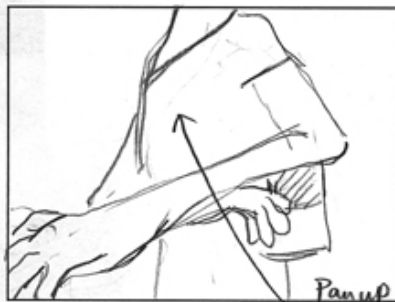
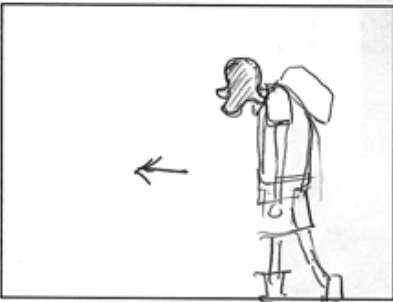


shot-06-A  
Walk and Stop



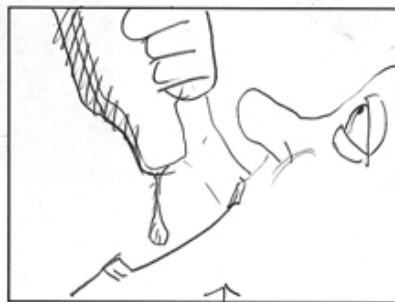
shot-06-B  
Walk and Stop  
dip

shot-05-B  
tired



shot-07-A  
0-120  
take  
tan

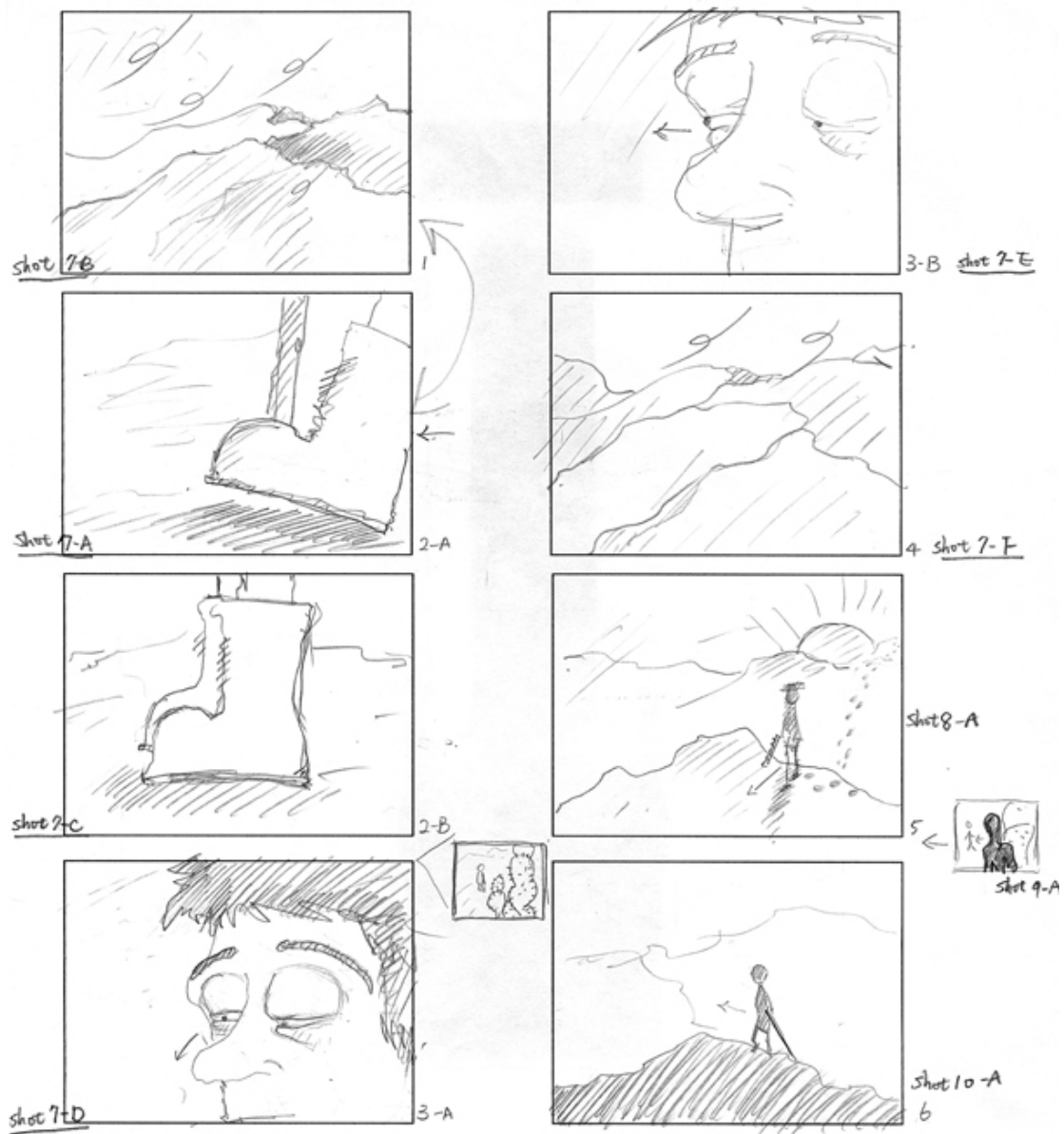
shot-05-C  
POV



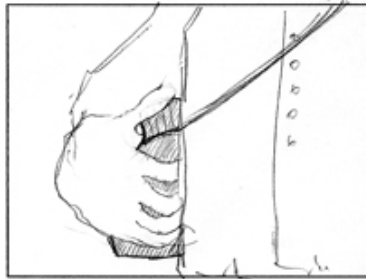
shot-07-B  
close up  
120-240

PAGE-2

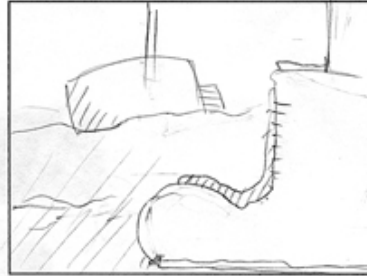
Storyboard  
Title : Longshi



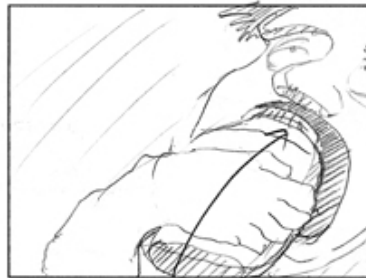
