3D model and animation of Male Guppy Fish

Manchester Metropolitan University

By [redacted]

BSc Computer Games Technology

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No part of this project has been submitted in support of an application for any other degree or qualification at this or any other institute of learning. Apart from those parts of the project containing citations to the work of others, this project is my own unaided work.

Signed [redacted]

Acknowledgements:

I would like to thank Kevin Tan for offering his constant support throughout the entirety of my project.

Abstract:

This is a computer games design and development project focusing on the 3D modelling and animation aspect of computer games design. The main goal of this project is to create the most realistic model of the male guppy fish possible, within the software that is chosen. By creating a model which both looks and moves in a realistic way, the other goal can be achieved. Attempting to get a response from a real female guppy fish. The software chosen is Autodesk Maya, then the model and animations will be exported to the Unreal Engine 4.

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Chapter 1 – Introduction

1.1 Background

This project is focusing on the realistic 3D modelling, animating and everything along the way of a male guppy fish. This is all to try to gain a response from a real female guppy fish. An example of this creation pipeline would be as follows: modelling, rigging, texturing, and finally animation.

An example of research into something very similar to this study would be Stephens et al (2003) paper on Modelling Fish Behaviour. In this he discusses research into the behaviour of the fish, in particular, locomotion. He says "Fish locomotion is classified on what parts of the body move, and whether the body or fins undulate or oscillate. Three undulatory forms of swimming found in common fish species are anguilliform, carangiform, and subcarangiform." From better understanding the method in which a specific species of fish moves, a more life-like animated model can be produced.

1.2 Approach

3D modelling and animation software will be used to create the subject of this project. The software II have chosen is Autodesk Maya 2017. I have chosen this as I am familiar with the software, along with the fact it is considered industry standard modelling software. I aim to make the best product I can from experience I have gained from the BSc Computer Games Technology course and online tutorials. This has so far produced a fully modelled and animated model.

1.3 Aims and Objectives

To produce a 3D modelled, rigged, textured and animated male Guppy fish.

Objectives**:**

- Researching the details of the fish species down to the last detail.
- To achieve the best model possible, I will be considering the differences between the popular 3D modelling software, namely Maya and 3DS max.
- To find the best animation methods for the subject, for example, a form of animation to best recreate the free-flowing tail of the guppy fish.
- I will also be researching the swimming techniques of the guppy fish, as this will be of utmost importance in attempting to gain a response from the real-life female guppy fish.
- To understand the ways in which the male guppy interacts with the female. This will benefit the animation stage, as it will increase the chances of the real-life female guppy responding to the modelled guppy.
- To find the best method of texturing the fish. E.g. physics based rendering vs diffuse.

1.4 Report Organization

This report will be organized into the followed format:

Chapter 2 Literature review - This will look at similar studies and development pipelines which are relevant to the study.

Chapter 3 Design – This chapter will focus on the design pipeline that I used when creating this product. These being: modelling, rigging, texturing and UV mapping, and animation.

Chapter 4 Implementation – This chapter will focus on implement the design ideas into the model, and then implementing the model into the game which was made alongside this project.

Chapter 5 Evaluation – This chapter will focus on the products feedback which will be gathered through an online survey.

Chapter 6 Conclusion – The report will conclude with a personal reflection of how the project went from start to finish, problems and solutions and what could have been done to possibly improve the product.

Chapter 2: Literature Review

Review of literature:

2.1 - Modelling:

What is 3D modelling?

In order to create the best possible model of guppy fish, the best software for the job must be used. There is a large variety of 3D modelling software to choose from. Because of this wide choice of software, some programs may outperform others in specific areas. For example, 3DS Max is considered to be an easier program to grasp and therefore could attract more new users because of this. However, Maya is known be to be superior power with regards to animation.

Maya.

Maya was first released in 1998 by a user with the alias Wavefront. This was then later acquired by Autodesk in 2006 and since then, engineers have been improving and adding to the software. In recent updates to the software, there has been a concentration on improving the way the modelling workflow works in Maya. This was done to help maximize productivity, streamline the user experience, increase efficiency and finally put creativity back at your fingertips. (Edulearn, 2013).

Maya is used by multiple creative professionals across many different industries such as Film and television. Maya was responsible to allowing the creation of the complex animations and effects in Transformers: Dark of the Moon. Maya has one factor in particular which could arguably make it much more appealing to a large array of users, this being that Maya is compatible with Windows, Linux and OSX platforms.

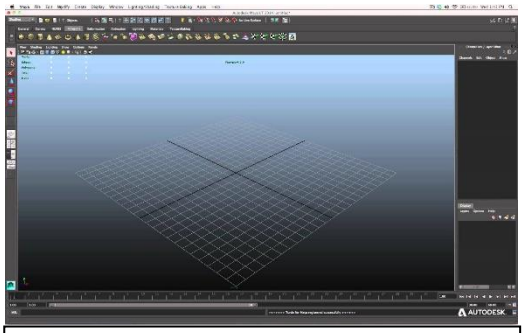


Fig 1. Maya workspace

3DS Max.

3DS Max is considered the most popular of the 3D modelling programs, largely due to its ease of access. 3DS Max has a very thorough modelling toolset with a huge library of modifiers which are all to help make the users life easier.

3DS Max is known for its dominance in the field of architectural visualization. Such as interiors and buildings. In these aspects, 3DS Max is considered the clear winner and as a result is the favourite of most designers and professionals working in these fields.

ZBrush:

ZBrush is a digital sculpture and painting program which is extremely proficient at creating very detailed models, right down to each individual detail. “Built within an elegant interface, ZBrush offers the world’s most advanced tools for today’s digital artists. With an arsenal of features that have been developed with usability in mind, ZBrush creates a user experience that feels incredibly natural while simultaneously inspiring the artist within.” (Pixologic, 2016). With the mention of usability, this shows that the developers of ZBrush have put in tremendous work effort to achieve a program which not only professionals can use, but also new users may pick up without being intimidated by the large array of tools and mechanics the software provides.

“Leave technical hurdles and learning curves behind, as you sculpt and paint with familiar brushes and tools”. (Pixologic, 2016). There are cons to ZBrush though, as there are to each program. This being that although ZBrush excels in detailed sculpting, it lacks in other aspects, such as animation. A large factor to also be considered, is the cost of ZBrush compared to other software.

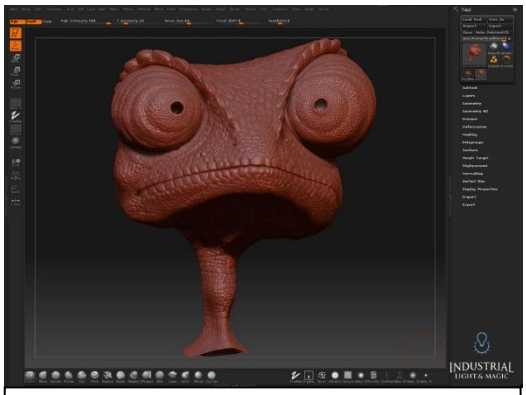


Fig 2. ZBrush sculpting

Mudbox:

Mudbox is a 3D sculpting and painting tool currently owned and developed by Autodesk. However, the original concept was developed by Skymatter, a company founded by former artists of Weta Digital. Mudbox is usually compared to ZBrush as both of these programs are much stronger in the mesh creation realm as oppose to a program such as Maya, which lends itself more towards an overall approach to the 3D modelling pipeline. Programs such as Mudbox and ZBrush will usually be used together along with Maya or 3DS Max as they can further sculpt the base models to a more detailed point. Mudbox allows the user to create a type of map known as a vector displacement map.

This lets the user create a high resolution mesh with high levels of details such as undercuts, which can then be saved as a map to later be used again on models. One aspect in which Mudbox clearly beats out ZBrush is with regards to texture painting. ZBrush uses polypainting, which colours the model based on its resolution. This means a highly detailed texture needs and equally high resolution sculpture. Mudbox on the other hand “offers a full-featured, layer-based texture painting workflow. Each map is assigned to a material channel and each channel can have multiple layers blended together. This is a more traditional workflow and is really easy to comprehend. It’s also not tied to the resolution of the model.” (Blog.Digitaltutors, 2014).

Blender:

Unlike the other programs, Blender has not found its way into a big name company like Autodesk, however it is still an extremely powerful program which has a very strong expertise in asset creation. “One of the best elements of Blender is its modelling tools. While all three applications have the

capabilities of creating the same asset, Blender is known to have a very intuitive and easy to understanding modelling workflow". (Blog.Digitaltutors, 2014).

As much as asset creation is Blenders stand out feature, it is not the only feature the software is capable of. Just like Maya and 3DS Max, Blender has the ability to rig, texture and animate. There is also an in-built game engine which can be used to quickly prototype these features. Blender has one reason in particular for its popularity amongst the smaller/indie developers; the program is free. Unlike Maya and 3DS Max who require subscription services, Blender has to sticker price, so for developers who aren't the most affluent, Blender is a smart choice of modelling software.

2.2 - Rigging:

Once a modeller has finished the modelling process, they have created a static mesh, this mesh is equivalent to something like a marble sculpture, it cannot move or be animated until this mesh has been rigged. Before these character models can be animated, the mesh must be setup with a series of joints and control points. "This process is typically completed by artists known as character technical directors (TDs), or riggers." (LifeWire, 2014). A character rig is essentially a digital skeleton applied to the 3D mesh. The rig is made up of joints, these joints act as handle which enable the ability for the mesh to then be animated.

Character rigs can vary in a range which allows for very simple animations and poses, to extremely complex animations which can take days of rigging in order to achieve. Placing the digital skeleton inside the mesh is considered the easiest part of the rigging process. Joints should be placed almost exactly as they would be in a real-life skeleton with exceptions in certain cases depending on what the model is.

Rigging- Main Methods:

The pipeline for rigging would be that for each limb, the root remains at the top, then a joint is placed for each joint as you move down the limb, and finally the terminating joint is placed at the final joint.

The riggings pipeline works through a hierarchy, with the root join being the first joint placed, all joints from this point take a spot lower down in the hierarchy. Forward kinematics is the process of setting up the model rig so that each joints movement only effects the movement of joints below it in the hierarchy. For example, when creating the swimming movement of a fish's tail, the animator would have to work through and manipulate the joints sequentially to achieve this. This would start from the moving the root joint, then moving joint which spans through the lower body and on towards the tip of the tail where the terminating joint would be placed.

Another method is inverse kinematics, which is the opposite of forward kinematics. Instead of working from the root joint to the terminating joint, the animator places the terminating joint where necessary and then the software would interpolate the above joints in the hierarchy automatically. The pros of using inverse kinematics is that joints can influence the movements of that joints parents. For example, inverse kinematics could be used in a humanoid models arm, which allow the animator to position the models hand and the rest of the arms joints would be calculated automatically. This method is very handy when animations require the model to keep, for example, the models hand in place but the rest of the arm to move.

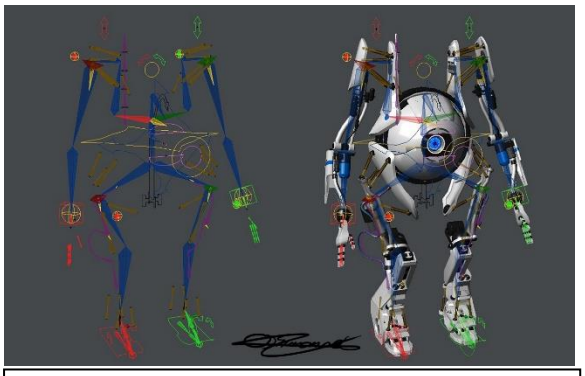


Fig 3. Rigging Example on humanoid model

2.3 - Texturing:

Texturing or texture mapping is the process of adding extreme detail, surface texture and colour information to a 3D model. This application to 3d graphics was pioneered by computer scientist Edward Catmull.

