TEXTURING TO CREATE REALISITC LOW POLY 3D MODELS

HO KEEN MUN

BACHELOR OF ARTS (HONOURS) GAME DESIGN

UNIVERSITI TUNKU ABDUL RAHMAN

MAY 2024

Declarations of Originality

I, Ho Keen Mun, declare that this research paper entitled “Texturing to create realistic low poly 3D models” is solely based on my original work except for the citations that have been acknowledge. I hereby declare that this project has not been previously submitted to any other party and will be submitted under the Degree of Bachelor of Arts (Honours) Game Design, under Universiti Tunku Abdul Rahman.

Ho Keen Mun

10/5/2024

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I would like to thank all who have contributed to the successful competition of this project. I would like to express my gratitude to my research supervisor, Ts. Dr Ang Kok Yew for his invaluable advice, guidance and his enormous patience throughout the development of the research.

In addition, I would also like to express my gratitude to my loving parents and friends who have helped and given me encouragement.

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List of Terminology

Terminology	Description
FYP	Final Year Project
PC	Personal computer
3D	Three dimensional
GPU	Graphic processing unit

Permission Sheet

FACULTY OF CREATIVE INDUSTRIES
UNIVERSITI TUNKU ABDUL RAHMAN

Date: _7 May 2024__

PERMISSION SHEET

It is hereby certified that _____Ho Keen Mun_____ (ID No: ____21UJB00171____) has completed this final year project entitled "____Chroma Journey: The Last Guardian____" under the supervision of _____Ts Dr Ang Kok Yew_____(Supervisor) from the Department of _____Game Studies_____, Faculty of Creative and Industries, and _____Ms Nik Norazira binti Abdul Aziz_____(Co-Supervisor)* from the Department of _____Game Studies_____, Faculty of Creative and Industries.

I hereby give permission to the University to upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

____

(Ho Keen Mun)

Chapter 1: Introduction

Nowadays, 3D modelling are applied in many industries and purpose, such as 3D games, movies, animation and physical items. It is always challenging and crucial to make a 3D model look realistic especially when it is used in a 3D game. This study aims to explore the potential of texturing in creating a photorealistic look of low poly 3D models. The study will be conducted through my game project which is a low poly game. The 3D models inside the game will be having low poly art style which make them doesn't look much realistic. Therefore, it could allow me to look through how much can texture helps in creating a realistic 3D model.

A realistic 3D model requires modelling, texturing, and lighting. The 3D models will be used in my game which is a low poly art style game. Therefore, I'm looking forward how to create a realistic low poly 3D model. Due to low poly art style, there is a cap to make the 3D model look realistic with modelling included topology and shape. The lighting will be relied on the lighting in the game engine but not the 3D model itself. Therefore, I'm exploring the potential of texturing to create a realistic low poly 3D model so that I could increase the immersion and quality of my low poly art style game.

The objective of my study is to investigate the effect and impact texture can made to create a photorealistic look of low poly 3D model. I would like to apply this technique to my current game project and study the result. There are some limitations of my work. One of them is lacking experience in 3D modelling. There are still lots of techniques and knowledge about 3D modelling that I need to learn. This limitation will slow my progress down in learning the impact of texturing in creating realistic 3D model. At the same time, it takes me more effort to justify the credibility of the information and data I have gathered.

1.1 Game Introduction

The topic will be linked to my game project which is Chroma Journey. I will be conducting most of the experiment of modelling and texturing in the game project. Chroma Journey is a 2.5D platform adventure game. The puzzle mostly will be performed as an obstacle that blocking the player proceeds to the next level or area. Different puzzles will be provided in the game so that player needs to keep exploring and think of a way to solve the puzzle. The goal of the game is to reseal The Four Fiends, meanwhile explore the game environment and solve puzzles.

1.2 Game Objective

The game objective is to avoid being busted by The Four Fiends while exploring the game environment. The player needs to get to The Four Auspicious Beasts' statue at last by proceeding the game level.

1.2 Game Genre

The game genre includes adventure, horror, platform and puzzle.

- Adventure:
  Player needs to explore the game environment to find the next path that proceed to the next level or area. Some hints of the puzzle can also be hidden in the game environment that require players to explore around.
- Horror:
  The game environment will be having dark and gloomy environment which could deliver depress and horror atmosphere to the player. At the same time, the Fiends in the game will search for the player and try to kill the player.
- Platform:
  There are certain areas that require player to jump or move around to get to the next area or escape for the Fiends. The game is also having 2.5D side view perspective which could encourage player to do platforming in the game.
- Puzzle:
  Player needs to think of a way to solve the puzzles provided in the game to proceed to the next area. Player also needs to explore the environment and gather the hints to solve some of the puzzles.

1.3 Game Story

There are The Four Auspicious Beast which are the Azure Dragon, White Tiger, Vermilion Bird and Black Tortoise that guarding the peace and order of the world by sealing The Four Fiends. The Four Fiends include Hundun, Qiongqi, Taotie and Taowu. Chroma, who is the protagonist, is created to guard the seal. One day, the seal of Azure Dragon was broken. The Four Fiends were unleashed. Therefore, Chroma is on his journey to reseal the Four Fiends and restore the world order.

The Four Fiends have their own personality and ability. Their unique and different ability will be applied as a challenge that player need to overcome in different level. The table below shows the characteristics of The Four Fiends.

Fiends	Characteristics
Taotie	The bottomless appetite monster that devours everything on its path, leaving the forest lifeless. The area is full of poison that no living creature can survive.
Qiongqi	The monster that stole the sound, leave the woods with silence and speechless.
Hundun	The monster of chaos who seized the sunlight, lead the world into darkness.
Taowu	The monster that stole the colour leave the world with black and white.

Table 1.1 Characteristics of The Four Fiends

1.4 Art Style

The game will be having 3D low poly with flat colour. Certain level will be applied with monochromatic backgrounds. 3D low poly could help to save time in modelling meanwhile flat colour save time in texturing so that our team could have more time to proceed with more 3D models and animations. At the same time, horror atmosphere with low poly 3D models could make a contrast in the game which might give player a fresh experience.

1.5 Unique Selling Point (USP)

Chroma Journey features a few unique selling points that most games don’t. One of them is introducing the Chinese mythology which are The Four Fiends. This is not usual in the current market even for the games that introducing Chinese mythology always talk about Journey to the West. The second unique selling point is the unique puzzle in the game. Some puzzles with be linked to The Four Fiends that requires player to solve to puzzles according to the behavior of The Four Fiends.

1.6 Target Market

The target audience of Chroma Journey will be the players who age around 13. Our game has a great reference to Little Nightmare. Little Nightmare has an official age classification that is for people who is 13 years old and above. At the same time, neither adult content nor sensitive content is existed in our game, therefore aim for players who are 13 is reasonable.

Not only concern of age, players who are interested in Chinese mythology are also our target audience. Our game introducing The Four Fiends which is a rare theme in the game market but also related to the Chinese mythology which could Chroma Journey a chance to stand out among the games with Chinese mythology theme.

1.7 Market Research

There are a few games similar to Chroma Journey, mostly because of the art style or gameplay, for example: Little Nightmare, Limbo.

- Limbo:
  Limbo use its own unique monochromatic art style to develop creepy and horror mood in the game which is also what Chroma Journey trying to develop, gloomy mood.
- Little Nightmare:
  Little Nightmare has the same camera perspective and similar gameplay with Chroma Journey. Besides, Little Nightmare also develop a horror and depress atmosphere in the game environment. Meanwhile, there are different bosses in different level try to kill players which has the same concept with Chroma Journey. Bandai Namco Entertainment had already announced that the Little Nightmares franchise sold more than 12 million units copy (Bandai Namco, 2023). This helps us to prove that the game genre is accepted by market.

1.8 Game Mechanic

Mechanic	Description
Stamina system	Related to player movement. Running and jumping consume the player's stamina. Stamina will restore slowly while the player is walking and restore faster while the player is resting.

Stealth mechanic	In the forest level where sound was stolen, players are required to crouch in the grass the pass through the monster. If players make loud noises, the monster will chase after players.
Checkpoint	There are markers in the game environment that represents checkpoint. The checkpoint will be enabled whenever the player reaches the marker. The player will respawn at the at the nearest checkpoint when the player dies in the game.
Interaction	There are certain things the player could interact with such as interact with the hiding spot to hide inside the hiding spot. Player could also pick up and throw various objects to solve puzzles.
Player movement	The player is able to walk, run, jump, climb, crouch and swim in the game. Some area require player to perform certain movement to pass through the area.

Table 1.2 Game Mechanic

1.9 Hardware and Software Requirements

Chroma Journey is available on PC platform. Even though Chroma Journey is a low poly 3D game that doesn't require a very high requirement of hardware, there is still a recommended hardware requirement to run the game smooth.

1.9.1 Hardware

Recommended User Hardware	
Operating System	Windows 7 & above
Processor	Intel Core2 Duo E8400, 3.0GHz or AMD Athlon 64 X2 6000+, 3.0GHz or higher
Memory	4 GB
Graphics Card	GeForce 9600 GT
Storage	10 GB

Table 1.3 Hardware Requirements

1.9.2 Software

The table below shows the software our team use to develop the game.

Software	Description
Unity Game Engine	The main game engine to develop the game. Unity 2022.2.1f1 is the version the game is using.
Visual Studio 2022	Scripting in Unity Game Engine.
GitHub	Collaboration tool that allows every team member work on the same project.
Google Docs	Write down and record the information or ideas of the game.
Discord	Voice call meeting for discussion and upload the latest artwork.
WhatsApp	Main communication tool as typing
3ds Max	Main 3D software for modelling, rigging and texturing.

Table 1.4 Software used in development

1.10 Budget

- Printing (RM200 x 4 members)
- Promotion Material (RM 150)

Total: RM 950

1.10 Schedule

There are Gantt Chart for both FYP1 and FYP2. The tasks in FYP1 and FYP2 are slightly different as both FYP has different time duration and priority work to work on. Below shows the Gantt Chart for FYP1 and FYP2.

No	Task	Group Members	Duration	Weeks						
				1	2	3	4	5	6	7
1	**Brainstorming**									
	Genre research	Everybody	2 weeks							
	Game Ideas	Everybody	2 weeks							
	Game concept	Everybody	2 weeks							
	Proposal preparation	Everybody	1 week							
2	**Designing**									
	Character Sketch	Keen Mun	2 weeks							
	Environment Sketch	Ziming	2 weeks							
	UI layout and design	Keen Mun	2 weeks							
	Level Design	Ziming	5 weeks							
3	**Production (Art)**									
	Modelling	Ziming, Keen Mun	3 weeks							
	Music and Sound effect	Ziming	3 weeks							
	Texturing	Keen Mun	3 weeks							
	Rigging	Keen Mun	2 weeks							
4	**Production (Programming)**									
	Player Movement	Wan Yi	2 weeks							
	Player Camera	Wan Yi	2 weeks							
	Enemy AI	Jane, Wan Yi	5 weeks							
	UI Function	Wan Yi	2 weeks							
	Game physics	Jane, Wan Yi	5 weeks							
5	**Milestone**									
	Progress presentation	Everybody	1 week							
	Bug fixing	Jane, Wan Yi	2 weeks							
	Quality Analysis	Everybody	2 weeks							

Figure 1. 1 FYP1 *Gantt Chart*

No	Task	Group Members	Duration	Weeks													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Production (Art)**																
	Modelling	Ziming, Keen Mun	10 weeks														
	Music and Sound effect	Ziming	10 weeks														
	Texturing	Keen Mun	5 weeks														
	Rigging	Keen Mun	3 weeks														
	Level Design	Ziming	7 weeks														
	Post Processing Effects	Ziming	5 weeks														
	VFX	Ziming	5 weeks														
2	**Production (Programming)**																
	Player Interaction Behavior	Jane, Wan Yi	12 weeks														
	Enemy AI	Jane, Wan Yi	12 weeks														
	Reward System (Clues)	Wan Yi	10 weeks														
	Sanity Bar system	Jane	12 weeks														
	Game physics	Jane, Wan Yi	10 weeks														
	Collectible Item	Wan Yi	5 weeks														
	Win / Lose Condition	Jane	3 weeks														
	SFX Implemention	Jane, Wan Yi	6 weeks														
	VFX Implemention	Jane, Wan Yi	6 weeks														
3	**Cutscene**																
	Start Cutscene	Everybody	6 weeks														
	Ending Cutscenes	Everybody	2 weeks														
4	**Milestone**																
	Final presentation	Everybody	1 week														
	Bug fixing	Everybody	3 weeks														
	Quality Analysis	Everybody	2 weeks														
	Game documentation	Everybody	2 weeks														
	Promotion	Ziming, Keen Mun	2 weeks														

Figure 1.2 FYP2 *Gantt Chart*

1.11 Project Scope

The table below shows the role of every team member and their respective research topic of their mini research.

Name	Role	Research Topic
Ho Keen Mun	– 3D Artist – UI Designer	Texturing to create realistic low poly 3D models
Leong Wan Yi	– Programmer – UI Programmer – Visual Effect Artist	The Impact of Non-Diegetic Interface Design on Player Experience in Platformer Games
Leong Xue Qian	– AI Programmer – Mechanics Programmer	Environmental Fluctuation: Player's Awareness and Adaptability in Platform Adventure Game
Wong Zi Ming	– Game Designer – Level Designer	Impact of Environment Atmosphere on Player Engagement

Table 1.5 Team members' roles and research topics

1.12 Summary

Our team named PolyMasters has 4 members which include 2 Game Design students and 2 Game Development students. The game we are working on, Chroma Journey is a 3D puzzle-platform horror adventure game. Meanwhile, every team member will conduct and experiment their study topic during the development of the game.

Chapter 2: Literature review

High quality textures on simplified 3D models

Low poly model could also have high quality textures on it. High quality textures could help in many ways to improve the appearance of the 3D models that used in video games. This might enhance the user and gaming experience when playing the video games. However, it is not that easy to apply a high quality textures on a low poly objects due to not enough poly faces to render the textures.