Storyboard  
Title : Longshi



shot 11-A  
7



shot 11-E  
10



shot 11-B  
8-A



shot 11-F  
11



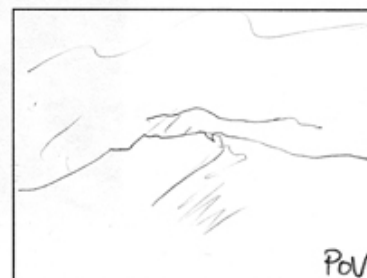
shot 11-C  
8-B



shot 11-G  
12



shot 11-D  
9



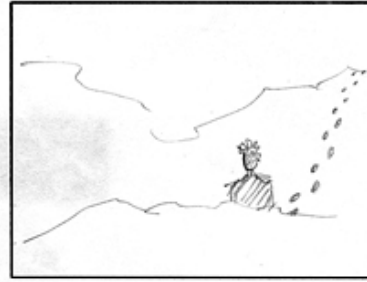
shot 11-H  
13

nothing

Storyboard  
Title : Longshi  
again AX2



shot 12-A  
14



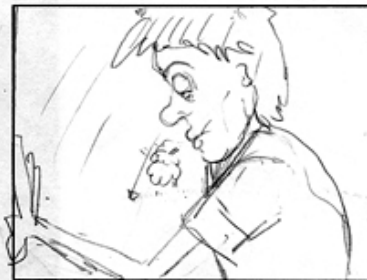
shot 14-A



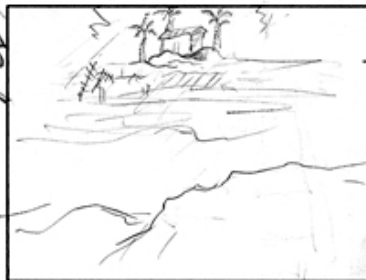
shot 15-A



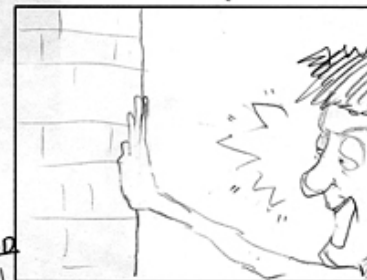