Texture mapping refers to the method that wrapped and mapped the pixels from a texture to a 3d surface, this is also known as diffuse mapping. It is this concept which has led to multiple other forms of texture mapping, for example, height mapping, normal mapping and many more. This variation of techniques is what makes near photorealistic models possible, while reducing the number of polygons needed to construct a realistic and functional scene.

One of the main features involved in texturing is UV mapping. UV mapping translates the coordinates of a 2D texture to a 3D model. Two of the main subsets of UV mapping is planar mapping, this is for flat object, and cyclical mapping which is for spherical objects.

The goal of UV mapping is to create seamless texture on models. When a model is created, the model is made up from multiple sections, so when a texture is applied to a model, these sections will cause the texture to split, or cut, in certain areas. This results in a model which could cause a break of immersion for the user, or could simply generate some annoyance in the user due to the lack of attention to detail.

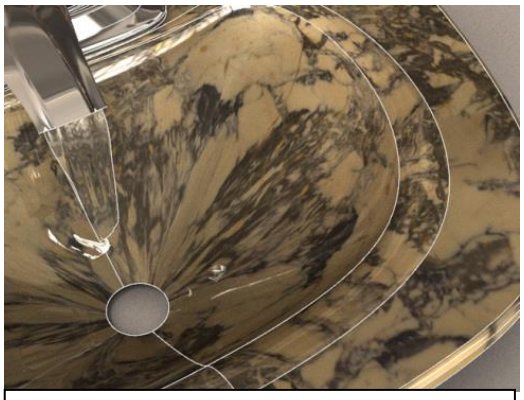


Fig 4. Texturing

By putting in the effort to make sure that each face of an objects lines up with the texture applied on the connecting faces, the model will end up looking much better and more professional because of this.

Diffuse maps have been an extremely popular and widely used method of texturing for a long time. A diffuse map defines both the colour and the pattern of the object it is texturing. Diffuse mapping has been described as "painting an image on the surface of the object." (cryengine.com 2014)

Using numerous different types of maps, a texture becomes something much more than just a painting on a canvas. Colour maps are only the first layer which simply gives a model colour. Bump maps do not actually add any extra geometry to a model, but they do create the illusion of raised and lowered areas on the model. Similar to the bump map, a displacement map raises and lowers parts of the model which does affect the geometry. Normal maps are the last of the pseudo-heightmaps and these control the direction which a models normals are facing which can change the way a model is affected by light. Specular maps enable the ability to choose which areas of the model are shinier than others.

Fig 5. Example of Diffuse texturing

Physics based render texturing is a much newer method of texturing objects. The main differences and reasons for the move towards this method is that physics based has a more detailed way of going about the behaviour on light and surfaces. Physics based allows for the combinations of two elements: micro surface detail and reflectivity. As a result, the final product produced is something much more lifelike than what could be made with diffuse map texturing. PBR uses a base colour, which will simply apply the colour to a material. A roughness value, which will control how reflective a material his. It is because of this reflective value that PBR is considered to be a much more photorealistic method of texturing. The other factor which contributes to the photorealism of PBR is the metallic element which can be added to materials. This can make objects look rusted, corroded or even like a shiny brand new metal.

Fig 6. PBR textures from UE4

2.4 - Animation:

"The 12 principle of animation are the most crucial techniques you must master as an animator. Created by the pioneers of animation, Frank Thomas and Ollie Johnston and first introduced in The Illusion of Life: Disney Animation, these 12 principles should be your ultimate guide to creating appealing and realistic character animations". (Blog.Digitaltutors. 2014)

Timing and spacing. This is what is responsible for giving object the illusion of moving within the laws of physics. Animation is done in key frame, so the timing here refers to the number of frames between two poses or moves of a character or object. Spacing mentions the position of the key frames. Depending on the spacing of the key frames, an animation could be very slow or very fast.

Squash and stretching is the principle which focuses on very in detail movements. This is something which applies to real-life. For example, when a ball dropped from a height hits the ground, it squashes as it makes contact with the floor and then will stretch back out as it starts to ascend. This concept can be used in facial animation of character to help express emotions.

Anticipation is used to set up the audience for what about to happen. When a character is about to make an action, there will be an action just before it which lets the user know what is coming up. The example here being that of a baseball pitcher. When throwing the ball, the pitcher will lean back before throwing the ball forward. Not only does this pre-action allow the user to know what's coming, but it also gives a believable feel of momentum.

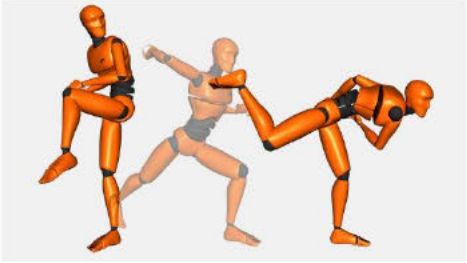


Fig 7. Animations Example: Anticipation

Easing in and out of movements is the next principle. This refers to the idea that when a person moves, they are not always a one constant speed. When a person walks up to a door in order to open it, they do not walk at a set speed and stop immediately as they approach the door. The person will decelerate in speed and as they pass through the door they will once again begin to accelerate. Without this effect, animations would seem robotic and unnatural.

Follow through and overlapping are similar in idea to easing in and out. The base of these principles is to make movements in the character's body seem natural and not robotic. Like how ease in and out mentions deceleration and acceleration, follow through talks about specific body parts will still move even when the animation has ended. Overlapping action is about each movement coming after one another, or overlapping one another. When waving, the shoulder will first move, then the upper arm, elbow and so on.

Arcing is the method of making sure that animations have some form of arc to them. In animation these rules should be adhered to. Humans do not tend to move in perfectly straight lines, their movement will typically have some degree of arc to them.

Exaggeration is done in order to add an extra sense of action to the animation. Depending on genre or the task set, animations may vary in how exaggerated they are, however it is there nonetheless. This is used because of the fun it can add to the animation and also the user. For example, in Naughty Dogs Uncharted series of game, when the character jumps, they wildly rotate their arms and run in the air. This add to the animation, giving it an increased sense of action.

Fig 8. Animation example: Exaggeration

Solid drawing is a concept more focused on in 2D animation, however still hold importance in 3D animation as well. Solid drawing refers to making sure that character poses are thought about long and hard. Making sure that weight and balance are correct otherwise it could lead to an odd-looking character pose.

Straight ahead and pose to pose are two different form of animation techniques. Straight ahead is thinking about each individual movement made by the model while creating an action or animation. When creating a sitting down animation, the character will be stood up, then they will begin to bend their knees and so on. This technique considers each detail when creating an animation. Pose to pose works in a different way. Capturing the poses that are the most important, in this case, the standing up pose and the sitting down pose will make up the animation. After getting these most important poses down, the details can then be worked on.

Secondary action refers to subtle animations which add more depth the main animation. For example, after an intense scene which involves running from the character, they could be breathing heavily with exaggerated chest movements.

Animation mainly focuses on the movements of a character. The types of character which are considered the easiest, or most natural to model would be bipedal models, such as humans. The reason for this is because knowing the feeling of the movements which one is animating makes the process much more straight forward. If an animator if attempting to animate the opening and closing of a human's hand, they need only look at their own hand in order to obtain all the information they need about that specific animation.

Bipeds are not the only characters though, there are also quadrupeds to take into consideration. Understanding the way something moves is the first hurdle for this task. For example, if someone if animating a dog walking, they need to have a thorough understand of the walk that dog walks. When a human walks, we move our upper leg forward, then swing our lower leg forward while altering the angle of our foot, then we alter the foot angle back to flat and take a step. When animating a dog however, there are 3 joints in the leg plus the foot. So it is of utmost importance to understand the way these creatures move in order to create lifelike animations.

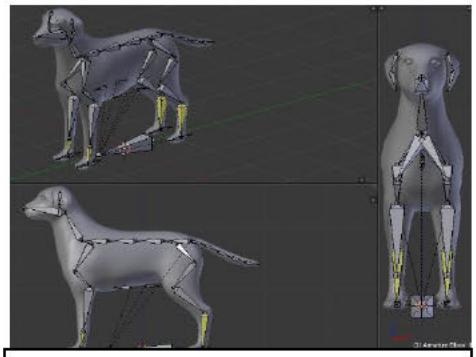


Fig 9. Animation Example: Quadruped

Another step up from animating an animal with 4 legs would be to animate something with even more legs. For example, a Spider. Spiders are an 8 legged insect, or more accurately, arachnid. When animating an animal such as this, once again it is extremely important to understand the way in which the creature moves. As much as 8 legs may seem more intimidating to animate, Spiders have a set pattern to the way in which they move which would make the animating process much simpler. The front two legs work like a human, moving at a slightly different angle as the skeletons are different, but as the left leg moves forward, the right moves backward. The set of legs behind the front counteract the movement of the front set. So as the front left leg moves forward, the left leg on the second row moves backwards. The third set of legs then mimics the first set and the fourth and final set mimic the movement of the second set. This means that during the animation process, an animator could select all the rigged joints in the first and third set of legs and animate these at the same time.

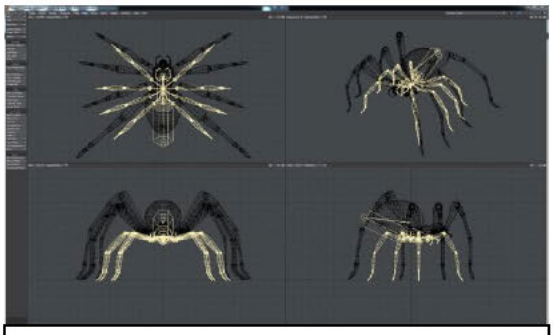


Fig 10. Animation Example: Arachnid

2.5 - Guppy behaviour:

Concerning the behaviour of the male guppy fish, the focus will be the behaviours and characteristics involved in the intimate interactions between the male and female guppies. "In guppies (Poecilia reticulate), male colour pattern is both diverse and heritable, and is arguably one of the most extreme examples of morphological polymorphism known." (Nature. 2013) Polymorphism refers to the patterns, which belong to many existing organisms. The patterns, which belong to guppies, mainly males, can vary heavily and this is due to factors such as heritage. A study undergone by Kimberly A. Hughes et al produced results, which showed that male guppy fish with rare colour patterns had higher reproductive fitness, acquired more mates and subsequently more offspring. This further backed the concept of NFDS, Negative frequency –dependant selection. NFDS is a form of selection, which suggests that the chosen mates are favoured by the rarity of their polymorphism.

Fig 11. Real Guppy colour pattern

2.6 - Fish tail animation:

A fish's tail (caudal fin ray) if made up of many tiny bones. These small bones, however, act in a very different way from the rest of the bones which make up the fish's skeleton. The tail of a guppy fish is much more free flowing, almost as if there are no bones in it at all.

One of the methods which could be used to animate this could be animating it like everything else; using key frame. By adding in key frames and then moving the joints which would be placed in the tail, an animation could be created. The problem with this method however, is that the animation wouldn't be very dynamic and it may also result in an animation which looks robotic as oppose to something free-flowing.

An alternative way to animate the tail, which would result in a much more life-like tail would be to use nCloth animation. nCloth is a type of animation which is used on clothing or similar things which have similar physics properties. nCloth allows for the user to change certain properties such as gravity. By applying this nCloth to solely the tail of the fish, as the animated spine of the fish moves, the tail animation should follow, resulting in a much more free-flowing swimming animation.