First and foremost, Song Liu (2015) and the team tries to create simplified 3D models with high quality textures with using KinectFusion algorithm. The study is conducted with using an HD RGB camera that is calibrated with Kinect depth camera. The experiment of the article is concentrated on the 2D texture map instead of topology of the 3D models. It is said that each polygon needs to be textured with more RGB details in order to create a better detail 3D (Song Liu, 2015). Song Liu and the team advised to use different 2D texture maps for all polygons, which means each polygon will have its own 2D texture map. There are 100 sample shots taken with using the HD RGB camera for comparison. There is high quality texture with using HD RGB camera that added with depth camera of Microsoft Kinect™ sensor. However, Song Liu and the team claimed that the quality of the texture is still limited by the dimension and the size of the colour volume which is heavily affected by GPU memory (Song Liu, 2015). This study and the 3D reconstruction method is running on a PC with GPU Nvidia GTX680 that has 4GB VRAM. The result is remarkable concern on the hardware they are running on. It is also explained that better hardware especially GPU could render higher texture quality and with higher efficiency. This method does not suit my project much as it requires an additional hardware which is the HD RGB with Kinect depth camera to capture higher colour volume of texture. It is expensive and time consuming for a small project. However, it does open a new path for people to study as the technology nowadays is swiftly improved.

In addition, XiaoJun Wu(2020) and Xianming Zhang is looking for a way to optimize 3D models with lowest mesh as possible without sacrificing the texture quality. They are researching on this topic to reduce the time rendering and file size of the 3D model in Web3D. 3D models are increasingly use in multiple fields and industry nowadays, including virtual reality as well. However, Web3D takes lot of time in transmitting and rendering 3D models. Therefore, XiaoJun Wu and Xianming Zhang investigate on this topic to speed up rendering and transmitting of 3D models in Web3D. This could help a lot in improving user experience. XiaoJun Wu and Xianming Zhang try to use normal map to maintain the texture quality of

low-quality mesh. They experiment it on a few different 3D models, and simplify the model meshes by reducing the numbers of triangle faces. After that, they observe and make comparisons on the outcome. Figure 2.1 shows 4 different outcomes on a same 3D model with different rate of simplification. Figure 2.1 a) is the original model which is a reference to compare and observe with other models after simplified. This could help us to see the effect of applying normal map. Figure 2.1 c) is the original mesh when facing light. The left side of the Figure 2.1.d) is the simplified model without normal map meanwhile the right side of the Figure 2.1 d) is the simplified model with normal map. It is easy to observe that the simplified mesh with normal map looks similar to the original mesh with light. However, the simplified mesh without normal map is having obvious sharp edges which is different from original mesh. At the same time, the number of triangular faces of the original mesh is 46430. After simplifying 10%, the number of triangular faces is 4644 (Xiaojun Wu, 2020). The file size before simplified is 49.8M and 1.1M after simplified (Xiaojun Wu, 2020). This could save storage and time for rendering online 3D artworks. My project is 3D low poly art style that has flat colour texture. It is time consuming with using flat colour texture consider of the workload that I have to handle in a short time. It is more worthy to use flat colour texture for 3D models. However, there are still chances for me to try applying the normal map into the game to see whether the result is convincing.

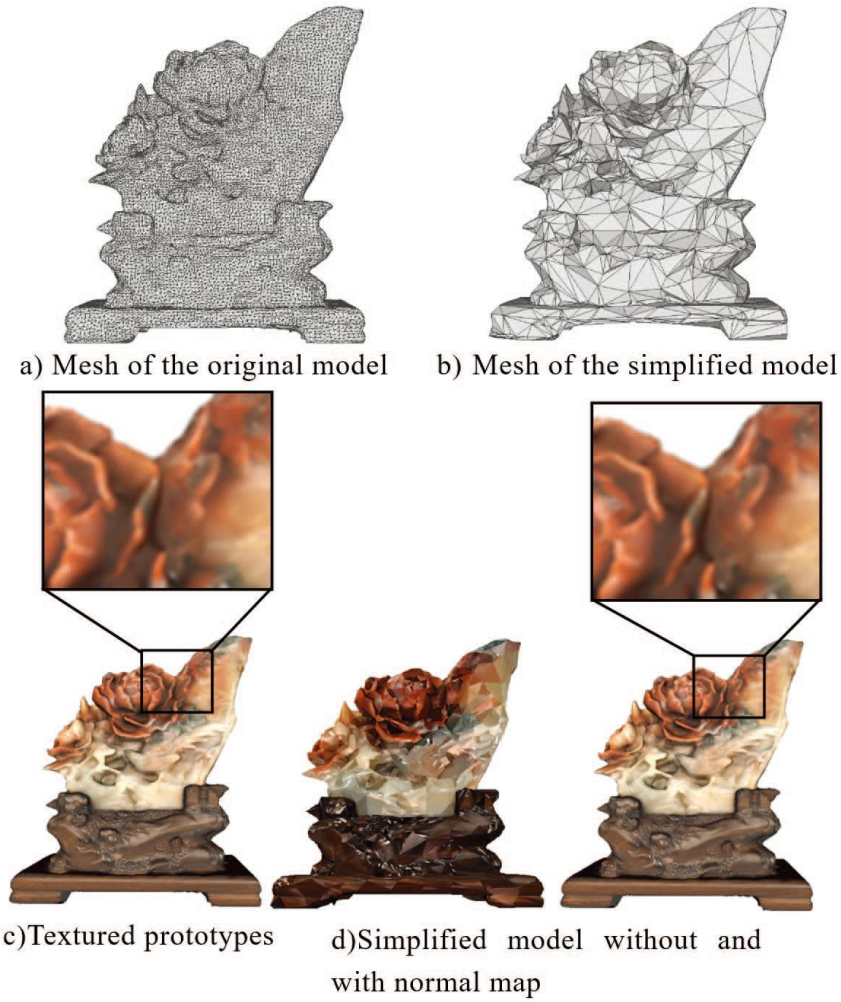


Figure 2.1 The simplified results with different rate

At the same time, Aysegul Dundar(2023) and the research team were researching on making fine detailed texture for 3D models with using multi-view and single-view images. It is said that there are many methods to learn 3D geometry and texture from single-view images. However, there is limitation with only single-view images. There will be missing texture in some parts of the model that might cause the unrealistic look of the model render output. Therefore, the research team presented a method to help improving this problem which is using both multi-view and single-view images at the same time. This is because there are some mesh and texture prediction when using single-view images. Meanwhile, multi-view images do not require annotation but rely on noisy predictions of pre-trained networks, noisy estimates of instance masks and again noisy estimates of camera parameters from pre-trained deep neural network models (Aysegul Dundar, 2023). The research team was inferring 3D models with realistic texture to test the result. The result was great that the research team improved on both multi-view datasets and single-view datasets. Single-view datasets achieve better FID score with discriminator augmented with learned embeddings and generator with position based attention in quantitative result (Aysegul Dundar, 2023). The research team compared the baseline Convemesh model with the proposed architecture in the last two rows of Figure 2.2. There were some improvements visibly between the baseline and the final models in

qualitative results. The research team showed a method to reconstruct 3D models with using multi-view images by employing pre-trained networks and it did help to generate a 3D model with quality textures.

Figure 2.2 Texture maps and rendering result from different viewpoint

On the other hands, polygons rendering is also relied heavily on graphics hardware and software. Therefore, William J. Schroeder(1992) and his research team were working together to research on an algorithm named marching cubes. Marching cubes is an algorithm that could create one to five triangle faces in the voxels that containing isodensity surfaces by extracting them from volume data (William J. Schroeder, Jonathan A. Zarge, William E. Lorensen, 1992). This algorithm was mostly used in scientific visualization at that time. Back in the days, a magnetic resonance scanner or medical computed tomography could generate over 100 slices with resolution 256 by 256 or 512 by 512 pixels. Even with greater resolution which is 1024 by 1024 pixels that generated by an industrial computed

tomography could also be extracted by marching cubes and produce 500,000 to 2,000,000 triangles (William J. Schroeder, Jonathan A. Zarge, William E. Lorensen, 1992). This huge data was troublesome and challenging for storing and rendering. Therefore, the research team was aiming to reduce the total amount of triangle faces in a triangle mesh but keep the original topology and geometry of the mesh. The research team was trying to implement decimation algorithm and work on a few experiments to achieve their goal. One of the experiments was tested on terrain modelling. Two sets of terrain were chosen to be applied the decimation algorithm which are Honolulu and Mariner Valley. Figure 2.3 shows the triangle faces amount of Mariner Valley decreased significantly meanwhile still preserving the geometry of the mesh after removing 90% triangulations. Figure 2.4 shows that Honolulu had fine details around the ridges even after 77% of triangulation reduction. It shows that the decimation algorithm does help to reduce triangle face meshes significantly without sacrificing the level of detail. The research team had successfully applied the decimation algorithm to triangle mesh. The number of triangles of a mesh was significantly reduced meanwhile preserve the original details and topology. It is time saving to render a decimated model and also cost saving because it will take lower hardware requirement to render. Most importantly, it could save lots of space to store the data. It could be applied to video games to optimize the game performance and reduce the file size of the game. Not only in gaming, it gives advantages to many industries that require to store many 3D meshes data. this article was written in 1992 which had big gap of technology compared to nowadays. It does give me an idea in saving data storage of 3D models, however it might not be suitable to apply in my game project. This is because most storage hardware now is able to store a big storage game that makes it not worthy to pay that much effort to reduce the file size of the 3D models. Besides, many of the models in my game had animation that require human hand to manually to take care of the topology and flow or the model will deform when animating.

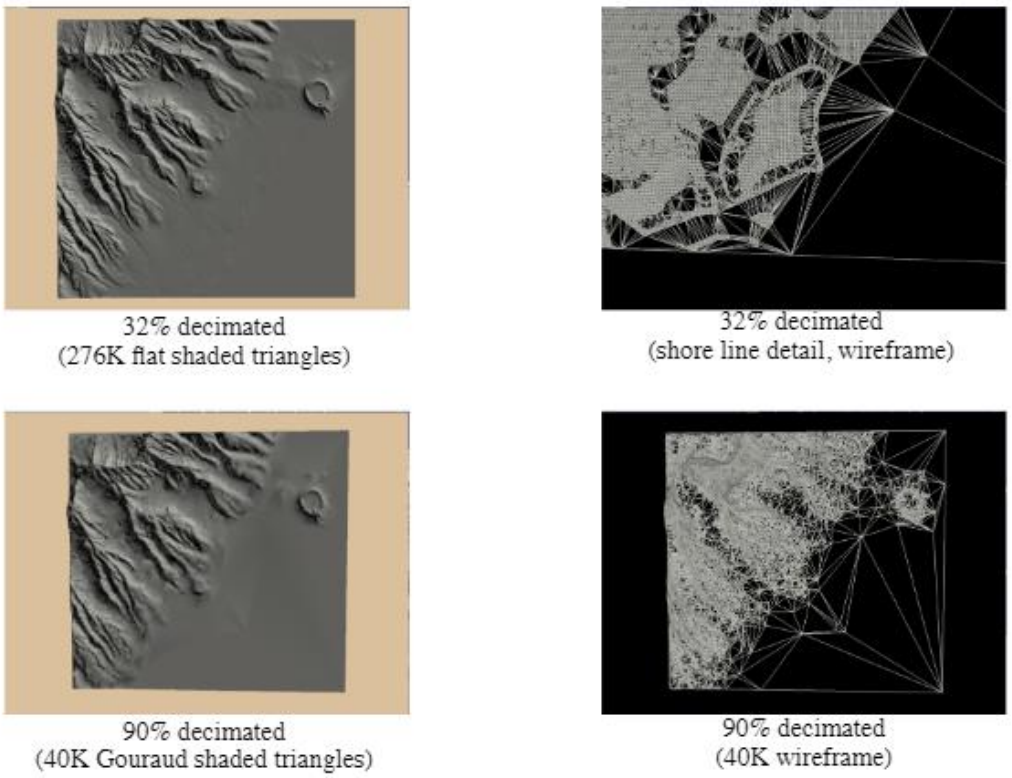


Figure 2.3 Comparison of Mariner Valley after decimated

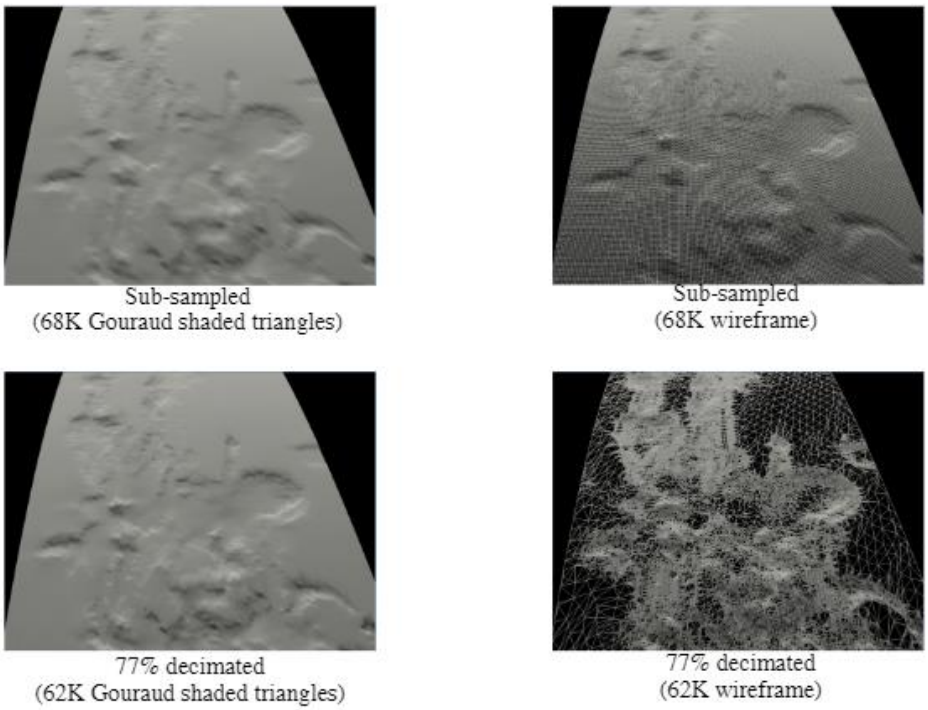


Figure 2.4 Comparison of Honolulu after decimated

Furthermore, Vera Moitinho(2015) and Juan Barcelo are researching the texture of archaeological objects to understand the past of the objects, including their features. In order to research on the archaeological object which is also a 3D object, they planned to measure the describe the microtopography of the object's surface. The research team 3D scanned both experimental and

archaeological surfaces. After that, they differentiated the objects following their texture patterns after analysing the objects' characteristics. The research team compared the archaeological objects with the experiment objects of their 3D digital areal surface texture patterns. The texture surfaces of the archaeological showed in figure 2.5 are having a wide range of texture direction. The texture surfaces of the archaeological is fine due to natural erosion (Moitinho & Barcelo, 2015). However, most of the manufactured archaeological samples are having coarse and regular surface. The manufactured archaeological objects have pattern that is modified by the impact that made by hammerstone. The direction of the texture will be strongly affected by the people who use the hammerstone on the object surface. This article research mostly on the history part of the archaeological objects but not digital art. It explains the features and surface texture of the archaeological objects and estimate the reason behind. It might help me to get an idea when I am developing the details and features of the 3D game objects texture in game. Not only texturing, it might help me in developing the details of the normal map of certain texture to create bumpiness.