shot 12-C  
15



shot 16-A  
19



shot 12-B  
16



shot 16-B  
20-A



shot 13-A  
17-18

like shot 10-A



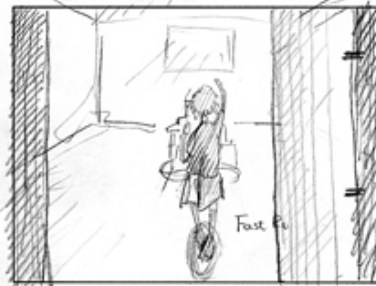
shot 16-C  
20-B

Storyboard  
Title : Longshi



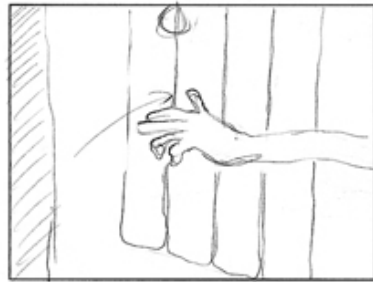
shot 16-D

21



shot 18-A

25



shot 16-E

22

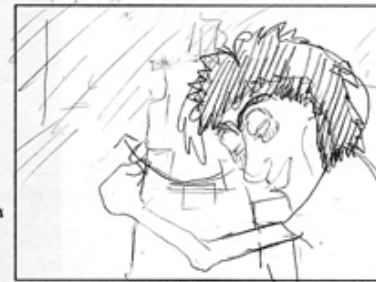


shot 17-A

a point of view from inside

shot 17-B

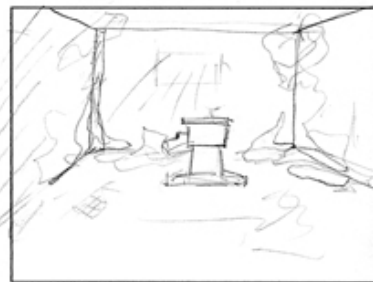
23



shot 19-A