Fig 12. nCloth example

Chapter 3 – Design

3.1 - Introduction

Creating the best and most realistic model possible will require a detailed look at the counter piece of the product; the real male guppy fish. Each stage of the design pipeline demands a close examination of the male guppy fish, to create a model which can be deemed, realistic. For example, which regards to texturing the fish, a design cycle could have been used, whereby applying some bright colour to a fish scale texture could have been used. However, as mention in Nature,2013, "In guppies (Poecilia reticulate), male colour pattern is both diverse and heritable, and is arguably one of the most extreme examples of morphological polymorphism known." This meant that small and intricate patterns had to be taken into consideration when creating this product, as these factors can all help lead towards a better chance as achieving the goal of this project.

This model is also going to be used in a simple game which will be developed alongside this. The game will be an endless runner in which the player must collect the items and avoid the rocks. It will be set underwater and the player will be in control of the guppy fish model through the game.

Each step through the design pipeline will be explained thoroughly and with visual aid.

3.2 - Equipment Used

Throughout the course of developing this project, I will be using the below software in order to aid me.

- Autodesk Maya
    - This was chosen due to familiarity, brought about through self-teaching and online tutorials. Along with this, we were currently using this particular program in another course which we would be undergoing throughout this year.
- Unreal Engine 4
    - This game engine was chosen above the alternative, Unity, due to numerous reasons. Higher confidence within the Unreal 4 engine, and a familiarity and understanding of the Blueprint system which the engine incorporates. Along with this, Unreal Engine 4 has a much higher level of detail than Unity. Therefore, helping bring my model to life and helping it look more realistic.
- Photoshop
    - Photoshop was chosen, once again, due to familiarity with the software. The use of this program would not be too important however, as its main and only use was to create the skin for the model. This was done using the layer system in photoshop. By layering the textures of the guppy fish on top of the UV maps which had been exported, a realistic looking textured model could be created.

3.3 Guppy Fish Anatomy

In order to create a replica Guppy fish within 3D space, it is best to understand the anatomy and makeup of the real-life Guppy fish.

The most obvious and most prominent of the fish's features would be the long sail-like tail. This is almost double the height of the fish and makes up for a large portion of its body.

Guppy fish have tremendous sight which allows them to see colours even through slightly murky or cloudy water. This means it is important to display the large eyes of the Guppy fish in the 3D model.

Although not as obvious as the two main features above, the guppy fish's body I coated in a layer of mucus. This protects them against bacteria, but also provides them with reduced water friction, allowing them to cut through the water as they swim. Creating a texture which as a slight glossiness to it will add the creating a good replica of this fish.

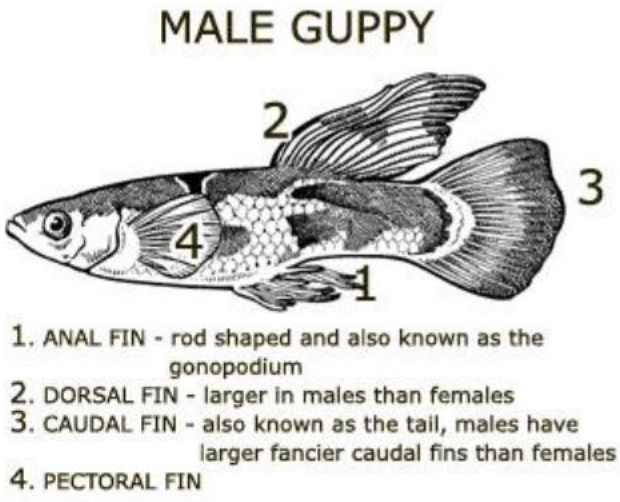
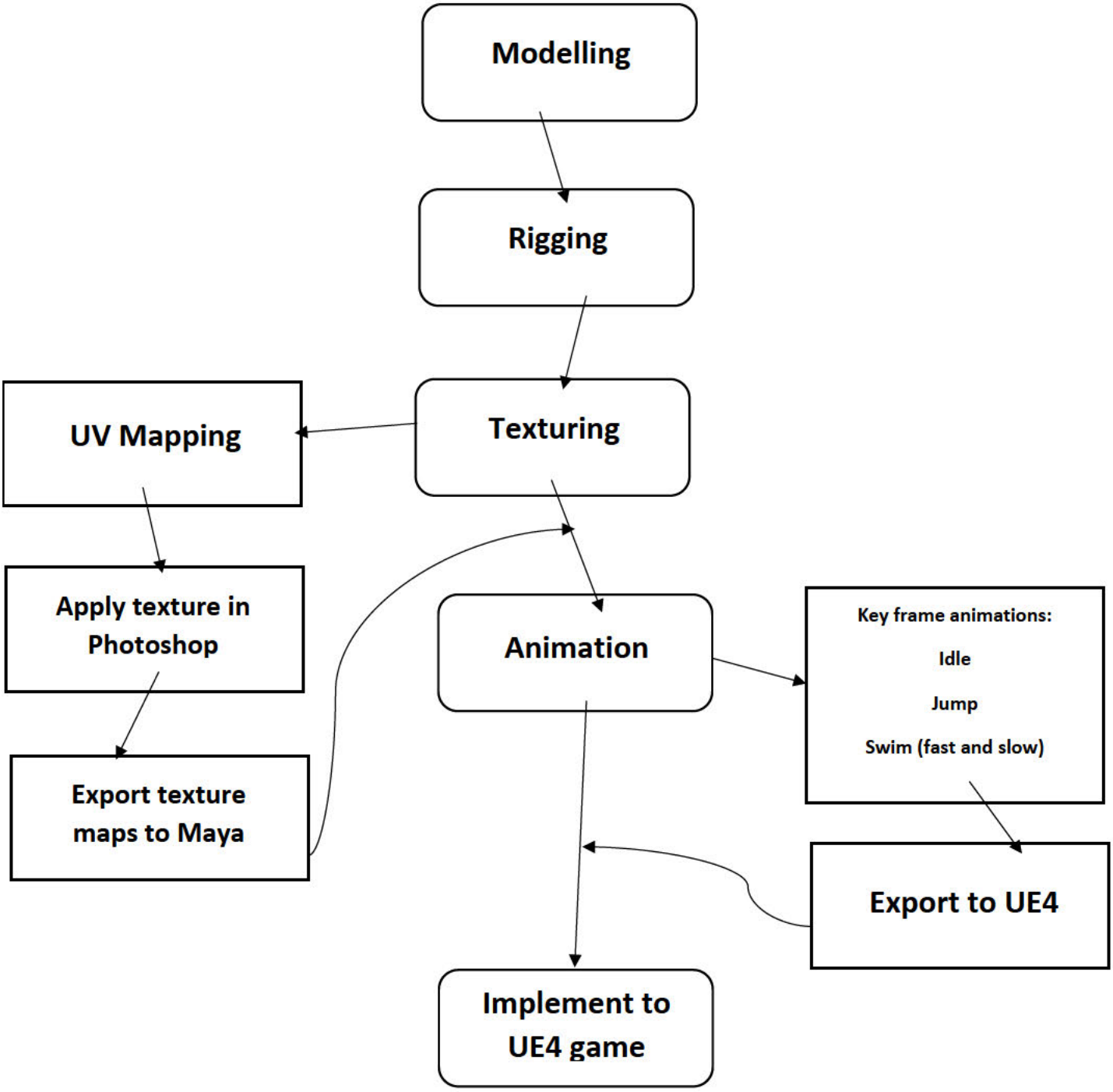


Fig 13. Anatomy of the Male Guppy Fish

3.4 – Design Pipeline

The below is a flowchart diagram which shows the process that was undergone during this project. The diagram will display all the main points in the design pipeline, along with the individual detail of each point and the game implementation which will take place after the design.



3.5 – Modelling the Guppy

Autodesk Maya was the chosen modelling software for this project for numerous reasons. These being mainly familiarity with the software and the fact that the software is considered industry standard with an understandable creation pipeline. Meaning, once the model is created, it has a natural flow into rigging, texturing and so on.

When creating the model, many references were taken into account as this would help achieve as product which most closely resembled a real life male guppy. From examined numerous videos and images on the anatomy of the male guppy fish, there are some certain features which should be noted as very important. These features being:

- Upturned mouth
- Smallish head
- Small body, but a large tail
- Longer more extravagant dorsal fin.

This list of features is extremely important to consider when creating a guppy. This is because, not only are these features of the male guppy, they are also what distinguish the male guppy from the female. Other notable features of the guppy such as, the slender body of the guppy. Although the main body of the fish is slightly oval, the body of the fish begins to streamline as it gets closer to the tail end. The pectoral fins are extremely fragile looking, much like the long flowing tail of the male guppy.

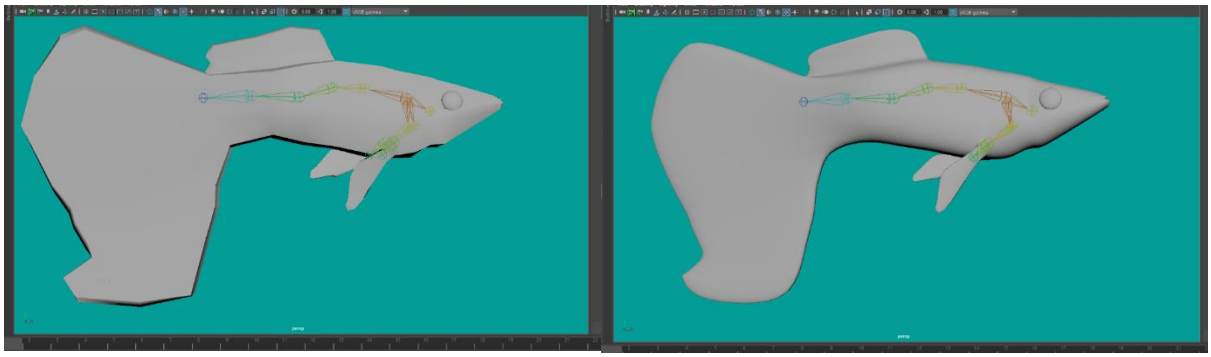


Fig 14. Guppy model: Work in Progress

The tail of the fish is considered the most important part of the fish. This is the feature which, along with the colouration and colour patterns of the fish, will be the biggest tell that it is indeed a male guppy. Once again, after looking at numerous references, the tail was modelled. It is important to note that the tail of the male guppy is much taller than the fish itself. The top of the tail does not go too much higher than the body of the fish, the bottom however, goes much lower than the bottom of the fish's belly. Continuing along with the fish becoming more streamlined towards the tail end, the tail itself is extremely thin and very free flowing. It is almost as if there are no bones in the guppies tail at all. The tails of male guppy fish can vary quite a bit in regards to shape and size, this is due to selective breeding, a process which is done in order to create animals with more desirable traits, in order to increase demand. As mentioned by Kelly Roper (small-pets.lovetoknow, 2014) "Selective breeding has led to the development of a number of distinct tail types."

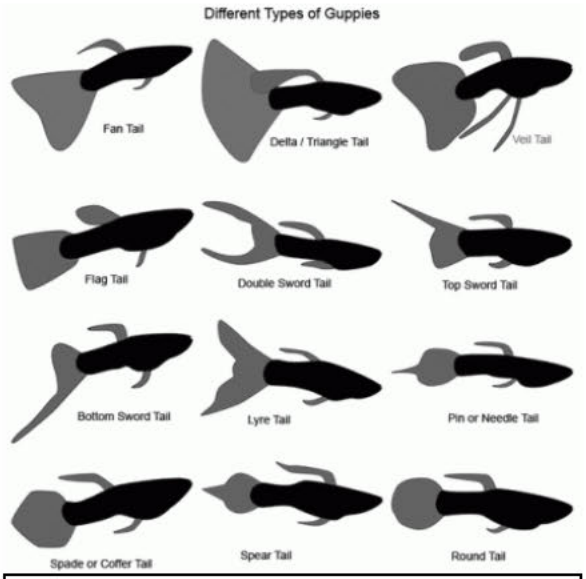


Fig 15. Known tail shapes of the male Guppy fish

The tail type which was decided for this product would be more traditional, triable/delta tail. This was chosen, since the tail is much larger and more obvious than some of the other types, along with the fact that colour and patterns will be portrayed much more strongly and obviously than many of the other smaller tail types.