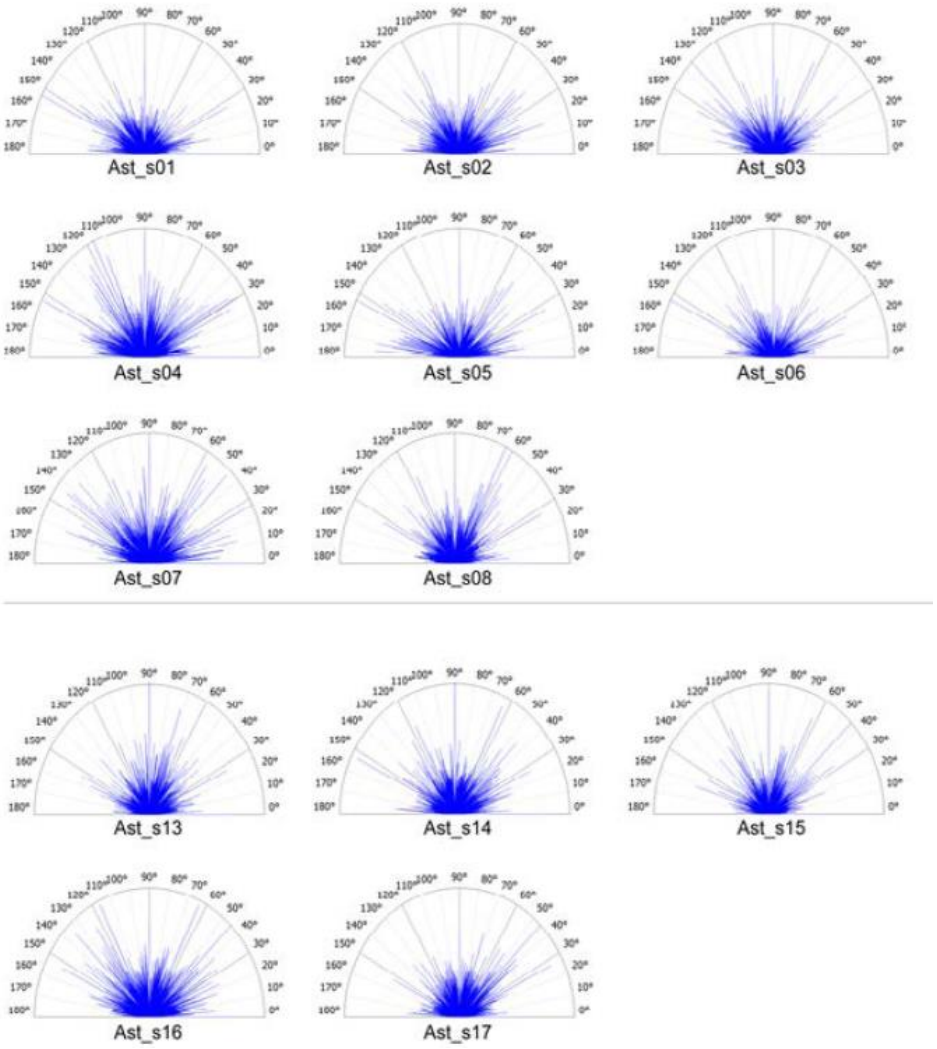


Figure 2.5 Texture direction of archaeological sample surfaces

Besides, Frederick M. Weinhaus and Venkat Devarajan(1997) researched on a techniques called Image Perspective Transformation or IPT technology. Unlike traditional texture mapping, IPT is able to generate real-time perspective simulation of real-world areas. It mapped every object surface with the texture from photo images of the real-world areas (Weinhaus & Devarajan, 1997). IPT could be applied in different approach which bring different advantages and disadvantages. Figure 2.6 showed the comparison of different approach. IPT system applied in many industries, such as urban planning, architecture, military training and much more. The industry will choose the suitable approach based on their needs. It was being said that the technology of texture mapping was greatly advanced and will grow rapidly in the coming decades. This research was done in 1997 which is long time ago. Nowadays, there are more efficient and effective algorithms to generate texture map. Therefore, IPT is not the best choice, but an option to consider when generating an 3D environment in real time or non-real time.

Geometry	Rendering	Advantages	Disadvantages
Height field	Painter's	• Algorithmic simplicity	• Minimal antialiasing • No handling of (urban) vertical faces
Height field	Floating horizon	• Good ridgeline antialiasing	• Minimal other antialiasing • No handling of (urban) vertical faces
Height field	Ray trace	• Efficient handling of large terrain sets • Amenable to speed optimizations • Amenable to parallelization	• Minimal to moderate antialiasing • Poor handling of (urban) vertical faces
Voxel	Ray trace	• Can handle (urban) vertical faces • Amenable to speed optimizations • Amenable to parallelization	• Geometry data base increases substantially to handle (urban) objects
Polygon	Depth buffer	• Good antialiasing using multires data • Handles urban & terrain objects equally	• Limited parallelization

Figure 2.6 Comparison of approaches

Apart from that, Jonathan Blow(1998) stated ways to implement texture caching system. Texture caching is to overcome the limitation of texture in 3D video games. It is to render only the texture that required to display to decrease the burden of RAM. Texture store at varying resolution is called MIP-maps (Jonathan, 1998). The higher the level of MIP-level, the bigger size it is. Golgotha uses 16-bit textures that are actually JPEG file in compressed, but the render engine detects the file as uncompressed (Jonathan, 1998). It saves lots of workload for the RAM or it will require 100MB of storage which is much bigger than the JPEG file. This allows the hardware to render high resolution texture meanwhile save storage space for rendering. However, it is recommended to determine the detail level in order to decide which MIP-map levels are needed. It could help a lot in optimizing the performance of the video game without sacrificing much detail level. Jon P. Ewins(1998) and his research team is researching on the selection of MIP-Map Level for texture

mapping. Different method of MIP-map has different costs and features. Therefore, it is crucial to choose a suitable implementation of algorithm to achieve an ideal result. It always considers of image quality, system integration and computational cost when choosing algorithm to implement. When considering the quality of texture image, per-pixel algorithm works better with image quality as it caused less blurring but it brings greater aliasing (Ewins, Waller, Martin, & Lister, 1998). It will the suitable algorithm for my project as there is not that much of animation in the game. At the same time, the camera perspective does not allowed player to take closer look at the main character while doing animation which reduce the negative effect of aliasing. Cost factor might not be much considered as my project is having low hardware requirement. This is because my project is a low poly style game that does not require much hardware memory to render the polygons and texture.

Not only that, Paul S. Heckbert(1989) explored mapping and filtering techniques. Paul S. Heckbert introduced a naive way to implement texture mapping which is using an algorithm for 2D mappings. The algorithm could define space coordinates and texture coordinates at each vertex of polygons, then transform the polygons to screen space. After that, it will compute x, y and z value at each pixel. It will utilise the resultant colour as the screen pixel value after sampling the texture array (Heckbert, 1989) . It read data from the image texture, then mapped to texture space and the nearest texture pixel value was recorded. It was fast and efficient, however it might cause texture aliasing which is terrible especially in animation. Therefore, Paul S. Heckbert explored another technique, prefiltering to try overcoming the aliasing problem. Images needed to be resampled before filtering. The filter class, elliptical Gaussian suited well to work with the theory of ideal image resampling. It helped to improve texture quality in rendering and image warping. Jerome Maillot(1993) and his research team also worked on another method of texture mapping which is interactive texture mapping that able to lower the distortion of the texture map. He used a data structure called “atlas” to try solving the problem. To solve texture distortion, the common way is to split the object into different regions (Maillot, Yahia, & Verroust, 1993). Atlas is linked to the geometry of the object and hard to construct. The research team combined atlas and interactive function to control the data which is efficient for segmenting a 3D object in region which could help to improve the problem of texture distortion. In my opinion, texture mapping is important however the filtering technique is suitable for my project as there is not that much of animation in my project. Therefore, it will be not worthy to work on filtering in my project.

Alessandro Merlo(2013) and his research team works on the visual enhancement in game engine. They created a few low poly models with simple geometries and apply different texture maps which are normal map and displacement map. They found out that tessellation shaders are better than normal mapping shaders. Unlike normal mapping shaders, tessellation shaders are able to refine and add details to low-poly models (Merlo, Belenguer, Vidal, Fantini, & Aliperta, 2013). Figure 2.7 showed that the model had better visual aspect including shadow after applying tessellation shader.

It allowed GPU to load low poly model with a normal map that is quality enough to fit a high-poly model. Damien Lappa(2017) researched on the procedure to create a photorealistic game texture. There are many software and program are able to create realistic texture, and the number of the tools are growing. Substance painter is one of the software that could come in handy when painting details in materials (Lappa, 2017). Figure 2.8 showed the possibility of creating realistic material with using Substance Painter. Substance Painter allowed artist to create impressive material. Despite having much software to create photorealistic textures and materials, creativity and capability of the artist are the main approach to achieve it.

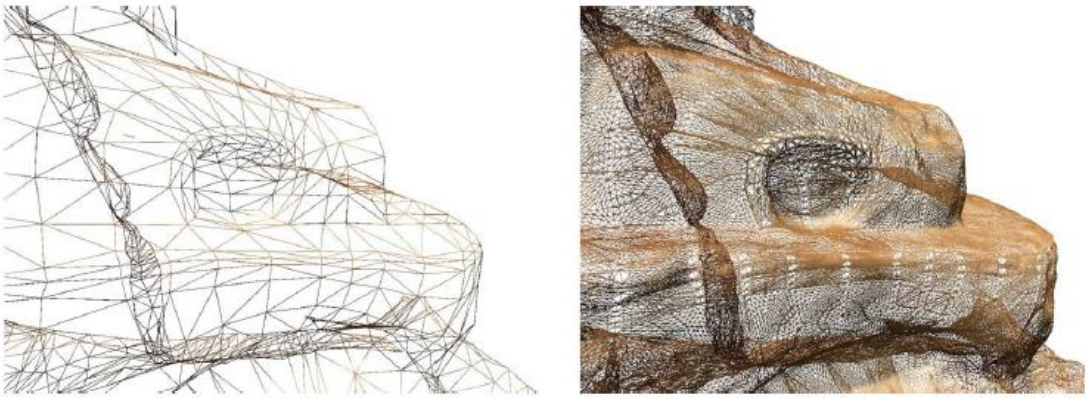


Figure 2.7 Comparison between geometry of original mesh (left) and result of applying tessellation shader (right)

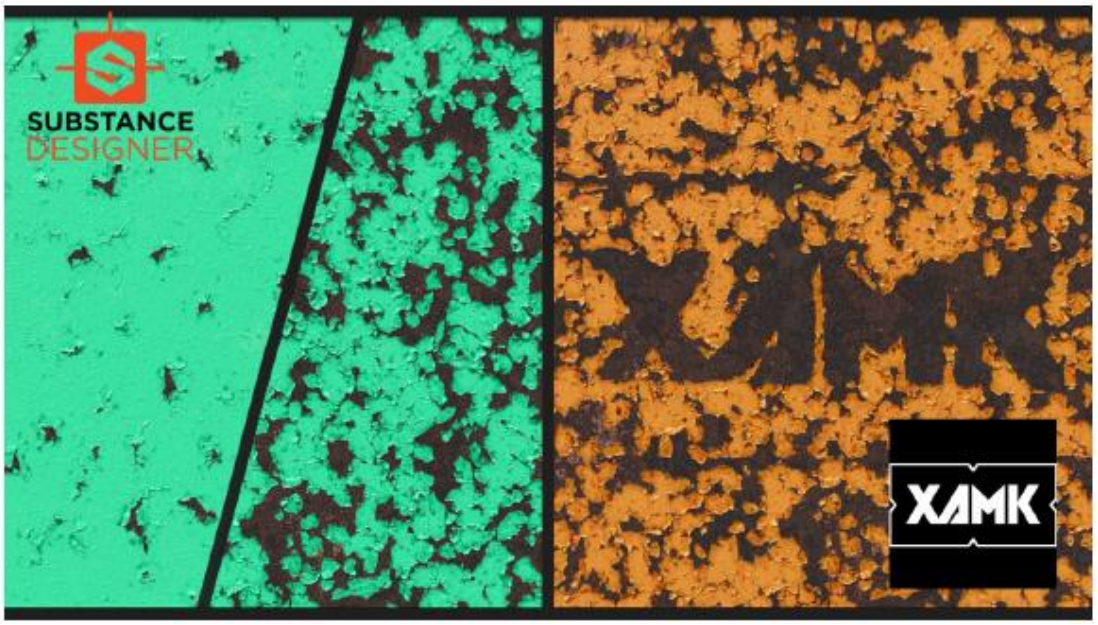


Figure 2.8 Substance Designer material

Manuel M. Oliveira(2000) presented a new method of texture mapping called relief texture mapping. This technique used 1-D forward transform as texture mapping to apply on polygons. It will manipulate the parallax and visible look of the 3D-shape of displacement surface (M, Oliveira, & McAllister, 2000). A 256x256 texel relief texture on a quadrilateral using two-pass approach could

run 9.42 frames per second in Pentinum II PC at 400MHZ (M, Oliveira, & McAllister, 2000). This technique helps a lot in efficient hardware implementation. Ziyad S. Hakura(2002) proposed texture image cache to achieve efficient hardware implementation. The 4KB cache change to 32KB cache have great reduce of memory bandwidth requirements, however it is less reduction when changing to 128KB. The caches that are small as 16 KByes with 2-way associativity could reduce the system memory and also reduce the latency to read the file (Hakura, 2002). This also helps to improve hardware performance.