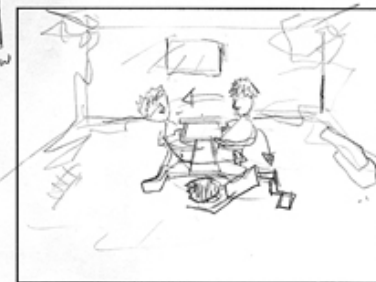
26

Looking around the pump



shot 17-B

23



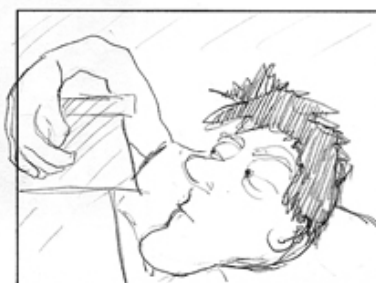
shot 19-B

27



shot 17-C

24



shot 19-C

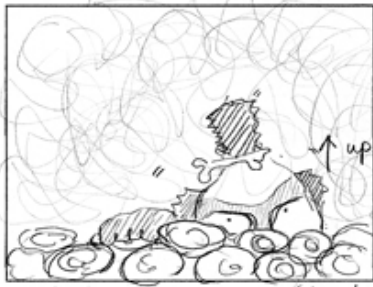
28-A

Page: 4/

Don u Don u



Storyboard  
Title : Longshi



shot 23-A



shot 23-B



shot 23-C



shot 23-D



shot 23-E



shot 24-A



shot 24-B



shot 24-C

Storyboard  
Title : Longshi



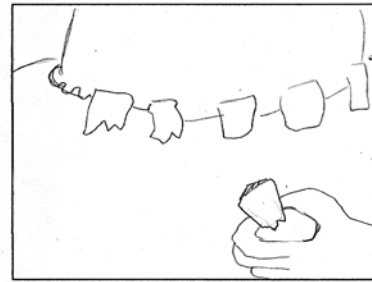
shot 26-A