3.6 – Rigging the Guppy

Rigging is a process where the 'digital skeleton' of the model is created. This rig is what then gives the model the ability to be animated in the later stages of the design pipeline. Rigging can be a potentially complicated and very in-depth process depending on the model in question. However, a fish is a simpler type of model with regards to rigging. The spine of the fish is the only real bone within the fish's body. Once the spine is in place, the foundation for animation is all in place.

While simple, it should be noted that the spine should contain numerous segments to best replicate the way that the fish's body moves when swimming. On top of this, rigging the tail may also be necessary. Rigging this will require numerous joints to create a movement akin to the real thing. When the guppy swims, the tail will not necessarily move in the same way that the rest of the bones will, so examining guppy movement is key in understanding where is best when placing joint within the models body.

3.7 -Texturing the Guppy

Texturing is a tremendously large point in this project, as the one of the major features of the male guppy fish is the colour of the scales and the patterns which are displayed on the fish. As Jean-Guy J. Godin mentions, "females prefer to mate with brightly coloured males in numerous species" (Female mating preferences for bold males in the guppy, Poecilia reticulate, 1996). With this in mind, a bright

colour alone is not enough when trying to best replicate the bright displays which the real guppy fish can produce. Patterns portrayed on the scales is also a factor when texturing.

When decided on what to choose for the model, I arrived at the conclusion that it would be best to completely replicate the colours and patterns on a real guppy fish. This was done using a texturing technique known as UV mapping.

UV Mapping is the process of taking the faces of the 3D model and flattening them into a 2D form. Once this is done, these UV's can be taken in photoshop or any other art program to colour over them and then finally add back to the model. For this project, the UV's were exported to Photoshop. Once there, the image of a real-life guppy fish was cropped down numerous times until finally each section of the UV's were filled with the corresponding part of the guppy image. For example, the dorsal fin UV would be filled with the cropped image of the guppy dorsal fin and the UV's of the eyes would be filled with the cropped image of the guppy's eyes, and so on.

By texturing like this, you can create a UV map which is perfectly designed for the specific model which is being worked on. There are multiple other ways of texturing in Maya, however these alternatives proved inferior in my experience. Using simple image projection can be difficult to work with, as some UV's may be slightly stretched, meaning that when the image is projected onto the model, it may also stretch. UV mapping is a superior form of texturing because it is considered a material within the attributes of the model, this means that a bump or normal map can then be added to the model. This can add even more detail to the model and produce something even more realistic.

Bump maps and normal maps produce a layer on the model which adds detail. Bump mapping produces a detail which is visible when you look at the model from the front, however, once the perspective is changed towards the side view of the model, the detailed which seemed real, aren't there. For example, on a model of a brick wall, a bump map could be added to make it look like there were details in between the bricks and the cement. A normal map however, will add these details which can be seen from all angles of the model.

3.8 – Animating the Guppy

Animation requires a closer look at how exactly the subject in question moves. Different creatures move in a multitude of different ways. For example, quadrupeds will typically move two limbs at a time, one limb from the back in sequence with another limb from the front, where a biped, such as a human, will simply walk one leg at a time. Fish, however, have no legs, and therefore animating them require a close look at how the body moves when swimming. Some larger fish, such as sharks will generally make slow and exaggerated movements, led by the head and followed by the rest of the body, finally reaching the tail. Small fish, such as the Guppy, aren't too different from this. However, it is much harder to notice these movements. Due to the size of the Guppy, their bodies move at a much faster rate than that of a bigger fish. Regardless of this speed, the animals still move in a similar way. Lead by the head, followed by the body and ending at the tail. The main difference in the movement being the long and free-flowing tail of the Guppy fish.

After watching how these fish move when they swim, it is hard to believe that there are bones in the tail of the Guppy. Almost like a piece of cloth under the water, their tails are very flowy in their movement. It is in expressing this tail movement where the key to creating the most realistic looking Guppy fish will come into play.

Considering that this model would be used in a small game, there were some very key animation which needed to nailed down, in order to create a more realistic reflection of the Guppy fish.

- An idle animation
    - Guppy fish tend to dart around in their enclosures, but in between these rapid movements, they float idly. Almost like a speed reduced version of when the fish is darting around. With this in mind, this animation shows a slow-moving fish, with the animation starting by a slight movement of the head, followed by a continued movement down the rest of the body, ending with an ever so slightly more dramatic movement in the tail.
- Swimming animation
    - Considering the game is an endless runner, this require the player to be moving at a constant speed. So, instead of the fish only moving at either very high speed or very low speed, this animation is an in between in which the player will be moving at most of the time. Therefore, the animation for this is a more exaggerated version of the idle animation. The movements throughout the body are much larger and tail animation is much more exaggerated.
- Darting animation
    - This is the key animation with regards to the Guppy fish. Considering the way, they move in their enclosures, it was important to include this animation within the game. This animation will be much more exaggerated than the previous animations, it will also be much faster. Although it is hard to catch flowing movement of a real Guppy fish tail, when watching the player's perspective, the dramatic and large movements of the tail are much more obvious.

3.9 Summary

This chapter shows the design route in which this project took. From examining the real-life subject, to creating a model and animations which best replicate these features. With this model approaching the end of the design stage, it was ready to be implemented into the game which had been created alongside it.

Chapter 4 – Implementation

With the model now created and the animation needed for the game now ready, the next step was to implement these into the endless runner game which was made alongside the Guppy Fish during its design process.

4.1 Game Engine

When deciding on which game engine to implement the model into, a few key reasons were what made the decision clear. Unreal Engine 4 was the chosen engine and the reasons for this choice are as follows:

- Familiarity with the engine.
    - Having worked with the engine for multiple years, doing multiple different projects, both inside and outside of the Computer Games Technology course, mean that there is a higher level of confidence when working with UE4. The Blueprint system with which the engine uses is also something I have familiarity with and a confidence in working with.
- Level of Detail in UE4
    - Based on personal experience, Unreal Engine 4 is more capable of creating a much more aesthetically pleasing project, than the alternative, in this case, Unity.
    - Since the project is to make a replica model of the Guppy Fish, it seemed the wiser choice to work in UE4.
- Ease of export
    - Autodesk Maya is incredibly compatible with Unreal Engine 4, so much so that there is an export option within Maya called “Send to Unreal”. Not only does this make exporting models and animations much easier, but it meant that should something go wrong once the export had completed, I had the ability to go and make whatever changes were necessary and then re-export very simply.
    - Even in cases where the Send to Unreal option isn’t used, importing an exported FBX file into UE4 is as simple as a drop and drop. Once imported inside the engine, a dialog box is displayed, and once the options the user desires are checked, the FBX will be imported into the Unreal project.

4.2 Blueprint

Unreal Engine 4 uses the Blueprint logic system as its primary form of programming within the engine. Although, there is the option to create a project using C++ language, Blueprint is the default option when creating a new project within Unreal. Blueprint was chosen for this project as mentioned before because of familiarity. In addition, there are a tremendous number of people using Blueprint in online tutorials, or for their own games and projects. This meant that should any problems arise during the course of the project, there was a large library of possible solutions in the form of online tutorials.

4.3 User Interface Implementation

As the game would only be a simple Endless Runner style games, a user interface was made. This would display the score and the controls to the player as they play through the game.

4.4 Adding the Textures

Texturing was a interesting step along the implementation line when developing the Guppy fish. In order to create a replica of the real-life counter part, it would be best to use UV mapping. By using UV mapping, it would be possible to replicate the bright and unique colours and patterns which male Guppy fish are so famous for. Using an art tool to create a completely original texture would be extremely hard, in terms of creating something which looks as unique as the scales of the Guppy.

When creating a model, a basic shape is the starting foundation and from there the vertices and faces are bent and moulded into the desired shape. This results in a tremendous mess when it comes to the texturing stage of the design pipeline. For example, in this project, the starting form of the Guppy was a simple cube polygon, this means that the UV's of a cube were moved around and distorted as they became the model whichi they now are. To overcome this, we use a technique called 'Planar mapping'. This technique allows us to completely reset a models UV's based on camera position. So by placing thr camera to look at the side of the Guppy would produce a fresh new UV, which would ovverwrite the previous UV's which couvered this same area.

Once the process of planar mapping had been completed amoungst te rest of the models surface, came the stage of cutting and sewing the UV's together. Cutting is the process of taking a specific UV, for example, the pectoral fins of the fish and cutting them around the edges. This would produce a perfect cut and result in two UV's; both sides of the pectoral fin. By doing this process of cutting, when the stage of adding textures came, it would allow for an even closer representation of the real thing, as the textures could be duplicated and rotated to be placed on both sides of the pectoral fin. This would also help in preventing the stretching of textures.

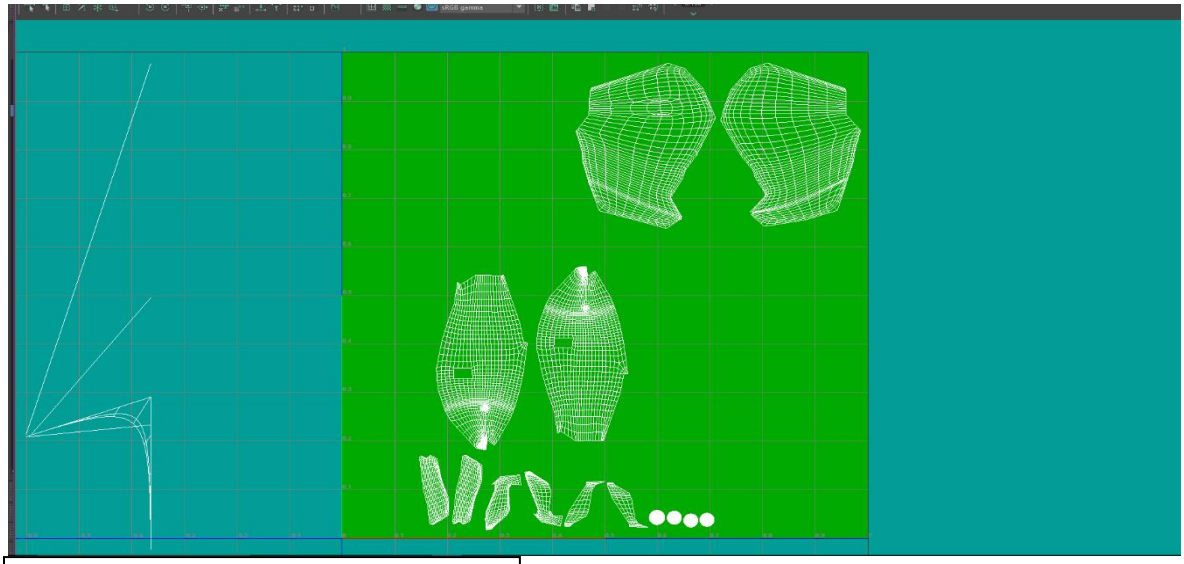


Fig 16. Untextured UV set

Once the UV's are all laid out within the 1 by 1 square, they are exported to Photoshop. Here the textures of the Guppy fish are applied to the UV's of the model. Using cropping within Photoshop, it is possible to layer the desired parts of the Guppy fish texture on top of the corresponding UV's. After this process is done with each part of the fish texture, the project within Photoshop is flattened down into one image, then exported back to Maya.