Meanwhile, there was a different and easier way to texture map especially on complex surfaces. Darwym R. Peachey(1985) mentioned that it is difficult to texture map complex surfaces with using two-dimensional texture functions which is a traditional mapping method. He introduced a new method which is solid texture functions that could easily overcome the problem. Solid texturing was applied to determine light and dark wood in Figure 2.9. According to Figure 2.9, The grain texture of the block in left image had more realistic texture compared to the block in the right image. The texture of left image in Figure 2.9 had continuous texture meanwhile the texture in the right image did not. The result was achieved without controlling the texture function. Solid texture could be generated by three-dimensional and two-dimensional functions (Peachy, 1985). It was capable to applied to arbitrary complex surfaces without countering much problem as traditional texturing.

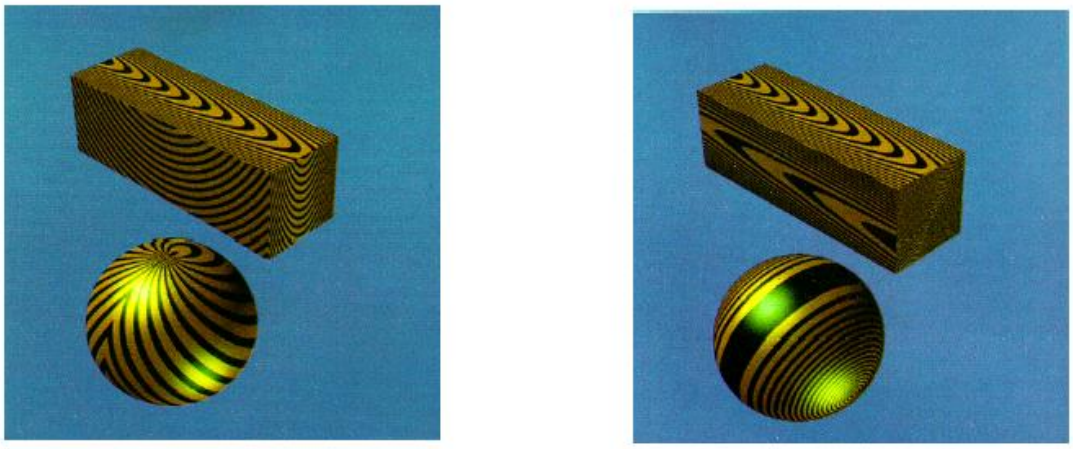


Figure 2.9 Solid texture of light(left) and dark(right) wood

There are many ways to achieve realistic texture. Most of the methods are using algorithms to experience the efficient and cost-saving way to texture map. There are many problems when texture mapping, such as complex surfaces, low poly faces, hardware storage and much more. Technology has been advancing these days that most of the problems are solved. Algorithms are getting better so does hardware performance. However, these articles give a lot of ideas to me

especially on the storage part of texture map. Realism of the texture should be balance with the performance in order to deliver a convincing user experience.

Chapter 3: Research Methodology

3.1 Design Structure

This paper is to study on using texture to create realistic low poly 3D models. It is defined on human experience if the 3D model looked realistic enough. Therefore, qualitative data will be collected through survey to investigate the emotion and expression artistic of people on how they define low poly 3D model. The survey also identify the priority of game feature when playing games.

3.2 Sampling

Simple random sampling will be applied when collecting sample data. This is because simple random sampling is the most cost saving ways to collect data in both money and time cost. Besides, my topic is mostly relying on human experience which is to define how realistic is a 3D model. This will make no difference to collect data from random people who are able to see compared to survey through specific group of people. Around 30 samples will be collected to help with the study.

3.3 Measurement Instrument

Google Forms will be the main tool when conducting survey. The questions are not complex, mostly asking about experience and opinion. Google Forms is free to use so it could save some money on doing survey. In addition, Google Forms is a well-known survey platform, therefore it will be more familiar to most respondents which could encourage them to fill in the form.

3.4 Questionnaire Design

Self-administered questionnaires will be applied when creating the questionnaire. It is the ideal way as it is cost-effective and also suits for my questions as the questions are delivered through Google Forms which is an online form. There are closed-ended questions, which mean there will be limited options for respondents to choose. It is considered that the questions are not that complex enough that require respondents to provide detail answers. Besides, it could speed up the data analyse progress with limited answers. There are also few questions that seek opinions from respondents about opinions on topics not related to reality of texture map.

3.5 Procedure

Link of the Google Forms will be sent to respondents. There are 2 sections in the form which provide different method of asking questions.

Section A will be 2 pictures for comparison at each question to let respondents decide which is more realistic and which is more suitable for the environment. Some of the pictures will be taken from my game project to let respondents to define.

Section B focuses on seeking opinions from respondents about game visual appeal. There are options provided for the respondents.

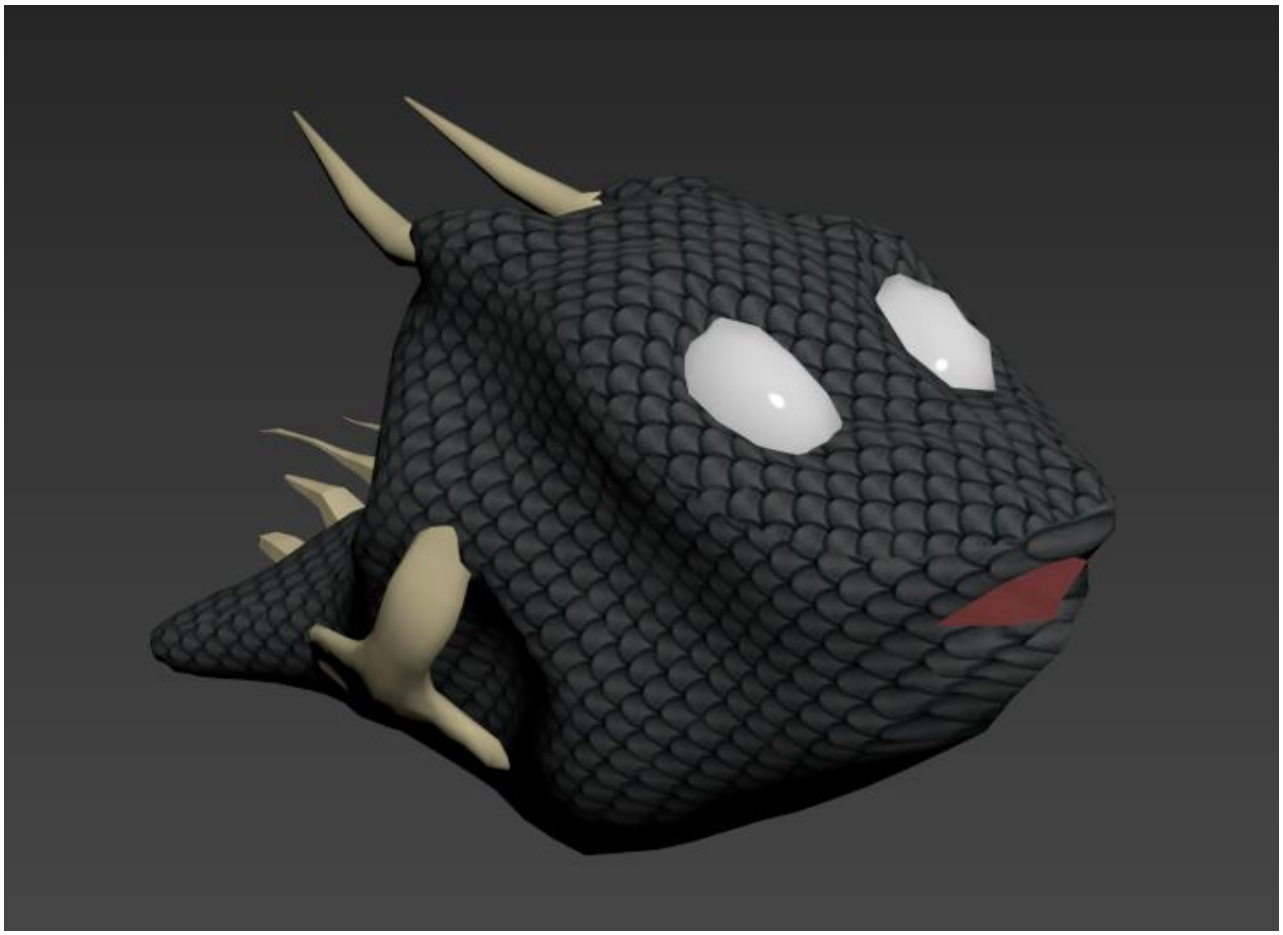
3.6 Limitation

One of the limitations is unable to receive feedback from respondents due to only limited answers are provided. Respondents are not able to write down in detail how they feel or think on certain part of the survey. The second limitation is that the results are unable to measure the accurate reaction from respondents. This is because many reference images provided in the form are not clear due to the images are taken from game scene which is dark. Meanwhile, the form is conducted through online. Therefore, it is not highly accurate to measure people reaction with closed-ended question.