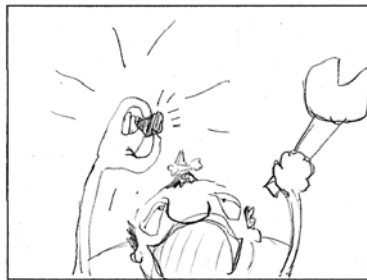
shot 26-E



shot 26-B



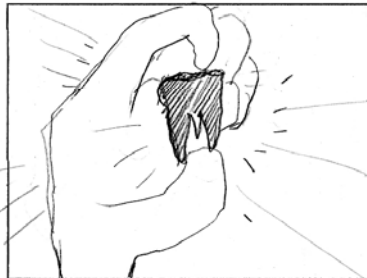
shot 26-F



shot 26-C



shot 27-A



shot 26-D



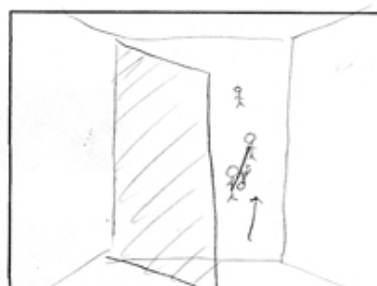
shot 27-B

Page: 8 /

Storyboard  
Title : Longshi

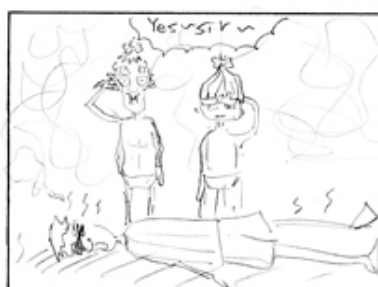


shot 7-C

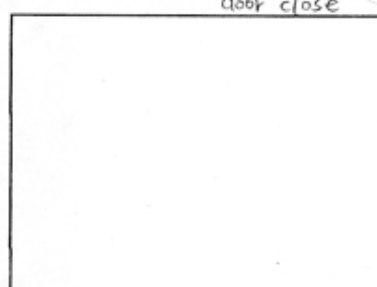


door close

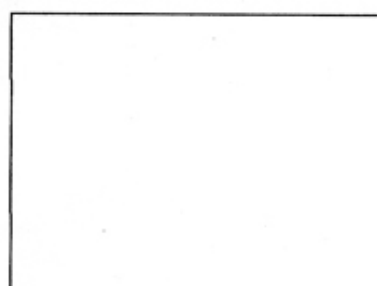
shot 8



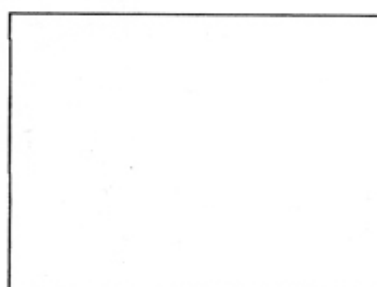
shot 8-A



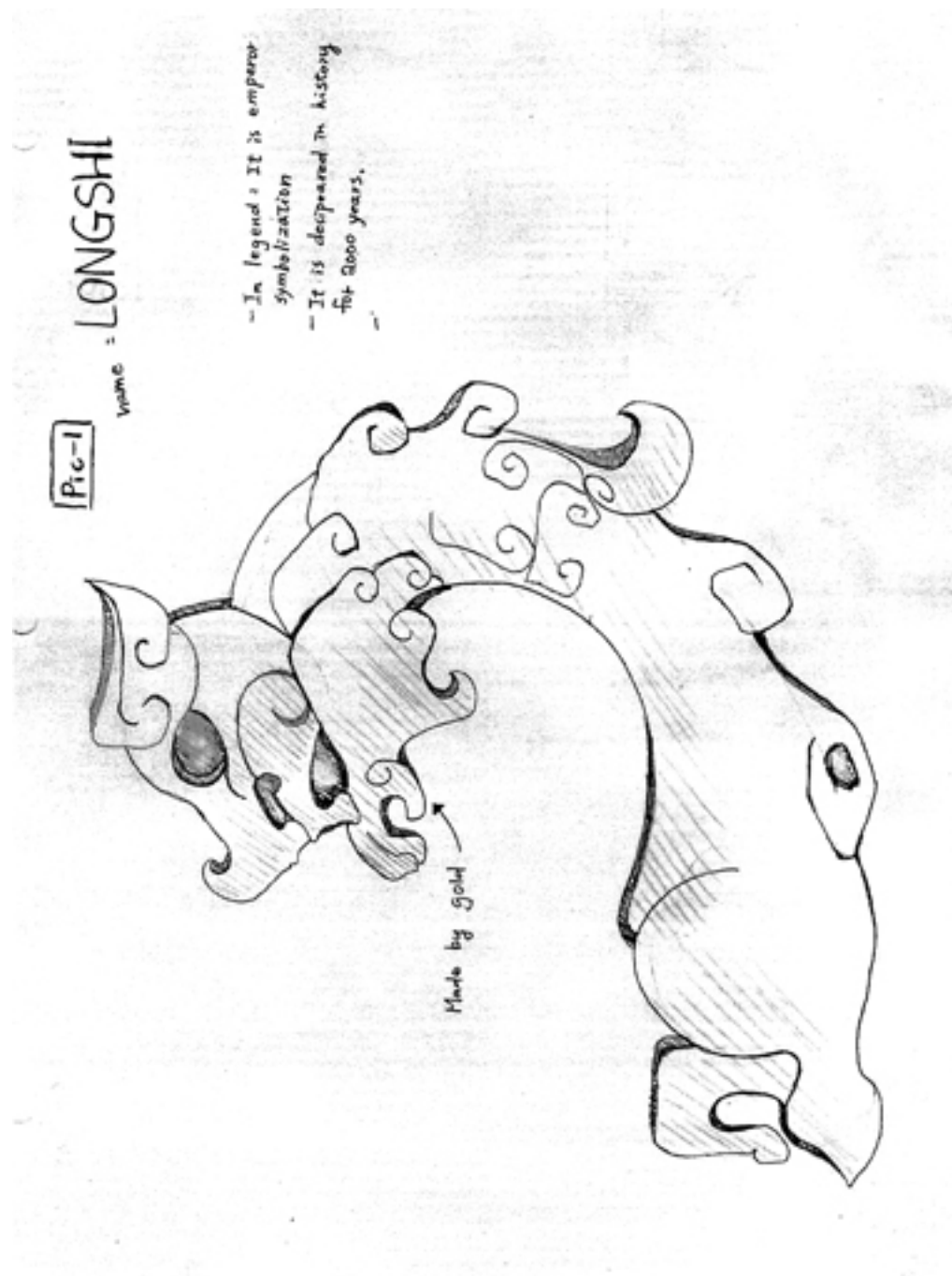