Once this newly textured UV map is back in maya, is can be applied as a material to the model. By using this method, a completely custom and personalised texture has been made to perfectly fit the model it was designed for.

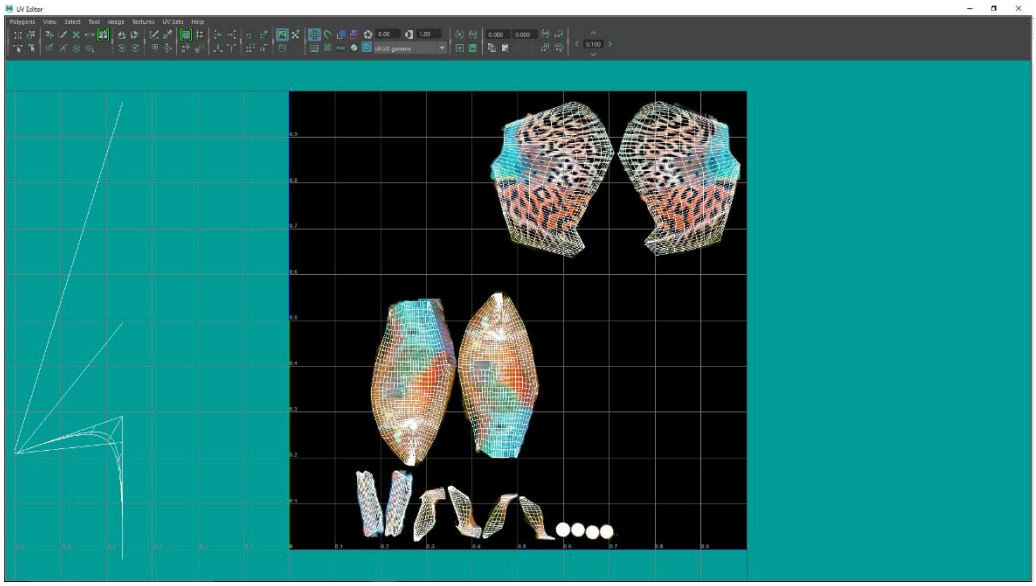


Fig 17. Textured UV set

4.5 Creating the Animations

When creating the game which the model would be the playable character for, there were certain animations that needed to be made, as these animations would go along with the games controls. These animations were and idle/slow moving animation, a constant speed animation which would be the speed the player would be moving at for the most amount of time, and lastly, a darting animation which would be played when the player activated the speed boost ability.

When creating the idle/slow moving animation, I wanted to best replicate the movement of a Guppy fish when they are drifting through the water slowly. At the same time, it was felt that the animation had to actually look at thought something was happening, otherwise this may be off putting to the player. This lead to the animation which was created. By key framing each indivdual joint along the spine of the Guppy, an animation which starts very subtly ends in a clear movement of the Guppy's tail. This animation ticked both boxes of imitating the slow glide which the Guppy fish performs, while also being an obvious tell to the player that mopvement is occuring at this slow speed.

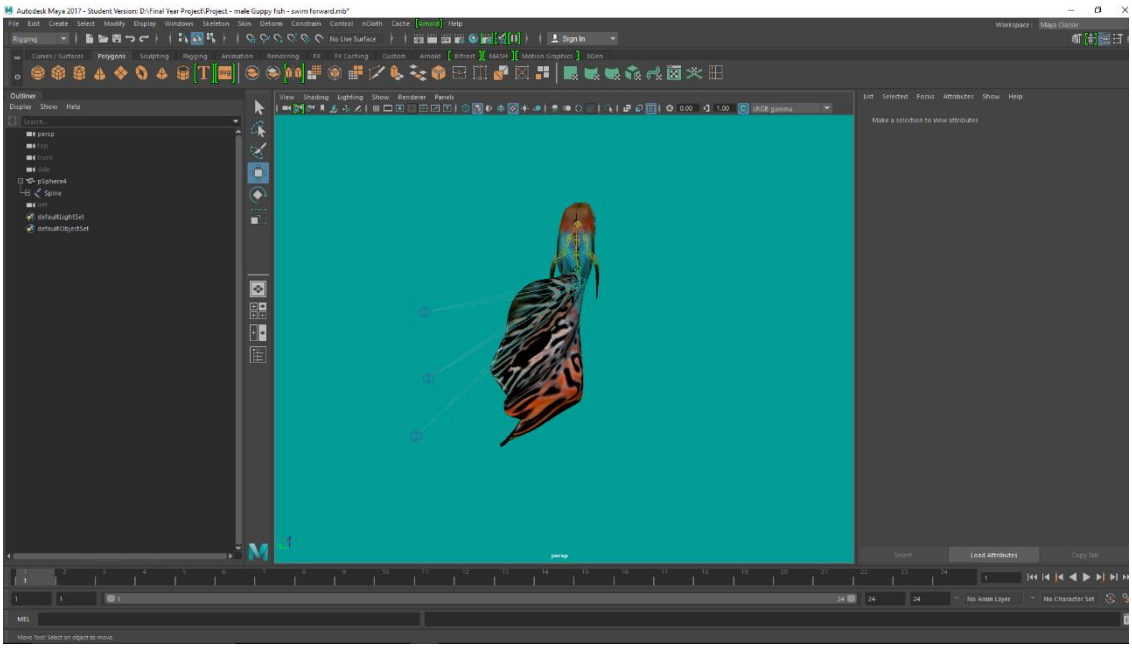


Fig 18. Model animation

The next animation would be the constant swim speed animation. As this game was going to be an Endless Runner game, it's extrememly important for the player to be constantly moving and continuing through the level. Therefore, it was equally as important to create an animation to go along with this. This animation was created by finding a medium between the slow moving and fast moving animations. Using key frame once more, the movements of the joints along the body were slightly more drastic than the joint movements of the slow animation, while remaining less drastic then the joint movements of the fast darting animation.

The last animation to create for the game would be the darting/fast speed animation. This animation would be the most dramatic and exaggerated looking one. The movements would be fast and very noticable from start to the finish. To be replicate this movement, this animation will only last around 1 second long, as when the real life Guppy fish performs this movement, they are in very short, but consecutive bursts.

4.6 Exporting Model and Animations

Once the design stage was completed, the Guppy Fish model and the animations were ready for exporting into the Unreal engine 4. In order to do this, there are a number of things which needs to be check first.

When exporting a model, Unreal Engine 4 will consider it as a static mesh even if the model in question is fully rigged. In order to make sure that Unreal Engine could import the model as a skeletal mesh, the rig hierarchy much be selected along with the main mesh of the fish, then the skin must be bound to the mesh using the 'Bind Skin' feature within the rigging menu of Maya. This will combine the mesh and the rig, making the rig the true skeleton of the model. With this stage, complete Unreal Engine will allow the model to be imported as a skeletal mesh to be used as a character.

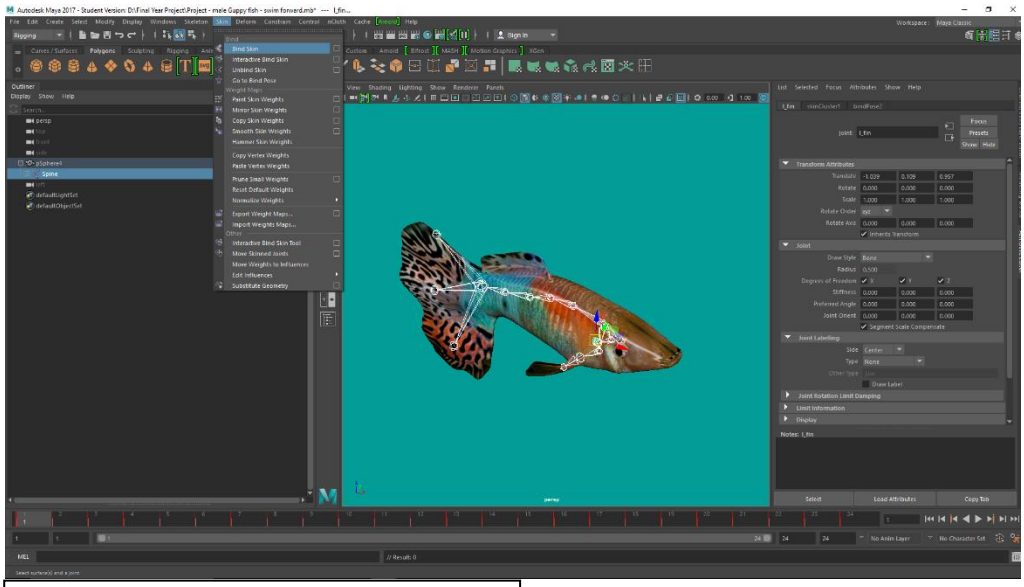


Fig 19. Rig and skin binding

Once the skin and rig are bound together, the animation must be baked. This process spreads the animation out over every frame of the animation. For example, when creating a 24-frame animation of the Guppy tail moving from left to right, at frame 1, the tails position could be towards the left, then at frame 12, the tail is towards the right position, and then at frame 24, the tail returns to the same position that it was at frame 1. Baking this animation will make the movement of the tail smoother by spreading this animation to be a gradual movement over the entire 24 frames.

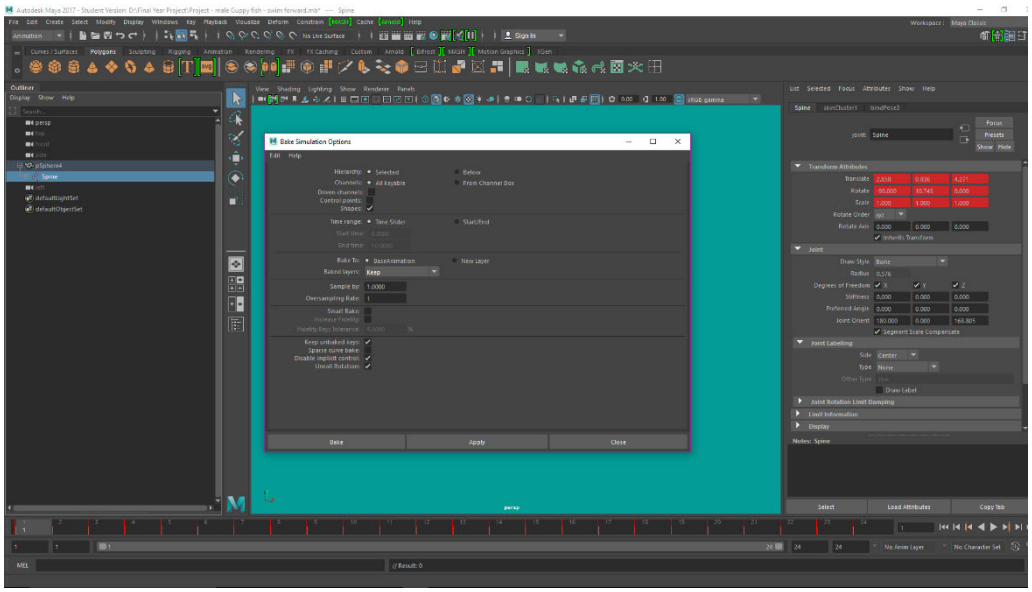


Fig 20. Animation baking

Once the animation is baked, it is now ready to be exported to the Unreal Engine 4 and set up to be the playable character. When exporting, however, there are some key things which must be checked when inside the export window. The ‘Animation’ box must be checked, otherwise Unreal Engine 4 will not recognize the exported model as a skeletal mesh, but as a static mesh.