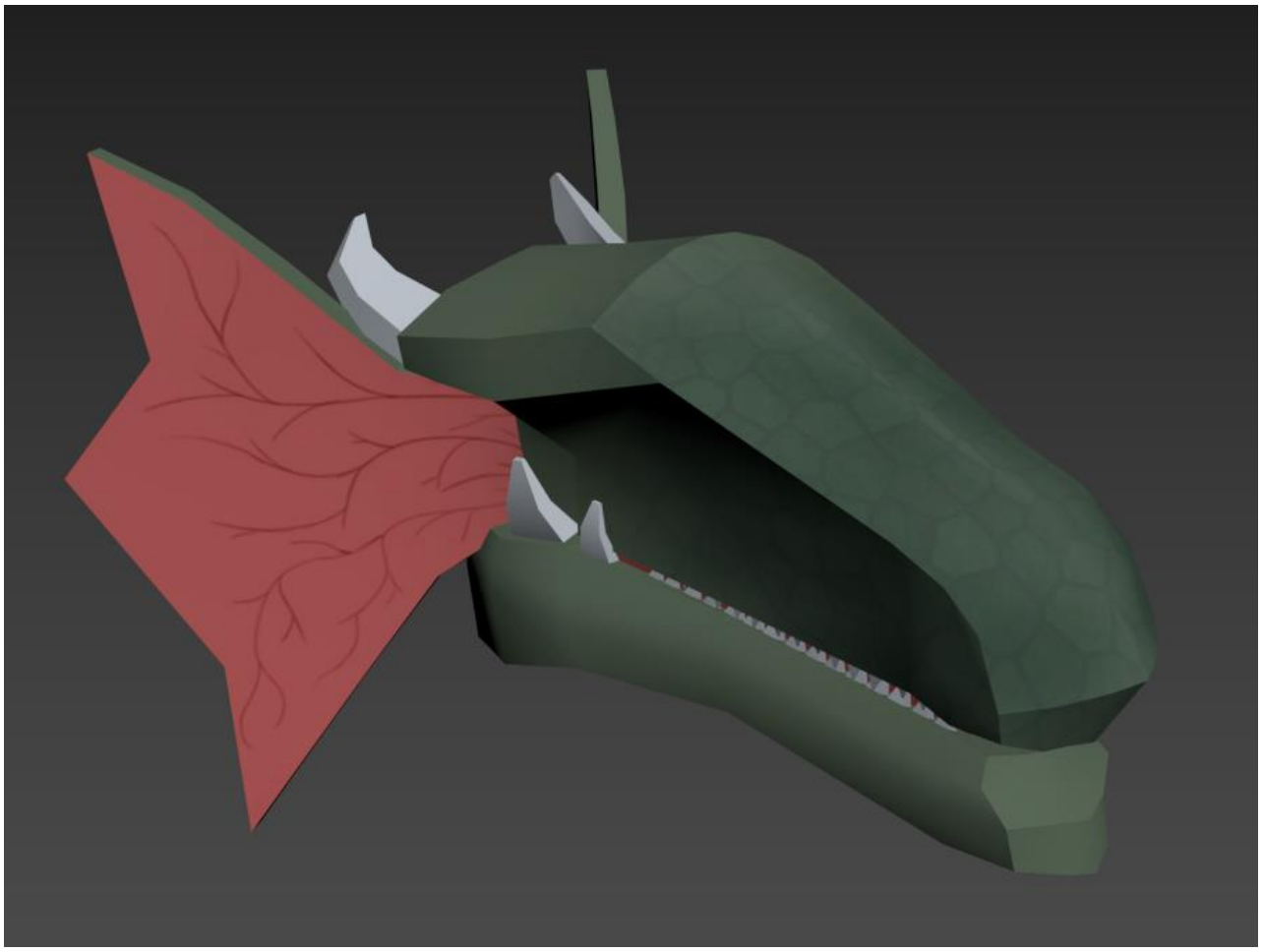
Chapter 4 Design & Implementation

4.1 Character Design

Chroma



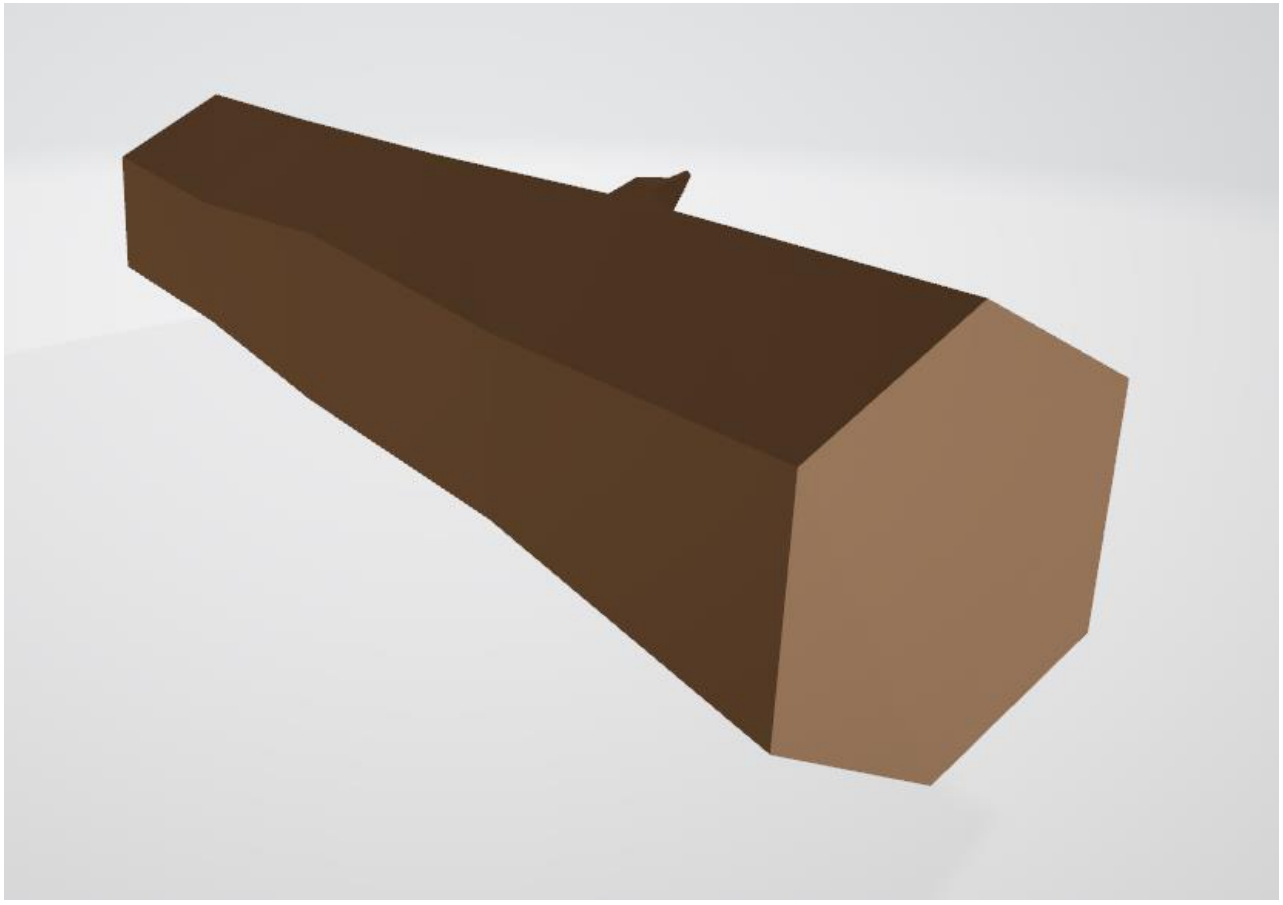
HunDun



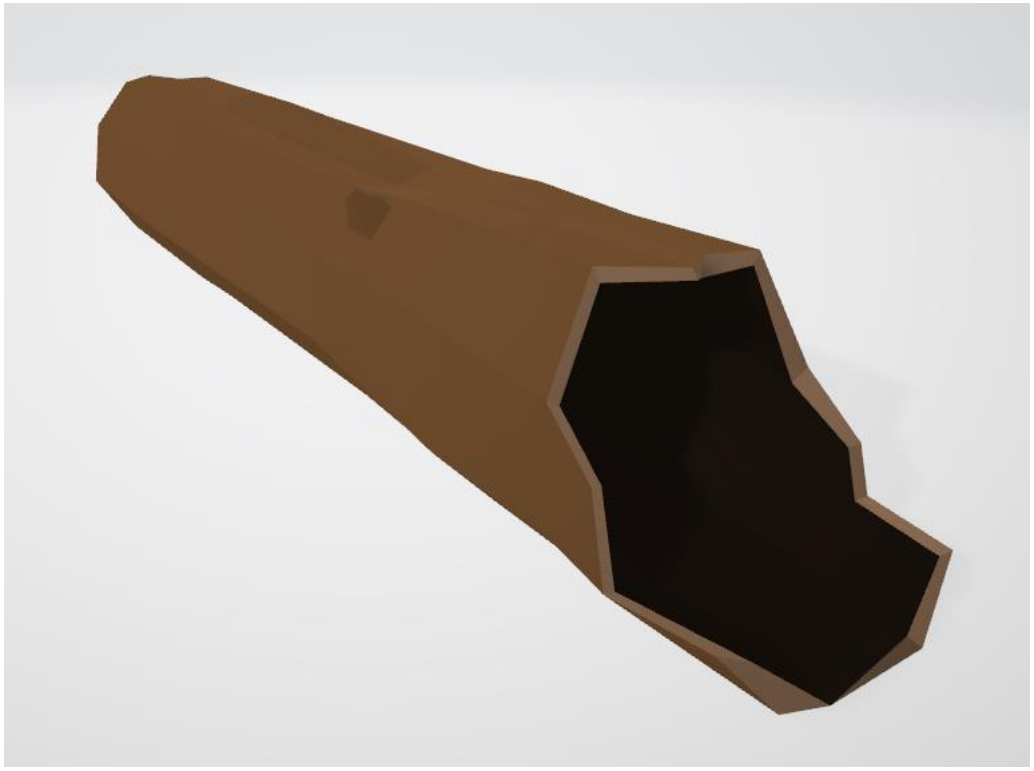
TaoTie

TaoWu

4.2 Props Design



Fallen Tree Trunk



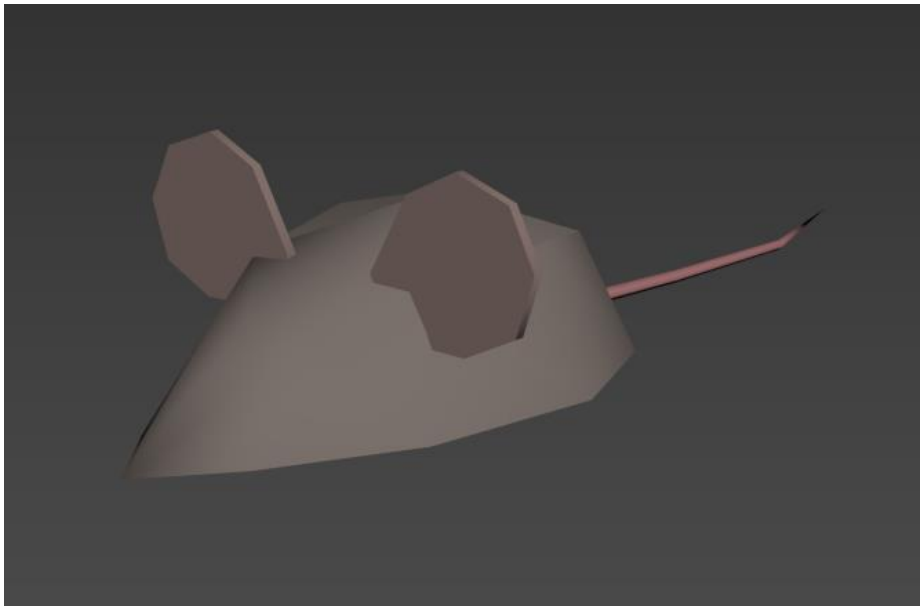
Hollow tree trunk

Tree 1

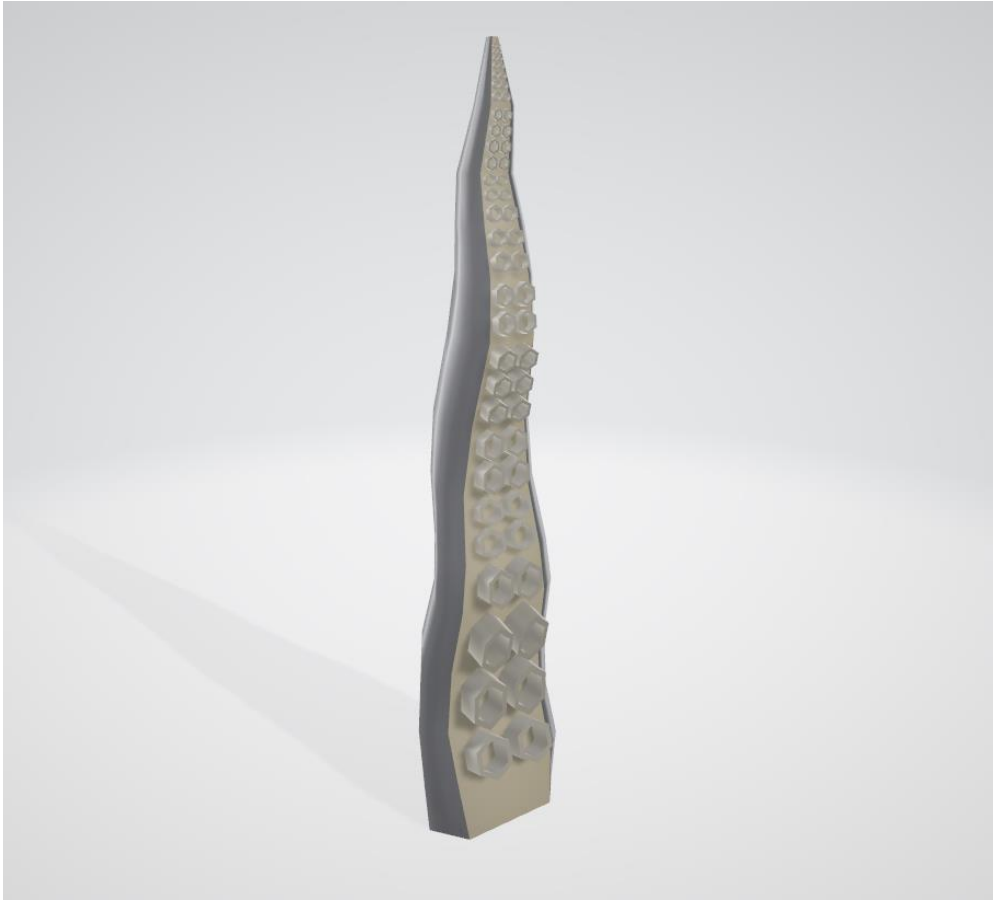
Tree 2

Tree 3

Seal Stone

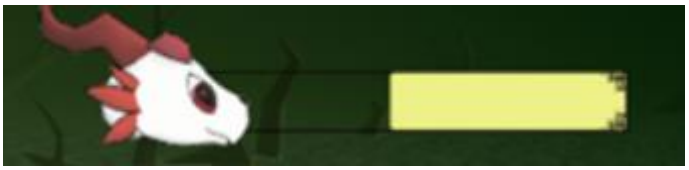


Mouse



Tentacle

4.3 UI Design



Stamina Bar

Header of stamina bar

Game Logo

4.4 Animation

Animations are not able to show in word but can only observe in game engine. Therefore, there will be no animations showing here. However, animations done for each character in game will be shown at below.

4.4.1 Chroma animation

Animation made for Chroma includes:

1. Idle
2. Walk
3. Run
4. Jump
5. Push
6. Pull
7. Crouch
8. Crouch walk
9. Aiming (throw)
10. Throw
11. Aiming walk
12. Swimming idle
13. Swimming forward
14. Climb
15. Climb (Hold)
16. Fall Down
17. Crouch Aiming Idle
18. Crouch Throw
19. Crouch aim walk
20. Throw
21. Swimming

4.4.2 TaoWu animation

1. Idle
2. Attack
3. Attack Idle
4. Take Damage

4.4.3 Tentacle animation

1. Idle
2. Attack

4.4.4 Mouse animation

1. Walk

4.4.5 TaoTie animation

1. Jump attack

4.4.6 HunDun animation

1. Idle
2. Run

5.0 Level Design

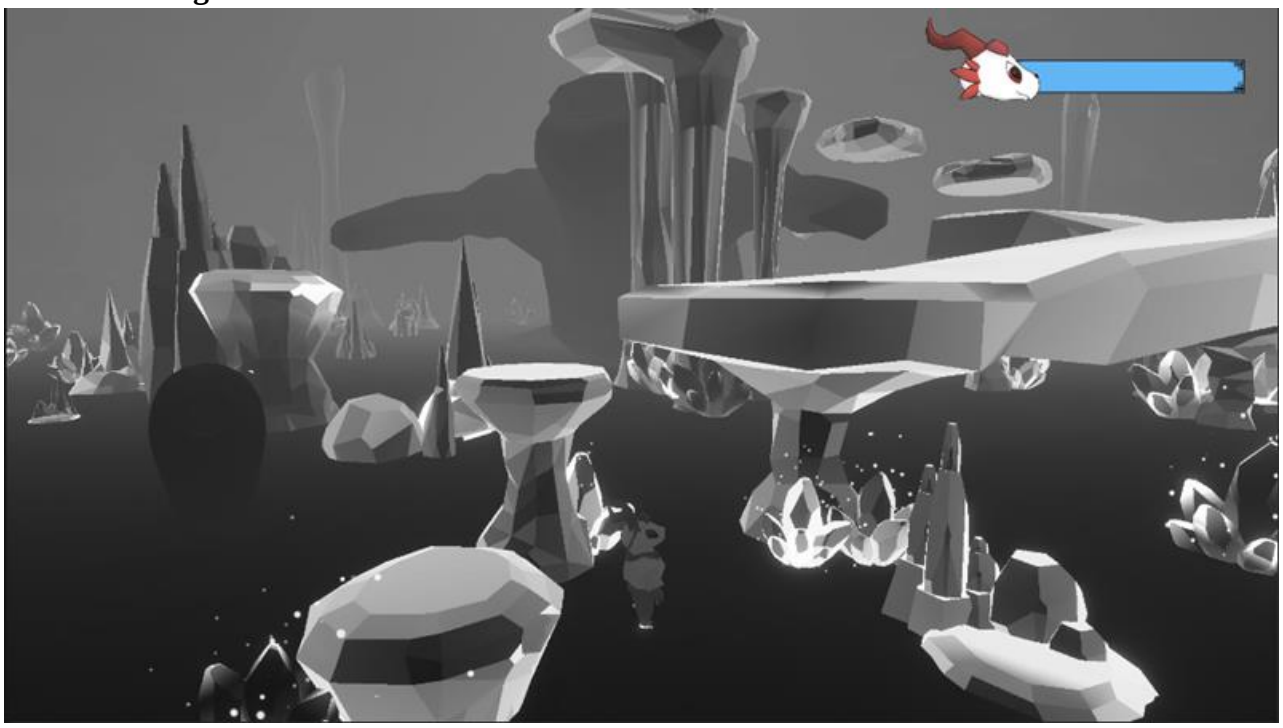


Figure 5.1 Level 4

The concept and environment of level 4 was designed. TaoWu will be the only boss in Level 4. In this level, players are required to repair the seal stone by holding ‘E’ key. Once the progress reach 50% that will be shown above the seal stone, the boss will stop player by decreasing the seal stone repair progress. At the same time, the platform will rise up that allows player to throw a light ball into the TaoWu’s mouth to stop it. After successfully throwing the light ball, TaoWu will be stunned for 1 minute. Players could continue repairing the seal stone and get to the next seal stone. There are total 3 seal stones that player needs to fix.