shot 9-A

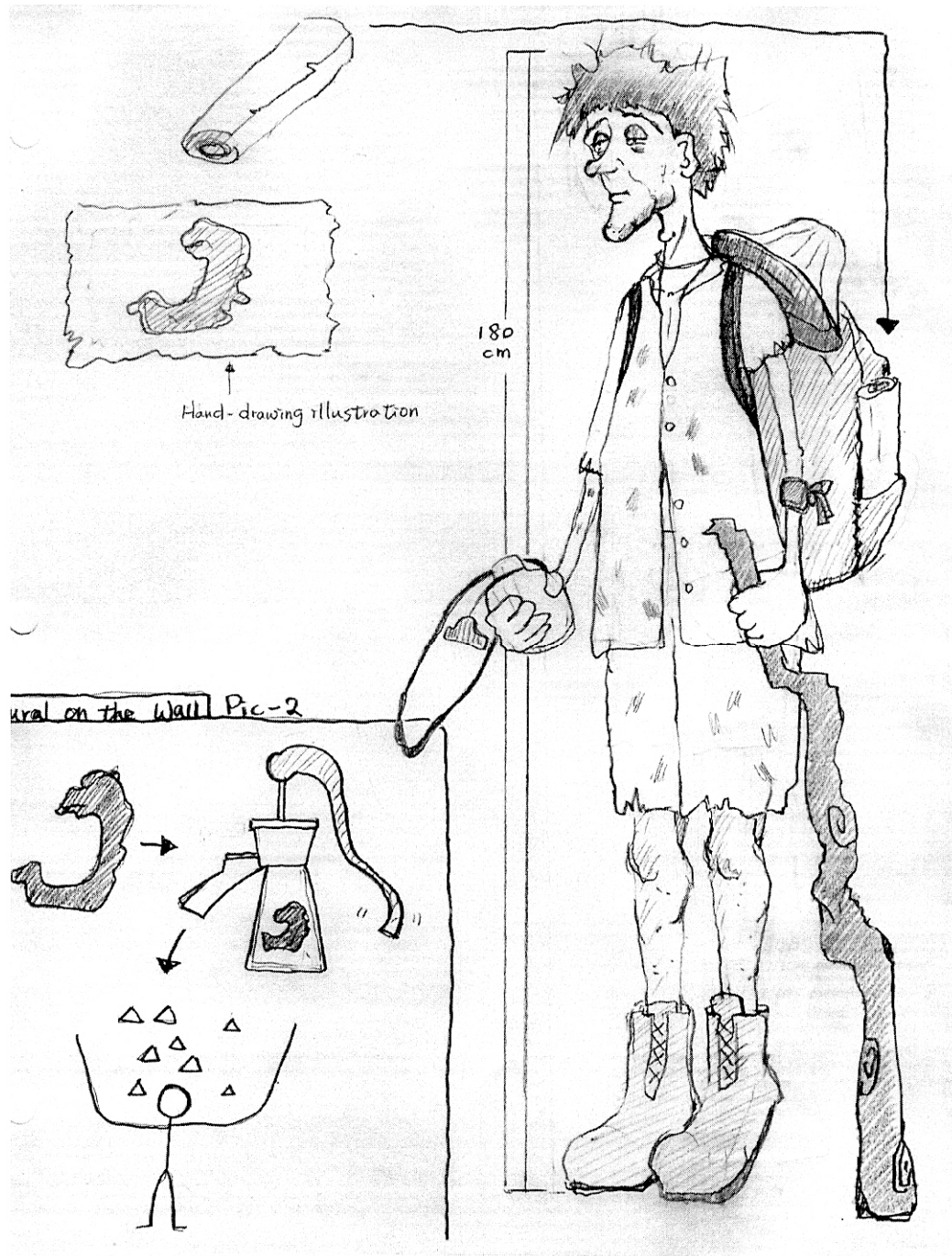


shot 9-B



b. Charater Designs

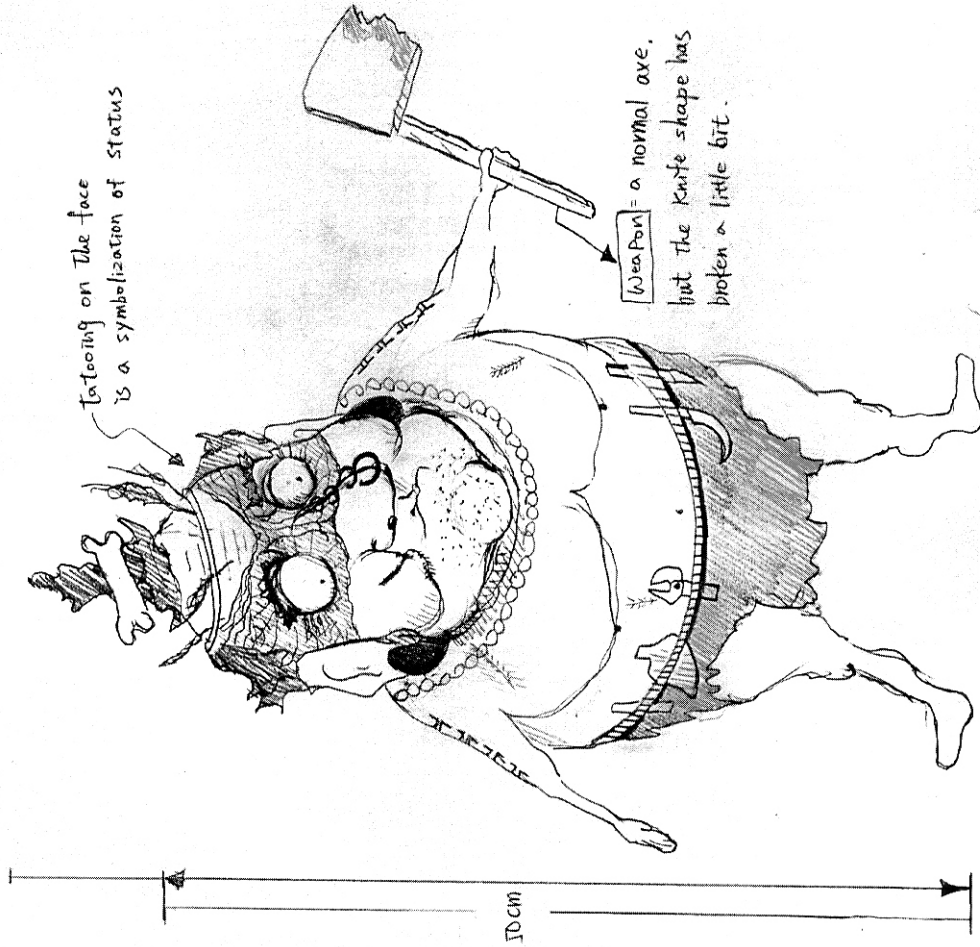




# The Oldest barbarian

- about 60's years old
- about 60 pounds
- He has a lot of battle experience  
! So there are a lot scar on his body

tattooing on the face  
is a symbolization of status



Weapon = a normal axe.  
but the knife shape has  
broken a little bit.

### The second barbarian

- about 40s' years old,

- about 30 pounds