Once inside of Unreal Engine, the import dialog box will appear. As long as the 'Import as skeletal' and 'Import as Mesh' checkboxes appear, the textured model, skeleton and animation should have successfully been imported into the engine.

4.7 Level Design

The game that has been designed alongside the model itself, is an Endless runner game where the main playable character will be the Guppy Fish. Considering this, the level would need to be accommodating to this character, therefore the level is based in the ocean, with spawning platforms which the Guppy Fish will swim across. These platforms are made up of a floor which has been textured to look like wet sand, and two walls either side of the floor to stop the player from deviating from the path. These walls have been given a simple seaweed texture, to keep in line with the ocean based theme.

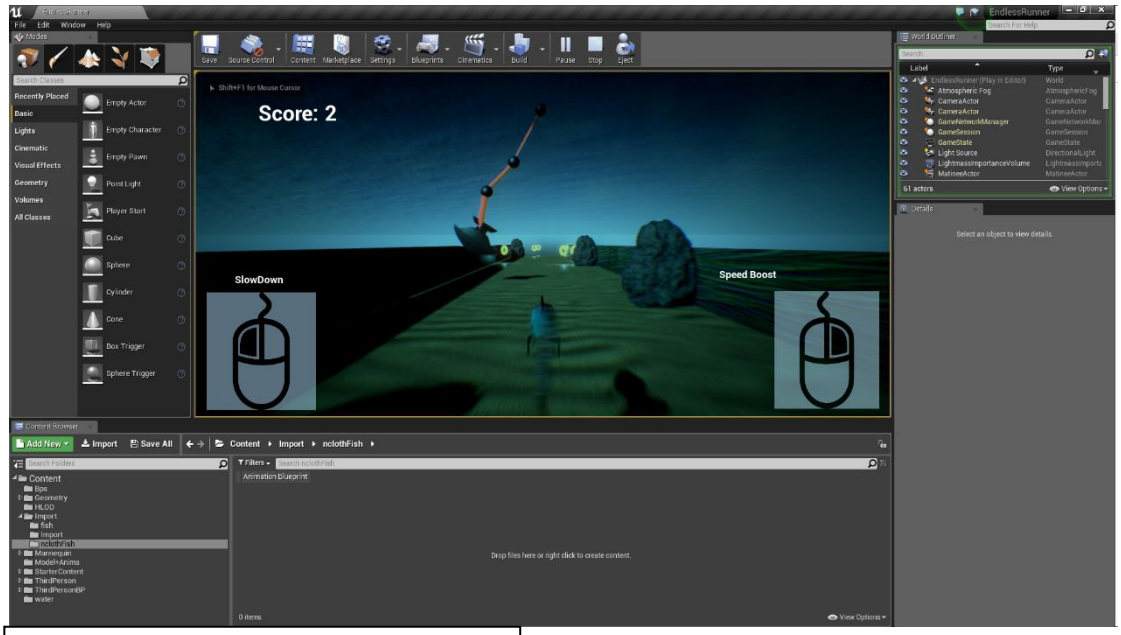


Fig 21. Gameplay of Endless Runner

As the player continues along the platforms, they will begin to change. Some platform will become 90-degree corner turns, both left and right. Some platform will force to player to jump, otherwise they will fall and be forced to start over from the beginning of the game.

There are some objects which have been placed on these platforms as well. The player will have to juggle between collecting the golden ring which spawn along the sea floor, as well as dodge the two types of enemies that have been implemented into the game.

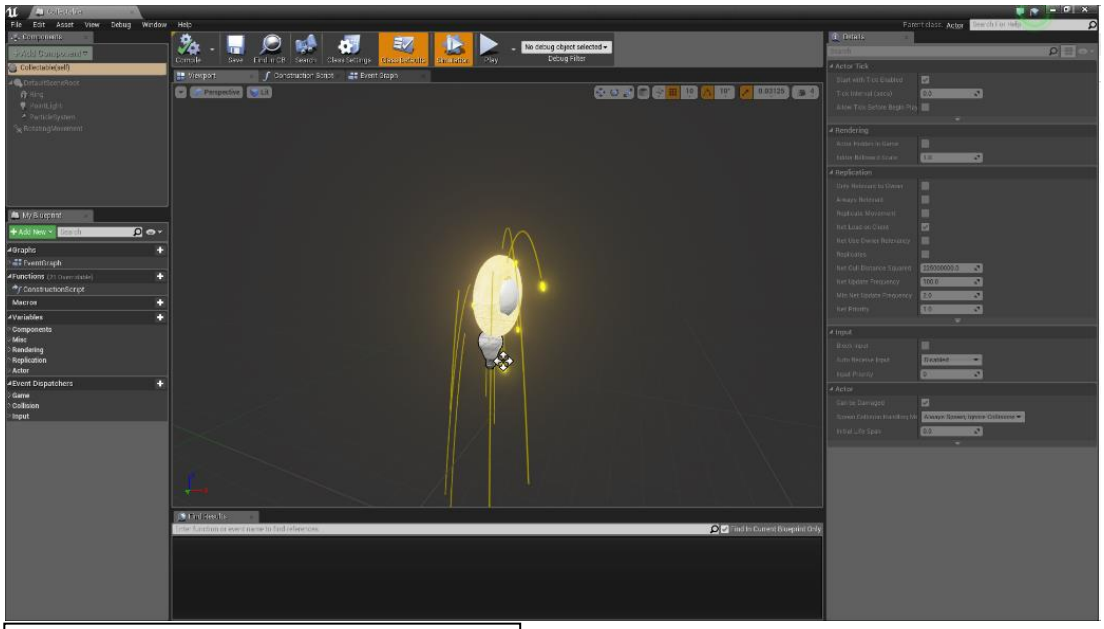


Fig 22. Collectable item

These two enemy types are the ‘Blocker’ enemy and the ‘Anchor’ enemy. The Blocker enemy is a large rock which will spawn randomly on each platform, except from the corner and jump platforms. The player must simply avoid the enemies.

The Anchor enemy is a swinging physics constraint object which will spawn randomly as the platforms are generated. The player must once again avoid this enemy. However, this enemy is harder to avoid as the movement of the anchor can be different each time the enemy spawns in. These enemies have been designed like this to keep in line with the theme of the game.

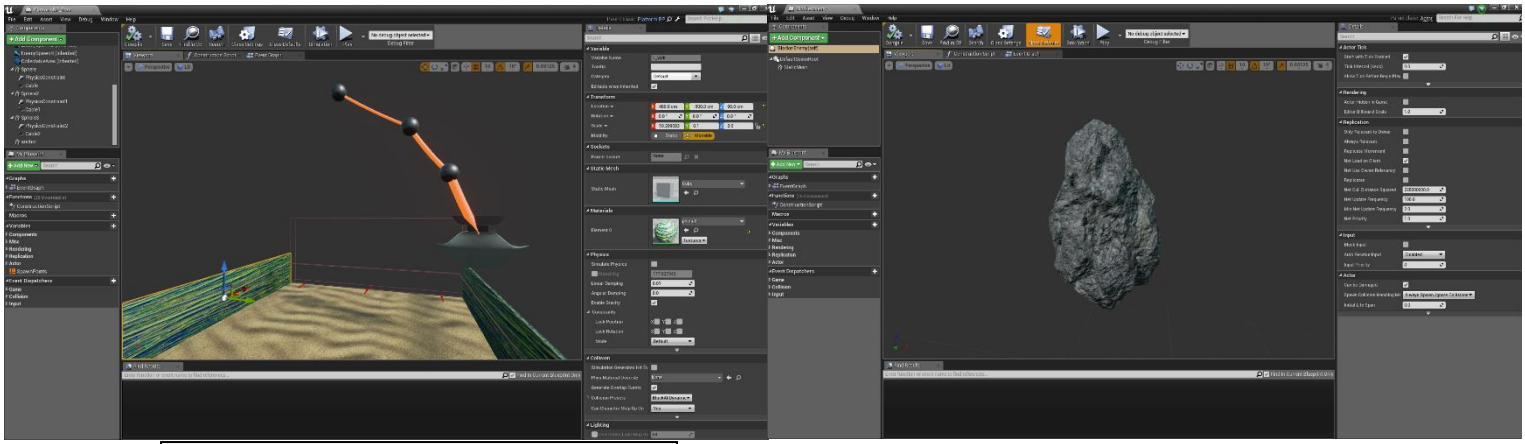


Fig 23. Enemy objects

Lastly, the player would have two powerups to use at their disposal. These powers would be to slowdown the Guppy's swim speed and to increase it's swim speed. These Power would be used by pressing the left and right mouse buttons. The purpose of these powers is to display regular behaviour exhibited by the Guppy fish. Guppy Fish tend to move rather erratically, switching between floating idly and darting at fast speeds. Using these powerups in the game is an interesting way of displaying these natural behaviours of the subject. These also have a practical use within the game. The player can use these abilities to slow down and collect more rings, or use the darting speed boost to evade the anchor enemy if they feel they may get hit.

4.8 Summary

With the modelling complete, rig bound, textures added, and animations created and baked, the whole package was them exported into the Unreal Engine 4 and applied to the game. With product now finished, it progressed into the evaluation stage.

Chapter 5 – Evaluation

5.1 Questionnaire Design

Taking into consideration the main objective of this project is to create the most realistic model, it was of utmost importance to put together a questionnaire which focused on this area of the project. These questions focused on mainly the visuals of the product which had been created. These questioned were as follows:

Are you familiar with Guppy Fish?

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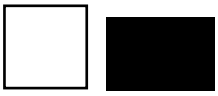
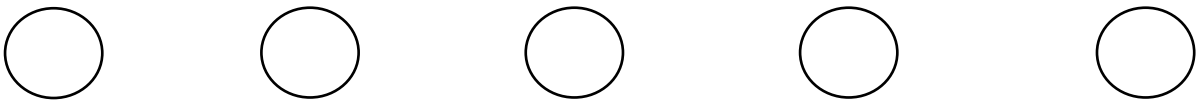
Can you tell the difference between a male and female Guppy Fish?



(Question from this point onward should be answered after viewing the model and animations) On a scale from 1 to 5, how would you rate the texture of the model?



Not Realistic Very Realistic

Male Guppy Fish have certain features, such as an upturned mouth and large fan-like tail. Would you say these features are represented on the model?

Could you offer any suggestions to help improve the project?

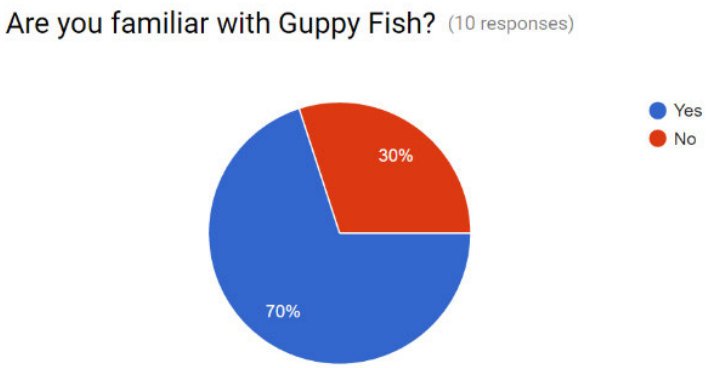
Long Text Answer…

These questions are set in this way to establish a base understanding of the respondent's knowledge of the Guppy Fish. After these first two questions, the respondent would be presented with an image of the rendered model and then linked to a video of the animations being played in the game engine. After viewing these pieces of media, the next questions would gauge their feelings towards the created model and animations, and how they felt that these compared to the real-life counter part of the project.