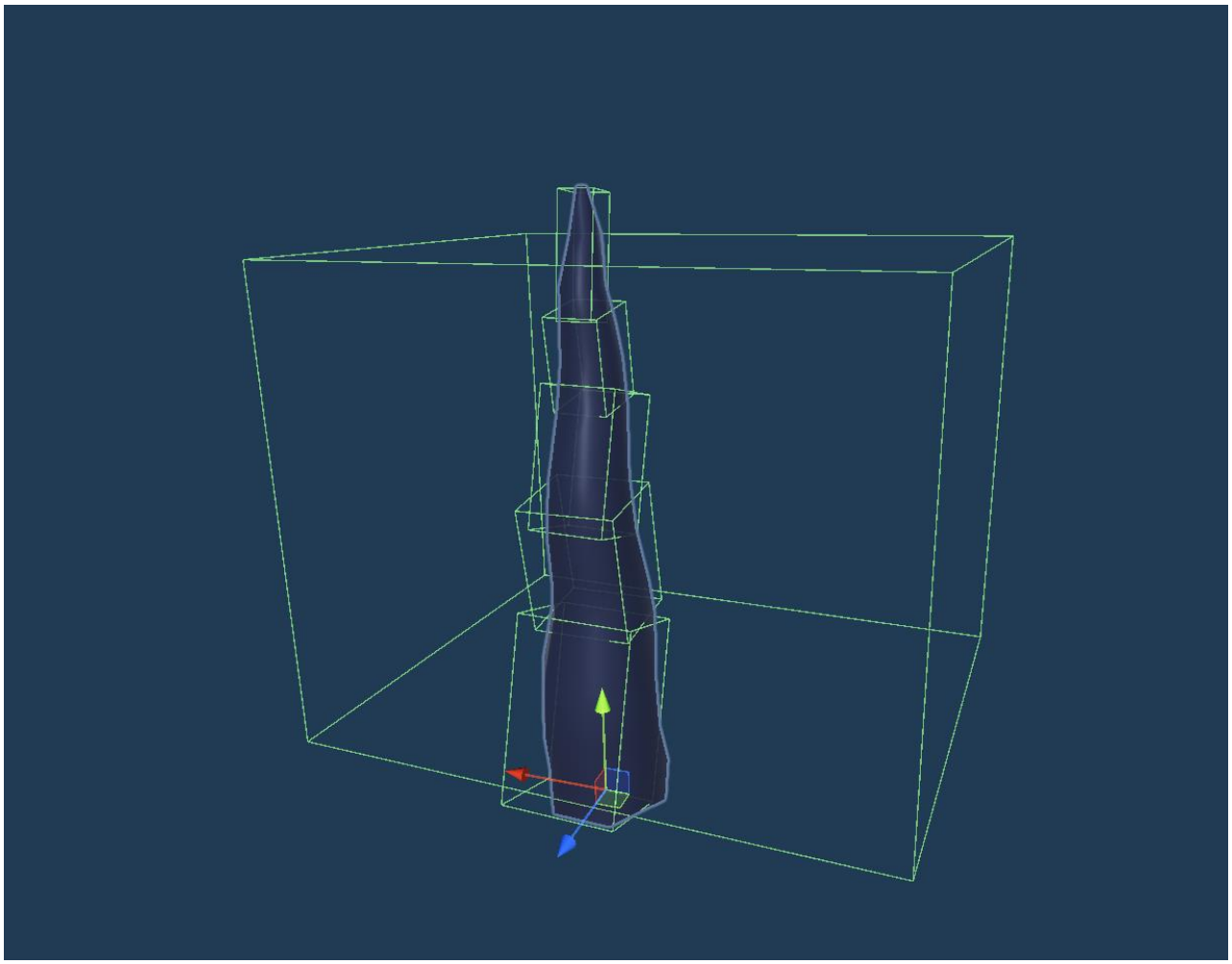
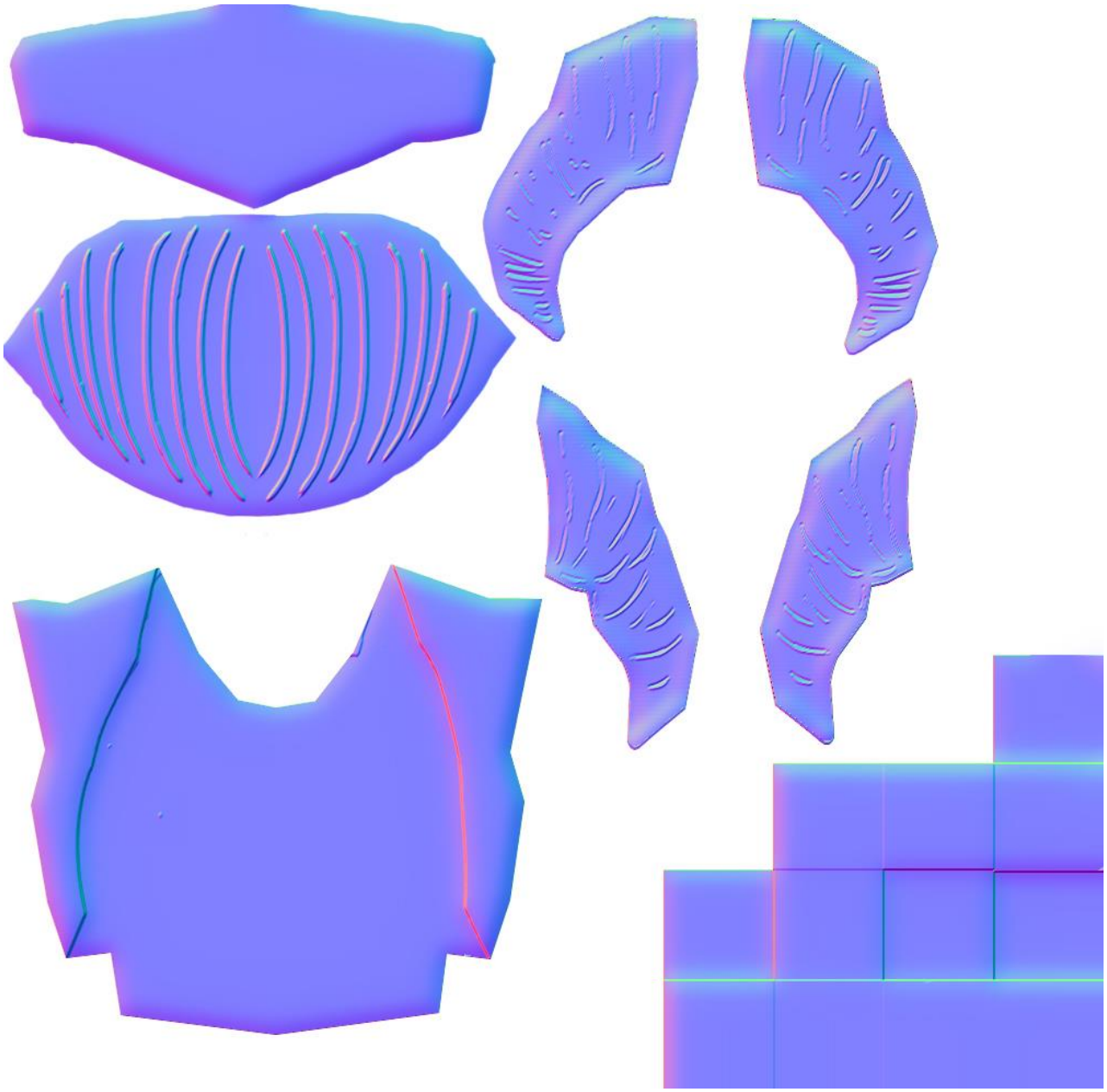


Figure 5.2 Tentacle

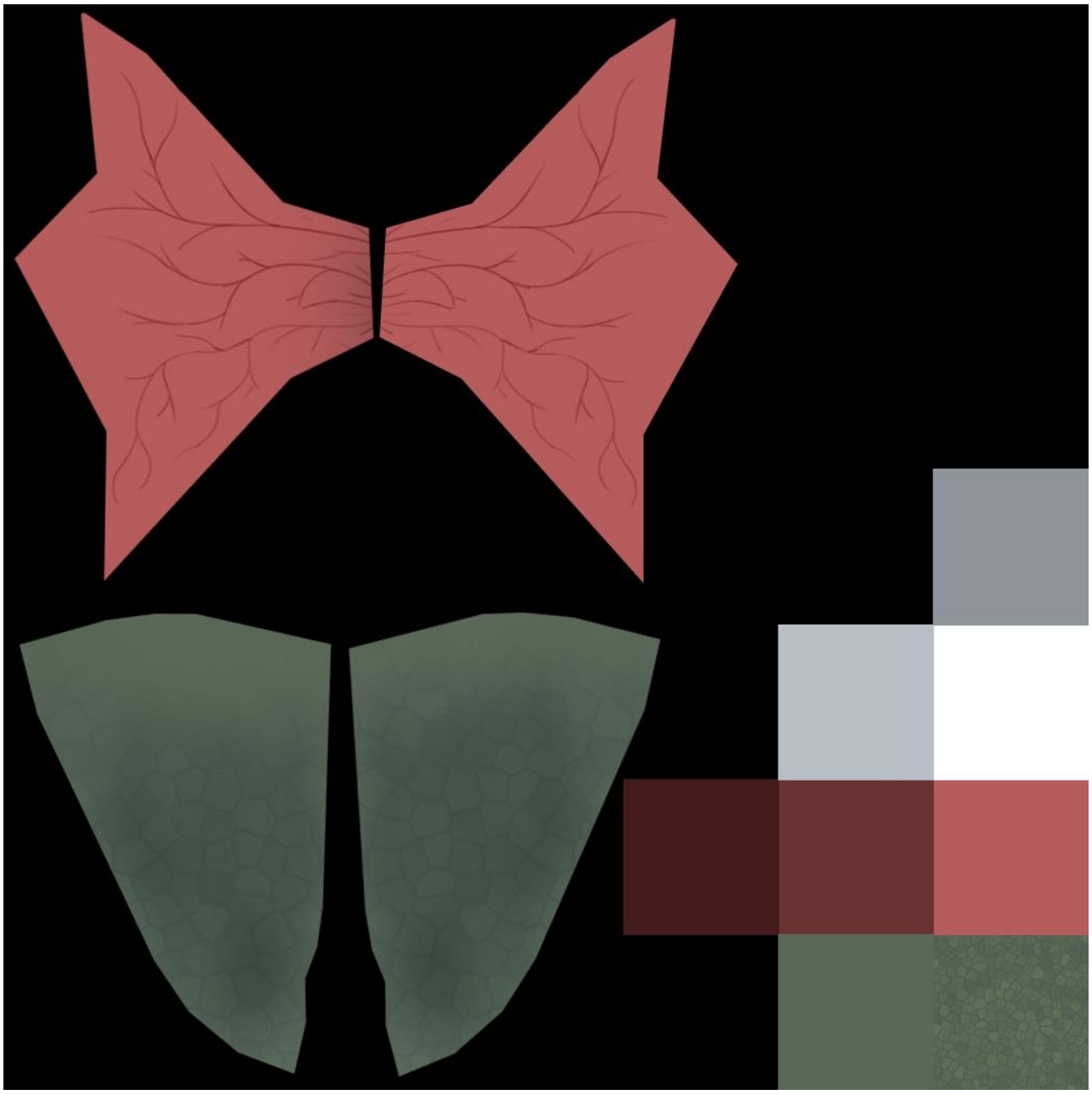
Tentacle will only appear in last level which is level 4. The biggest green box will detect when players pass through the front of tentacle. Once players pass through, it will attack players that slow player down. There are 5 small green boxes are the collider box of the tentacle which will trigger the slowing function.