- He is about his golden age

and he is very ambitious.

- He want to supersede the oldest

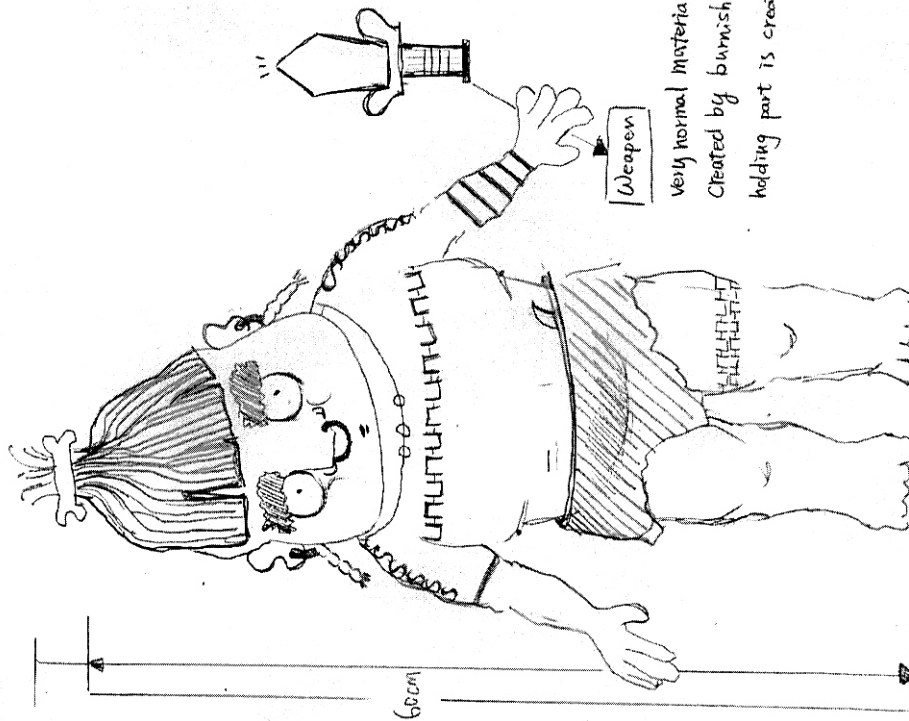
barbarian often he dead, however

he still very respect the oldest barbarian



### The third barbarian

- about 20' years old
- about 40' pounds
- He never go to battle before, and this time is one of the less hunting experience
- He is kind of weakness, he always do others tell him to do.





## 7. Appendix C

### a. Color Stills