5.2 Questionnaire Results

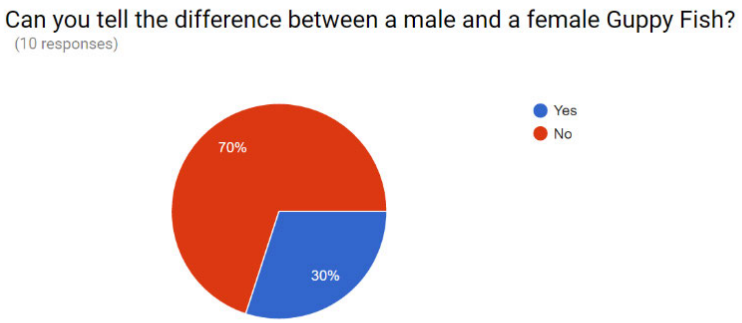
The responses to the questions in the questionnaire provided quantitative data, which allowed for easy visual representation in the form of graphs. 10 people participated in the questionnaire, and from these 10 are people of varied background in relation to both games and games design/development. These carried from people who are familiar with computer games and take part in the Computer Games Technology course, to those who do not play computer games. Having responses from people with varied backgrounds like this helps provide a wider range of responses and makes any patterns that may appear in the answers to the questionnaire seem more fair. For example, someone with a gaming background may notice small discrepancies with a model, whereas someone with no knowledge in the background may not notice these small details.

Question 1:



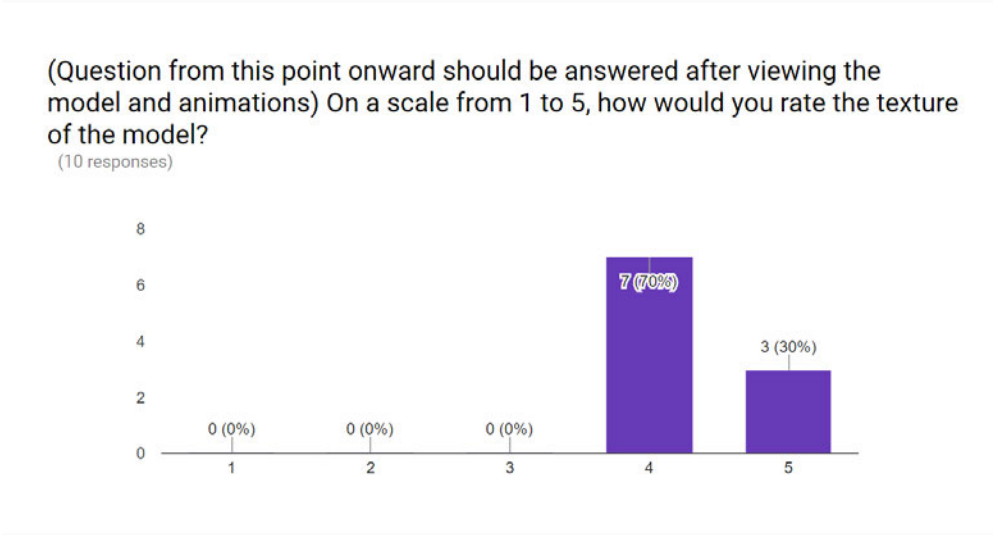
This question was to gain some insight on what the respondent knew about the subject matter. The majority knew of the species of fresh water fish, however a few did not know of them.

Question 2:



Once more, this question was to gain more insight on the respondent's understanding of the subject matter. However, this time, it was to gather whether they could tell the species apart by the two genders. Most people did not know that the appearance of the male Guppy differed so greatly to the appearance of the female.

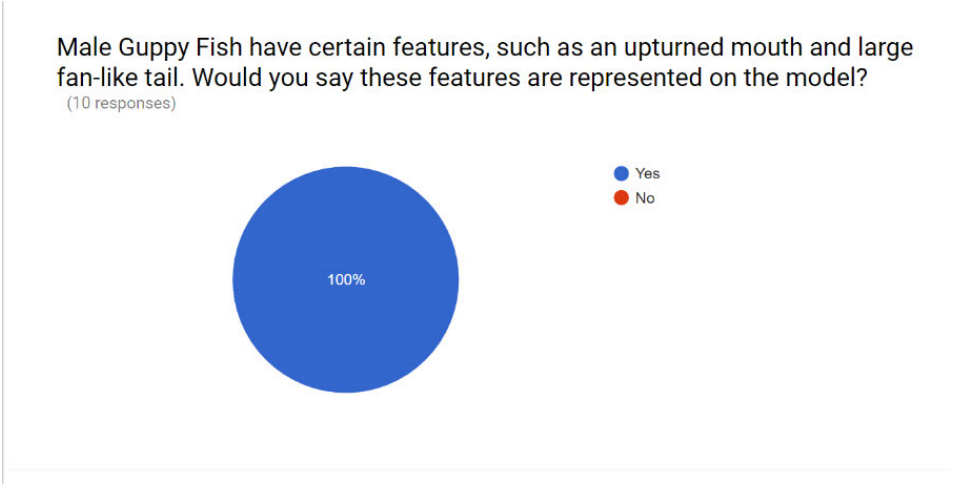
Question 3:



Once a base line of understanding had been established, the next set of questions would first have the respondent view an image of the rendered model and a short video displaying the animations of the Guppy which had been implemented into the game, which was made alongside this project.

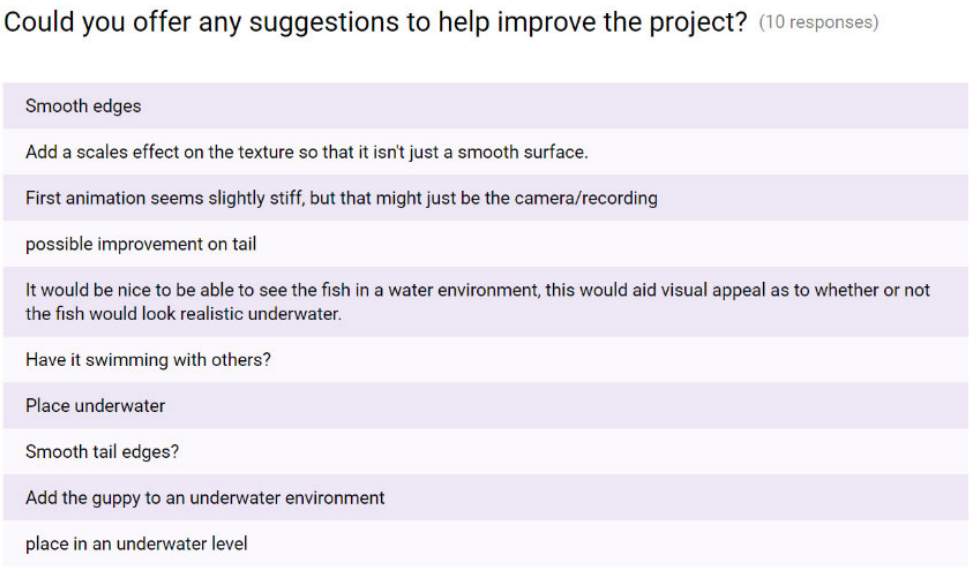
Once these were viewed, the respondents could give their opinion on the appearance of the Guppy model. Every response was a positive response, with most rating the realism of the model at a 4, and the remainder rating the model at a 5. This was the goal of the project; to create a realistic representation of the Guppy Fish.

Question 4:



This next question gained a completely one-sided answer, and a positive answer at that. This question informed the respondent of the details which are present in the anatomy of the male guppy fish, which aren't present in the female and then asked if they felt these features were well represented on the 3D model.

Question 5:



The last question would ask for a longer answer from the respondent. Asking what advice, they would offer to help improve this model. Some answered with suggestions such as "smooth edges" and "slightly stiff first animation". These responses were immediately acted upon and the detail of the model was increased and the animation was made once more, this time more fluid.

However, the most common response was the place in the model into an underwater environment. This has also been acted upon, and the endless runner game which was made alongside the project is now entirely based underwater. The level features a moving water surface, underwater camera features, such as a slight blur on object further in the distance and the blue tint on the camera. The platform texture were also changed to match this underwater theme.

5.3 Summary of Results

Overall, the feedback on all aspects of the model were very positive, with all 10 of the respondents having agreed that the Guppy looks like a realistic representation of the real-life Guppy. These results also shed a light on the area's which required some further improvements, such as the tails smoothness on the edges and the game scene being underwater. These criticisms lead to an even better product.

5.4 Problems and Solutions

Throughout the course of this project, almost all the bumps along the way have been ironed out by myself simply going through each process multiple times, too make sure no mistakes had been made, or by a simple search online to understand similar problems other may have come across. However, nCloth proved to be a rather troublesome issue along the course of this models creation.

The original design plan was to use the Maya plugin, nCloth, as the material for the tai of the Guppy. nCloth applies a property to a model which transforms said model from a stiff, rigid mode, into a cloth-type model. When going through this process, the nCloth was applied and then the nCloth properties were painted on using 'Paint vertex properites'. This allows for only select areas of a model to have this nCloth applied to them. However, once this had been completed, the animations would begin to lag. This was presumed as just a process which required a large amount of processing power and therefore not a big issue once the model and animation had been exported into UE4. This is when the larger issue arose. When importing the nCloth model into UE4, the engine would not recognize the model as anything other than a static mesh. This was tested numerous times, to make sure this wasn't a one-off error.

A non nCloth version of the model would be imported, and would be successfully recognized by the engine as skeletal. This exact same model would then have nCloth applied, but no other setting or properties changed, yet this time the engine would not recognize the imported model as skeletal.

To combat this issue, joints were applied to the tail of the fish in 3 different areas. By doing this, animations could be keyframed to the tail. To try and best replicate what the nCloth would have been able to do, the animations of the tail were very exaggerated, to best help the appearance of the flowy tail.

5.5 Personal Reflections

The following sections contain my personal reflections on how the project went on, from start to finish.

5.6 Research Evaluation

With regards to research, the main focus was examining the subject of the project; the Guppy fish. This involved observing numerous pictures and videos of the fish, but also research their anatomy and the difference between genders in the species. This said, the use of other works and web articles have provided a great amount of information in learning about the significance of the Guppy's colours and patterns.

5.7 Design and implementation Evaluation

The design and implementation of my project went almost exactly how I had planned from the beginning stages of the project, minus the issues mentioned about nCloth. Using a variety of reference and examining the subject matter, I feel I could very capably create a realistic male Guppy Fish. Having learnt Maya techniques, such as using an image plane to act as a guideline for creating the model, I felt very confident in creating the base model of the fish. In addition to this, from watching numerous online tutorials on 3D modelling, I could regularly change the model into wireframe mode. When creating a complex model, some problems may not necessarily appear on the surface, but within the wireframe of the model itself. So, learning this technique from others in the field meant that I could consistent check for any overlapping edges within my model. This meant that when it came to the smoothing stage, there would be no unexpected mishaps with the model.

Rigging was a simple process, and apart from having to backtrack a small amount when adding the additional joints for the tail, I feel the rig was a perfect fit for this type of model.

Texturing was a personal high point in this project. Having learnt the new technique of planar mapping and then taking this custom UV set into Photoshop to create the realistic Guppy fish texture is something I was particularly proud of. For this stage, once the material had then been applied to the model and the Guppy looked just like the pictures I had been referencing gave me a tremendous boost in my confidence in the project going forward.

Lastly, creating and implementing the animations into the game which had been made alongside the project. For myself personally, animation was the stage which required a lot of trial and error. When creating an animation, there would always be a thought that something could possibly be done slightly better along the track of the animation. As someone mentioned in my questionnaire response, they felt that the first animation, the slow-moving animation, looked a bit stiff. It was a challenging point in the process of the project. However, I feel as though definitely overcame this point and created some well received animations.