6.0 Texture Map

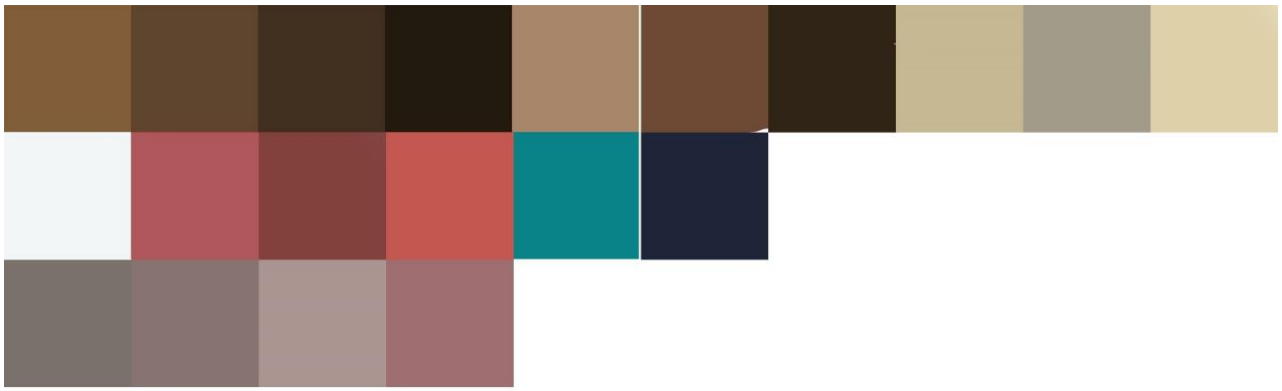
TaoWu texture map

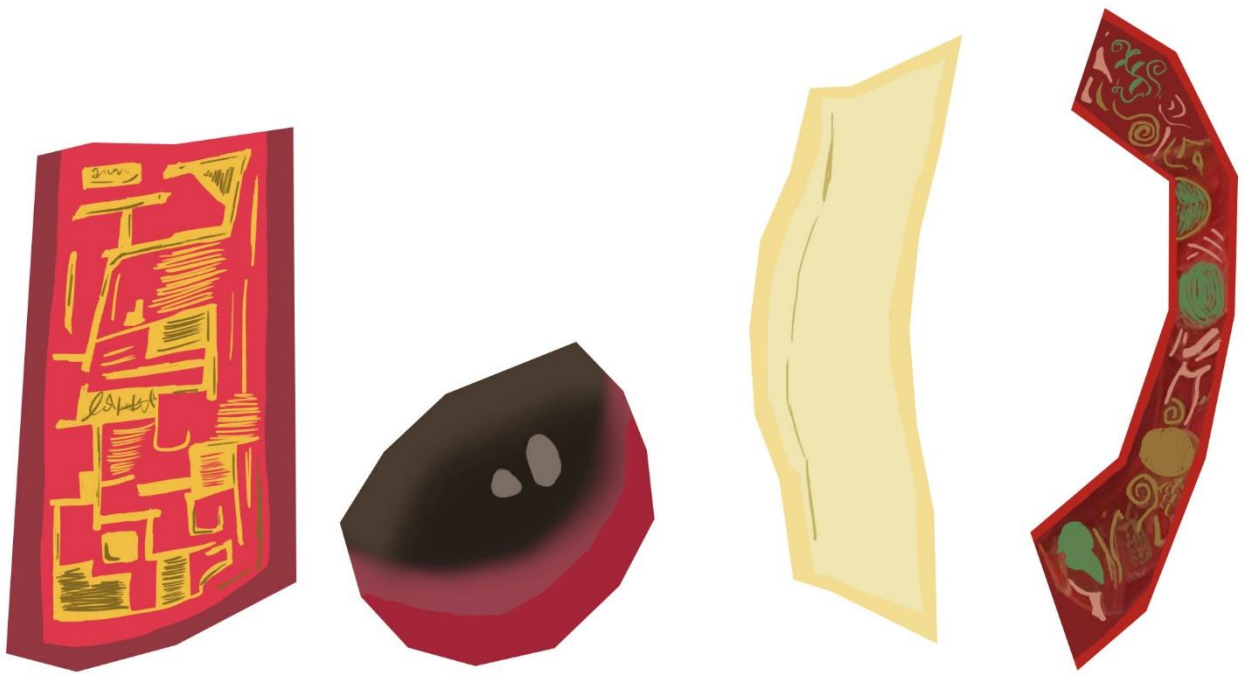


TaoWu texture normal map



TaoTie texture map





Chroma texture map

Chapter 5: Result & Evaluation

5.0 Introduction

This chapter will analyse the data and findings from the survey. Descriptive analysis is applied to examine the respondents' data. The analysed data will be presented in table, pie chart and bar chart form to show a clearer understanding of the data.

5.1 Data Presentation

5.1.1 Reality perception on different images

Figure 5.1.1 shows the comparison of reality perception on 2 images. According to table 5.1.1, A which is the image shows 3D model with normal mapping look more realistic compared to B which did not apply normal mapping. More than half of people which is 60% of people think that the image with normal mapping look more convincing. There are more people think that the texture that applied normal map look more realistic than the one without normal map. Normal mapping does improve the reality perception to people.

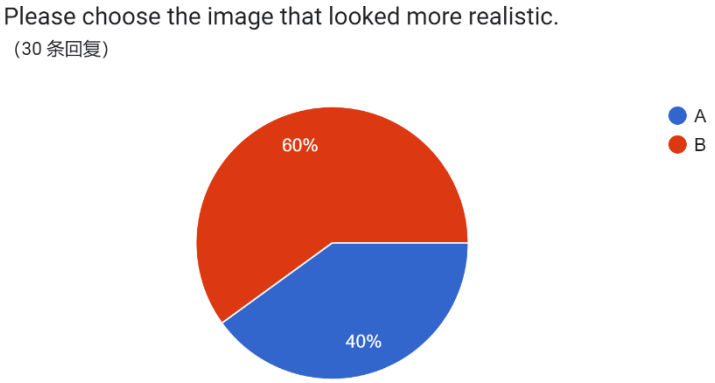


Figure 5.1.1 Comparison of reality perception

Comparison of reality perception		
	Frequency	Percent
A (with normal map)	18	60
B (without normal map)	12	40
Total	30	100

Table 5.1.1 Comparison of reality perception

5.1.2 Environment affection to texture mapping

Figure 5.1.2 shows the capability of people to identify the difference of texture in a dark environment. Huge amount of people that have up to 93.3% are unable to identify the difference of texture in the image due to dark environment provide insufficient colour and lighting to audience. According to Table 5.1.2, only 2 people are able to identify the difference of texture that showed in a dark environment. There are more people cannot identify the difference of the texture that showed in a dark environment than the people who can. Game environment is also one of the factors need to concern with when texturing.

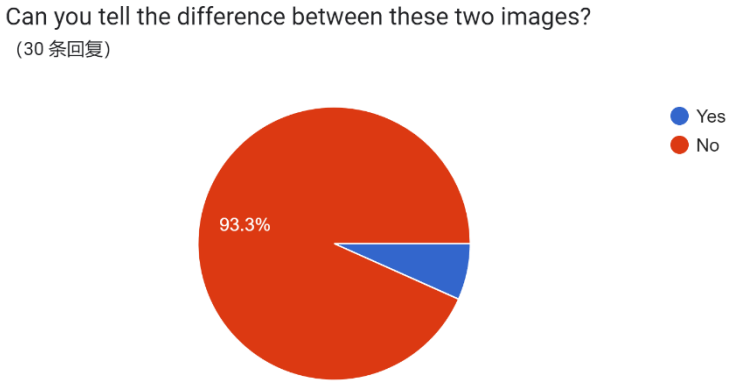


Figure 5.1.2 Capability of identify texture difference

Capability of identify texture difference		
	Frequency	Percent
Capable	28	93.3
Incapable	2	6.7
Total	30	100

Table 5.1.2 Comparison of identify texture difference

5.1.3 Comparison of texture on suitability

Figure 5.1.3 shows the suitability of different texture with or without normal map. Table 5.1.3 shows that 26 out of 30 people think that A which is texturing with only solid colour is more suitable to the scene. Meanwhile, 4 out of 30 people thinks that B with normal mapping and different texture is more suitable to the scene. There are more people think that the model with solid colour texture looks more suitable in the game scene than the normal map texture. Realistic texture not always the most suitable texture to apply in game. It also related to the game art style, environment and texture quality.

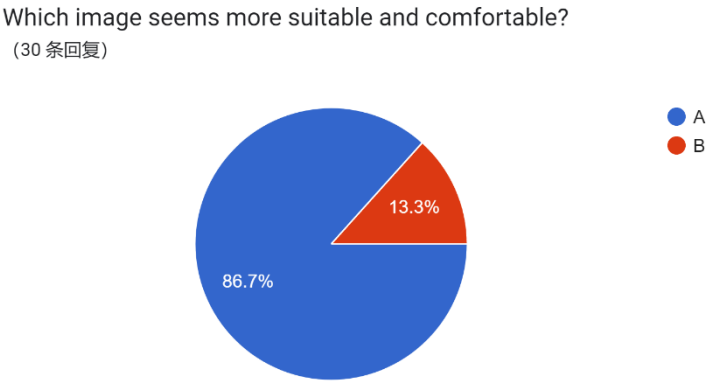


Figure 5.1.3 Comparison of images on suitability

Comparison of images on suitability		
	Frequency	Percent
A (with only solid colour)	26	86.7
B (with normal map)	4	13.3
Total	30	100

Table 5.1.3 Comparison of images on suitability

5.1.4 Comparison of texture on visual appeal

Figure 5.1.4 shows that 75.9% of people choose A with only solid colour to be the most comfortable texture in the scene. Meanwhile, there is 24.1% of people think that B with normal mapping and different texture is the most comfortable texture in the scene. More people think that the model with solid colour texture looks comfortable in the game scene compared to normal mapping. Solid colour texture seems more comfortable to people in low poly art style game.

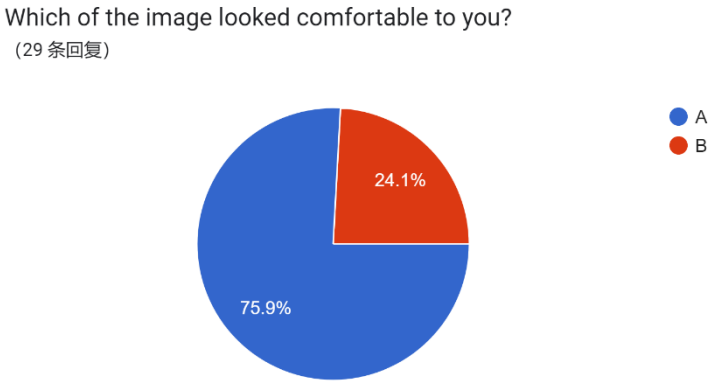


Figure 5.1.4 Comparison of images on visual appeal

Comparison of images on visual appeal		
	Frequency	Percent
A (with only solid colour)	23	75.9
B (with normal map)	7	24.1
Total	30	100

Table 5.1.4 Comparison of images on visual appeal

5.1.5 Preference on realistic graphic

Figure 5.1.5 shows the percentage of people that prefer video games with realistic graphic. According to table 5.1.5, there is 86.7% of respondents who prefer video game with realistic graphic. Meanwhile, there is 13.3% of respondents who does not has great preference on realistic graphic in video game. The amount of people who prefer realistic graphic in video games are more than people who do not prefer.

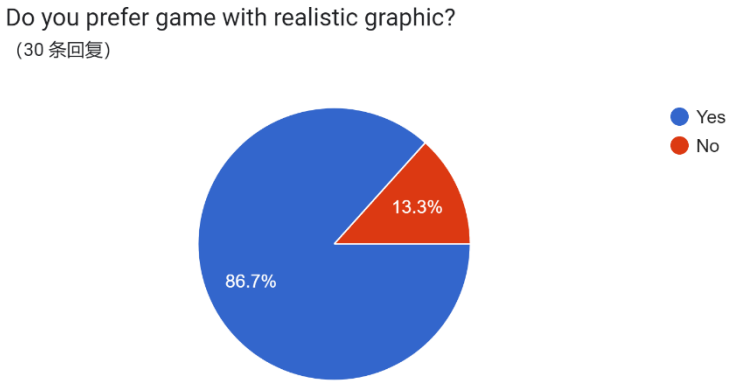


Figure 5.1.5 Preference on realistic graphic

Preference on realistic graphic		
	Frequency	Percent
Prefer	26	86.7
Not prefer	4	13.3
Total	30	100

Table 5.1.5 Preference on realistic graphic

5.1.6 Priority of choosing game

Figure 5.1.6 reveals the priority of respondents when choosing a game to play. Table 5.1.6 shows that budget, game story and creativity are the elements respondents most concern with when choosing game. There are only 5 respondents prefer graphic and 3 respondents prefer game mechanics. Only 1 respondent provide other answer which is 'fun or not'. Graphic is not the most important element to develop a game, but still important enough to enhance the game quality.

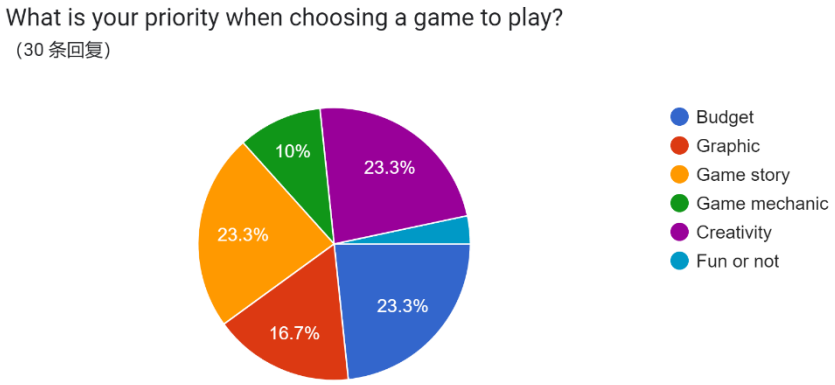


Figure 5.1.6 Priority of choosing game

Priority	Frequency	Percent
Budget	7	23.3
Graphic	5	5
Game story	7	23.3
Game mechanic	3	10
Creativity	7	23.3
Other: Fun or not	1	3.3

Total	30	100

Table 5.1.6 Priority of choosing game

5.1.7 Graphic and game's quality

Table 5.1.7 reveals the amount of people who think graphic does affect the game's quality. According to Figure 5.1.7, there is 83.3% of respondents think that graphic affect the perception of game's quality. Only 16.7% of respondents disagree that graphic affect game's quality. Huge amount of people does think graphic play an important role in enhancing game's quality.

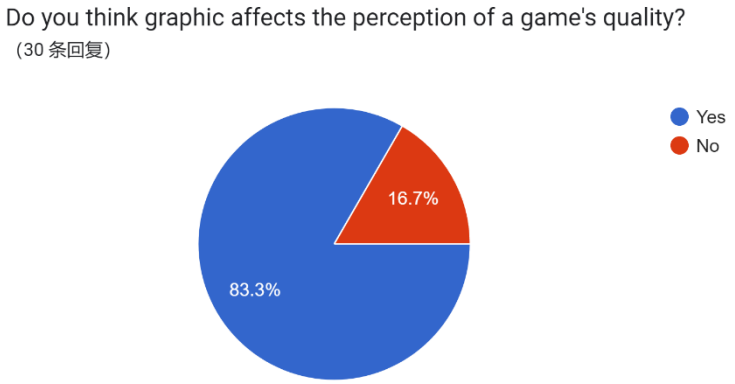


Figure 5.1.7 Graphic and game quality

Preference on realistic graphic		
	Frequency	Percent
Affect	25	83.3
Not affect	5	16.7
Total	30	100

Table 5.1.7 Graphic and game quality

5.2 Analysis

5.2.1 Descriptive analysis of importance of graphic to gameplay experience

Figure 5.2.1 reveals the importance of graphic in enhancing gameplay experience. Table 5.2.1 shows the descriptive analysis of 30 respondents thought on importance of graphic in enhancing gameplay experience. The mean score is 3.47 with a standard deviation of 1.33. The highest score of mode is 5, which represents 'strongly agree', which shows that a lot of people think that graphic play a great role in enhancing gameplay experience. For instance, it has proved that graphic is important in enhancing gameplay experience.

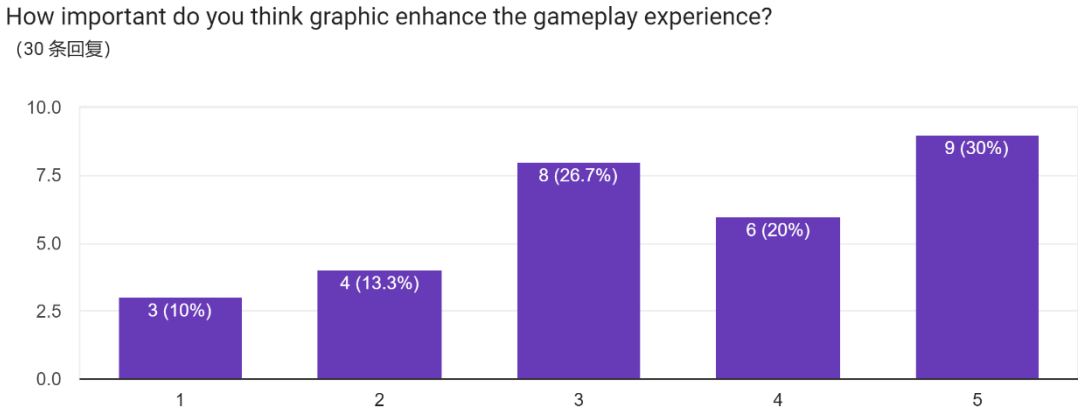


Figure 5.2.1 Importance of graphic to gameplay experience

Importance of graphic to gameplay experience						
	N	Minimum	Maximum	Mean	Mode	Standard Deviation
How important do you think graphic enhance the gameplay experience?	30	1	5	3.47	5	1.33
Valid N	30					

Table 5.2.1 Descriptive analysis of importance of graphic to gameplay experience

Chapter 6: Discussion and Conclusion

6.1 Introduction

This study investigates and explores the possible way to achieve realistic texture map in low poly model. There are a few methods of texture mapping helps in improve realistic sense of texture map which has their advantages and disadvantages. This chapter includes the findings and discussion of the result. Lastly, this chapter discusses the limitation and recommendations for future studies.

6.2 Discussion

Nowadays, the quality of graphic visual in videos game is getting better. Many games and software are capable of presenting realistic material and texture. Many triple A title games are also focusing on presenting great and realistic visual appeal. No doubt that many of the consumers and gamers now tend to purchase the game with great graphics. This study is also conducted on my game project which is having a low poly 3D art style.

The recommend way to create a realistic texture is to look for a seamless image with 1:1 ratio that apply with normal map to create realistic sense, for example, look for a tree texture on internet and apply to the 3D tree object. After that, normal map could be applied to the same 3D tree object to create bumpiness which could create a more realistic and convincing surface under lighting. At the same time, it does achieve efficient hardware implementation which could optimize the game performance. Player could play the video game smoothly and without requiring high performance of hardware requirements.

Although it is ideal to have realistic texture in game, it might not be the best texture method to have in game. The texture mapping method need to consider many factors including game arts, game environment and the game atmosphere. At this stage, cost is also in my concern as there is not much time to conduct the experiment and study in the game project. It is found that realistic texture does not fit into my project game which is a low poly art style video game. Most respondents think that the texture with solid colour only suit the game scene well. At the same time, it is much cost saving in time and hardware storage memory when using plain solid colour as texture to most 3D objects in game.

It is noble to pursuit realism in texture creation in video games, however it should not be the last and only thing to be concern about. The ultimate goal is to create texture that serve the game well, in hardware implementation, artistic vision and cost.

6.3 Conclusion

In a nutshell, realistic texture mapping does enhance the gameplay experience especially on graphic visual. Although realistic texture is important, it is crucial to understand that realism is an enhancement but not priority based on the game art style and design. Low poly model could also deliver with realistic visual with applying suitable texture method. There are many software that could help strengthen the realism of texture on low poly model, which could also help saving time in texturing. Realistic graphic could immerse player in the game world, but unique game art could also give player unforgettable gaming experiences.

6.4 Limitation

This research contains several limitations such as accuracy of tested result and sample size.

The measurement of the realistic texture in game is not highly accurate as only few of the objects are tested with solid colour texture and real-world object texture. The options of provided texture are not enough to examine the difference between textures when observing the realistic texture. Most of the conducted game scene are having dark scene that cause user cannot see the texture clearly, especially for the texture that apply normal map.

Besides, the sample size collected from respondents are not enough to decide the priority of people on graphic. The survey is to identify realism of game scene image and game feature priority. The data collected is not able to identify what is the priority of player when playing games.

6.5 Recommendation for future work

This study is only applying qualitative data to measure the outcome of the study. Thus, this study may not be precise enough to explore the realism of texture on low poly and priority game feature of video games. Therefore, future studies could consider applying combination of both qualitative and quantitative data. Quantitative data could be focusing on the numerical measurement on the texture as realism of a texture could be defined by both human experience and numerical measurement. Polygon counts to measure how fine is a 3D model is also defined by numbers.

Moreover, future studies could also consider enlarge the sample size to 200-250 so that it could increase the accuracy of the overall result. Questionnaire of the survey form should include information of respondents' gender, age, race and education level. This is because those factors are related to respondents' culture which possible to affect their aesthetics. At this stage, probability

sampling technique could be applied to the study as it will take each member from each population to gets same possibility to be chosen into the sample size. It could help reducing the cultural bias and increase the accuracy of the result.

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Appendix

Appendix A

Project Paper Consultation Logbook	
Project Title	Texturing to create realistic low poly 3D models
Student Name	Ho Keen Mun
Student ID	2100171
Year/Semester	Year 3 Semester 3
Supervisor	Ts Dr Ang Kok Yew

WEEK 01	
Comments: Final year project requirement briefing.	**Supervisor signature:**
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 02	
Comments: Consultation of the proposed game ideas. Receive feedback on which the game idea to work on and how to improve it.	**Supervisor signature:**
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 03

Comments: • Proposed 2 game ideas and receive feedback from lecturers and supervisors. • Choose 1st game idea: Chroma Journey as the main game idea to works on • Start modelling the main character of the game	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 04

Comments: • Consulted and received feedback to develop sketches of characters, game flow, game environment. • Sketched 2 NPC characters in game, which are Qiong Qi and Tao Wu. • Finish modelling the main character.	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 05

Comments: • Show sketching of enemy designs and 3D model of the main character. • Advised to make a partial area in the level for tutorial purpose so that player know the movement. • Advised to put assets even though they are not perfect or complete as placeholder for alpha showcase. • Start designing UI for gameplay and main menu.	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 06

Comments:

- Receive feedback to set level environment as priority to work on.
- Need to show more progress during the next consultation included props, environment design, game mechanic and much more.
- Start modelling props for level environment.

Supervisor signature:

Progress (please circle the feedback)

1 2 3 4 5

Poor Satisfactory Good

Date:

WEEK 07

Comments:

- Receive feedback on level design.
- Consult with supervisor regarding mini research.
- Adjusting content of mini research.
- Done modelling props for the level environment.
- Done rigging and texturing the main character 3D model.
- Made few animations for the main character, such as idle, walking, running and jumping.

Supervisor signature:

Progress (please circle the feedback)

1 2 3 4 5

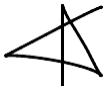
Poor Satisfactory Good

Date:

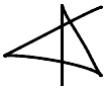
WEEK 08

Comments: • Receive feedback on game demo showcase. • Main character looks fierce, advised to tone down red color and make the horn smaller. • Interactable props in game need to make difference to stand out. • Environment advised to have deem light, not too dark. • Advised to add throw light mechanic to make it more interesting.	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

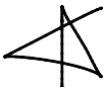
Project Paper Consultation Logbook	
Project Title	Texturing to create realistic low poly 3D models
Student Name	Ho Keen Mun
Student ID	2100171
Year/Semester	Year 4 Semester 1
Supervisor	Ts Dr Ang Kok Yew

WEEK 09	
Comments: • Advised by supervisor to work on the proposed plan instead of changing plan. • Advised to cooperate with team members instead of working on own tasks. • Finished all animation of the main character.	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 10	
Comments: . • Advised to showcase more on the Unity and game side instead of art and document. • Done modelling and texturing the final boss	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 11

Comments: • Advised to keep working harder and update more progress in Unity game engine and game side. • Done modelling, texturing and rigging the Hundun. • Done modelling Taotie	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 12

Comments: • Advised to polish the environment, such as the tree in the second level is too flat. • Done texturing, rigging and animating Taotie. • Done all the animation of Hundun. • Add on some extra animation for main character, such as holding and falling animation.	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 13

Comments: • Fixed the root problem of TaoTie and main character • Advised to speed up progress	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 14	
Comments: • Advised to show more content in Unity game engine scene	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 15	
Comments: • Done HUD design for stamina bar • Advised to add self-protect mechanic to enhance the gameplay experience	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 16	
Comments: • Done rigging and animating the Final Boss • Advised to speed up progress	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 17	
Comments: • Done modelling and texturing the seal stone • Complete the opening cutscene of the game	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

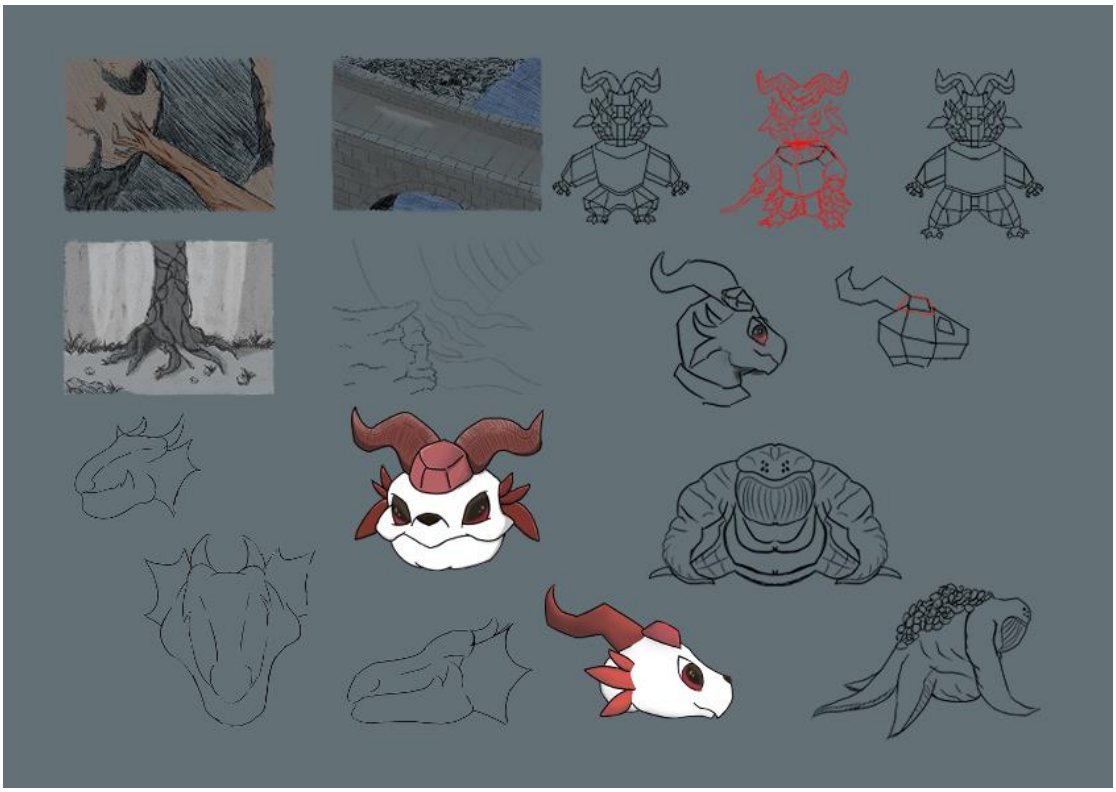
WEEK 18	
Comments: • Done modelling, rigging and animating tentacle • Done adding movable collision box on the tentacle	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 19	
Comments: • Designing environment of level 4	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 20	
Comments: • Done making environment of level 4 • Advised to wrap up everything for demo showcase	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**
WEEK 21	
Comments: • Done making game poster and game icon • Advised to combine everything in game engine as fast as possible	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

WEEK 22	
Comments: • Advised to improve the end game cutscene • Advised to change the ambience sound and sound effect for the cave level • Done game teaser and end game cutscene	**Supervisor signature:** 
Progress (please circle the feedback) 1 2 3 4 5 Poor Satisfactory Good	**Date:**

Appendix D

Poster Board



Concept Board

Name Card (Front)

Name Card (Back)

Appendix E

Final Project Title Form

Fill in the information below as detailed as you can after confirming project title.

Project Type:

- ☑ Product Based Project
- ☐ Research Based Project

(tick the appropriate box)

Student ID	Student Name	Email & Contact no
2100171	Ho Keen Mun	robect2@gmail.com 016-2298270
2101503	Leong Wan Yi	leongwy1103@gmail.com 017-8914905
2001345	Leong Xue Qian	qianxue.jane@gmail.com 011-36618226
2003878	Wong Zi Ming	zimingwong2@gmail.com 011-51284354

Supervisor: Ts Dr Ang Kok Yew

Project Title:

Chroma Journey: The Last Guardian

Project description:-

Chroma Journey is a 2.5D low-poly platform adventure game where the guardian of the East seal, Chroma starts his journey to repair the seal of Four Fiends - Hundun, Qionggi, Taotie, and Taowu to bring back peace to the world.

Student name	Individual Project Scope
Ho Keen Mun	• UI arts • Cutscenes • Player character 3D model and animations • Enemy character 3D model and animations • Poster and teaser
Wong Zi Ming	• Concept art of game environment and character • Design game level and game environment • Ambient sound and sound effect
Leong Wan Yi	• Player movement • Ui function • Visual effect • Item interaction • Game environmental changing function
Leong Xue Qian	• Enemy AI • Main menu function • Game mechanic script

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TEXTURING TO CREATE REALISITC LOW POLY 3D MODELS

HO KEEN MUN

BACHELOR OF ARTS (HONOURS) GAME DESIGN

UNIVERSITI TUNKU ABDUL RAHMAN

OCTOBER 2023

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