5.8 Time Management Evaluation

Partly thanks to the supervisor of my project, creating weekly/bi-weekly checkpoints for me to meet, I feel I could keep a steady pace throughout the course projects beginning to its end. It is because of this that I never truly felt overwhelmed by what I still had left to do along the pipeline, as I had plenty of time to simply focus on what I was working on at that point in time.

Along with this, earlier in the course, a timetable was created which contained the deadlines for specific parts of the project. So, keeping up with this timetable helped lead to better time management and subsequently, a better product.

5.9 Summary

The original goal of this project was the create a realistic 3D model version of the Guppy fish and then place that model into the Unreal Engine 4. This has been slightly added to, as I have made a game alongside this project, which this model now features as the main playable character in. As stated in my personal reflections, I believe I have achieved the goals set out in this project. Overall, I would say I am proud of what I have created.

Chapter 6 – Conclusion

6.1 Concluding thoughts

This project set out to create a realistic 3D model and animations of the male Guppy Fish. It was of utmost importance to make sure that this product looked realistic and moved in a way alike to the real counter part of the model. In addition, it was important to then apply this creation to a self-made game in the Unreal Engine 4. Using numerous references of the male Guppy fish, in the form of images, video's and a questionnaire which would result in bettering the product. From this questionnaire, 100% of the respondents agreed that the model looked realistic, providing confidence in the goal of the project having been achieved.

Appendix

Terms of Reference

Title: Model and animation of a male Guppy Fish.

Course-Specific Language:

BSc (Hons) Computer Games Technology (CG)

• To study the history of computer games, game genres, game structures and game design principles and to use the skills acquired to specify and evaluate new game applications;

• To become knowledgeable in the use and development of computer graphics software/game middleware tools and to be able to apply this knowledge to the implementation of real-time interactive systems;

• To learn structured approaches to computer programming;

• To learn how the theories and techniques of behavioural systems can be used to enhance the playability and sophistication of computer games;

• To study a range of mathematical tools and techniques and to be able to use these, in particular, to solve problems in the area of game modelling and animation; and

• To gain an appreciation of the multidisciplinary environment in which commercial games are designed and produced and to acquire skills in project management and team working.

Overview:

For this project, I will be creating a 3d model of a male guppy fish. To further this, the modelled fish will be rigged and animated in order to replicate the movements of the real-life counterpart.

To achieve this, research into the various methods of modelling, animation, rigging and texturing will need to be undergone and from this research, I will be able to decide on which software to use, to achieve the best result possible. Research into the behaviour of the subject at hand, namely the male guppy fish, will has need to be done. This is to achieve the best and most realistic animations regarding the way the animal swims, but also the way the animal interacts with the female of its species.

Project Background:

To model, rig and animate the most realistic male guppy fish possible. This is in order to attempt to gauge a response, or to trick, a female real-life guppy fish. To do this, realistic animations which mimic the real fish will be key.

An example of research into something very similar to this study would be Stephens et al (2003) paper on Modelling Fish Behaviour. In this he discusses research into the behaviour of the fish, in particular, locomotion. He says “Fish locomotion is classified on what parts of the body move, and whether the body or fins undulate or oscillate. Three undulatory forms of swimming found in common fish species are anguilliform, carangiform, and subcarangiform.” From better understanding the method in which a specific species of fish moves, a more life-like animated model can be produced.

Aim:

To produce a 3D modelled, rigged, textured and animated male Guppy fish.

Objectives:

- Researching the details of the fish species down to the last detail.
- To achieve the best model possible, I will be considering the differences between the popular 3D modelling software, namely Maya and 3DS max.
- To find the best animation methods for the subject, for example, a form of animation to best recreate the free-flowing tail of the guppy fish.
- I will also be researching the swimming techniques of the guppy fish, as this will be of utmost importance in attempting to gain a response from the real-life female guppy fish.
- To understand the ways in which the male guppy interacts with the female. This will benefit the animation stage, as it will increase the chances of the real-life female guppy responding to the modelled guppy.
- To find the best method of texturing the fish. E.g. physics based rendering vs diffuse.

Deliverables:

The deliverable will be a 3D modelled and animated male guppy fish that will be then be tested against a real-life female guppy fish in hopes of gauging a response.

Resources:

The resources I will require for my project will largely be in the form of software. After research into the multiple 3D modelling software programs, I will make my decision on which I feel is best for the project. The most likely choices for this will be either Maya or 3DS Max. The other resources will mainly be items for research. These being books, journals, articles and websites.

Time Table:

- 28/09/2016 – Terms of Reference initial draft
- 05/10/2016 - Finalise Terms of Reference
- 12/10/2016 - Begin first chapter of Literature review
- 21/11/2016 – Finalised literature review. Modelling process begin.
- 12/12/2016 – Finalised Model. Model rigging.
- 24/12/2016 – Finalised rigging. Model texturing.
- 31/12/2016 – Finalised texturing. Model animation.
- 30/01/2017 – Evaluation design
- 20/02/2017 – Report outline
- 06/03/2017 – Draft presentation
- 24/04/2017 – Report and Product

Learning Outcomes:

By the end of this project, I hope to have learnt the following:

- The advanced techniques of 3D modelling.
- The advanced techniques of 3D animation
- The advanced techniques of texturing
- The advanced techniques of rigging a 3D model

Problems:

Problems may arise at multiple stages throughout the project as a whole. 3D modelling isn't something we have gone into depth with, with regards to the course, so learning on the go may produce some road bumps, however I believe these should not be insurmountable.

This applies to rigging, texturing and animation also. Having not gone into depth with these techniques means that extra research will be absolutely necessary. Animation in particular as this will arguably the most key element in making the best and most life-like model. Animation in key frame will require patience and could also involve some trials and error.

Thankfully Lynda.com along with Autodesk's website tutorials will be able to provide with me any information required. All of these potential problems should be obstacle to overcome with the resources that are available to me.

Ethics Form

ETHICS CHECKLIST

This checklist must be completed **before** commencement of **any** research project. This includes projects undertaken by **staff and by students as part of a UG, PGT or PGR programme**. Please attach a Risk Assessment.

Manchester Metropolitan University

Please also refer to the University's Academic Ethics Procedures; Standard Operating Procedures and the University's Guidelines on Good Research Practice

Full name and title of applicant:	[redacted]
University Telephone Number:	
University Email address:	
Status: All staff and students involved in research are strongly encouraged to complete the Research Integrity Training which is available via the Staff and Research Student Moodle areas	Undergraduate Student ☑ Postgraduate Student: Taught ☐ Postgraduate Student: Research ☐ Staff ☐
Department/School/Other Unit:	Faculty of Science and Engineering
Programme of study (if applicable):	Computer Games Technology
Name of DoS/Supervisor/Line manager:	Kevin Tan
Project Title:	A Realistic Model + Animation Of A Male Guppies Fish for UE4/Unity5
Start & End date (cannot be retrospective):	26/09/2016 - 24/04/2017
Number of participants (if applicable):	1
Funding Source:	na

Brief description of research project activities (300 words max):

To model and animate a realistic looking male guppy fish in order to gain a response from a

	YES	NO
Does the project involve NHS patients or resources? If 'yes' please note that your project may need NHS National Research Ethics Service (NRES) approval. Be aware that research carried out in a NHS trust also requires governance approval. Click here to find out if your research requires NRES approval Click here to visit the National Research Ethics Service website To find out more about Governance Approval in the NHS click here	☐	☑
Does the project require NRES approval?	☐	☑
If yes, has approval been granted by NRES? Attach copy of letter of approval. Approval cannot be granted without a copy of the letter.	☐	☑

NB Question 2 should only be answered if you have answered YES to Question 1. All other questions are mandatory.	YES	NO
1. Are you are gathering data from people?	☐	☑
For information on why you need informed consent from your participants please click here		
2. If you are gathering data from people, have you:	☐	☐
a. attached a participant information sheet explaining your approach to their involvement in your research and maintaining confidentiality of their data?	☐	☐
b. attached a consent form? (not required for questionnaires)	☐	☐
Click here to see an example of a participant information sheet and consent form		
3. Are you gathering data from secondary sources such as websites, archive material, and research datasets?	☐	☑
Click here to find out what ethical issues may exist with secondary data		
4. Have you read the guidance on data protection issues?	☑	☐
a. Have you considered and addressed data protection issues – relating to storing and disposing of data?	☑	☐
b. Is this in an auditable form? (can you trace use of the data from collection to disposal)	☐	☑
5. Have you read the guidance on appropriate research and consent procedures for participants who may be perceived to be vulnerable?	☑	☐
a. Does your study involve participants who are particularly vulnerable or unable to give informed consent (e.g. children, people with learning disabilities, your own students)?	☐	☑
6. Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited (e.g. students at school, members of self-help group, nursing home residents)?	☐	☑
Click for an example of a PIS and information about gatekeepers		
7. Will the study involve the use of participants' images or sensitive data (e.g. participants personal details stored electronically, image capture techniques)?	☐	☑
Click here for guidance on images and sensitive data		
8. Will the study involve discussion of sensitive topics (e.g. sexual activity, drug use)?	☐	☑
Click here for an advisory distress protocol		
9. Could the study induce psychological stress or anxiety in participants or those associated with the research, however unlikely you think that risk is?	☐	☑
Click here to read about how to deal with stress and anxiety caused by research procedures		
10. Will blood or tissue samples be obtained from participants?	☐	☑
Click here to read how the Human Tissue Act might affect your work		
11. Is your research governed by the Ionising Radiation (Medical Exposure) Regulations (IRMER) 2000?	☐	☑
Click here to learn more about IRMER		
12. Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	☐	☑
Click here to read about how participants need to be warned of potential risks in this kind of research		
13. Is pain or more than mild discomfort likely to result from the study? Please attach the pain assessment tool you will be using.	☐	☑

Click here to read how participants need to be warned of pain or mild discomfort resulting from the study and what do about it		
14. Will the study involve prolonged or repetitive testing or does it include a physical intervention?	☐	☑
Click here to discover what constitutes a physical intervention and here to read how any prolonged or repetitive testing needs to managed for participant wellbeing and safety		
15. Will participants to take part in the study without their knowledge and informed consent? If yes, please include a justification.	☐	☑
Click here to read about situations where research may be carried out without informed consent		
16. Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	☐	☑
Click here to read guidance on payment for participants		
17. Is there an existing relationship between the researcher(s) and the participant(s) that needs to be considered? For instance, a lecturer researching his/her students, or a manager interviewing her/his staff?	☐	☑
Click here to read guidance on how existing power relationships need to be dealt with in research procedures		
18. Have you undertaken Risk Assessments for each of the procedures that you are undertaking?	☐	☑
19. Is any of the research activity taking place outside of the UK?	☐	☑
20. Does your research fit into any of the following security sensitive categories: • commissioned by the military • commissioned under an EU security call • involve the acquisition of security clearances • concerns terrorist or extreme groups If Yes, please complete a Security Sensitive Information Form	☐	☑

I understand that if granted, this approval will apply to the current project protocol and timeframe stated. If there are any changes I will be required to review the ethical consideration(s) and this will include completion of a 'Request for Amendment' form.

☑ have attached a Risk Assessment
☑ have attached an Insurance Checklist

If the applicant has answered **YES** to **ANY** of the questions 5a – 17 then they must complete the MMU Applicat

Signature of Appli[redacted]e: 27/10/2016 (DD/MM/YY)

***Independent Approval** for the above project is (please check the appropriate box):*

Granted

☑ I confirm that there are no ethical issues requiring further consideration and the project can commence.

Not Granted

☐ I confirm that there are ethical issues requiring further consideration and will refer the project protocol to the Faculty Research Group Officer.

Signature: Kevin Tan Date: (DD/MM/YY)

Print Name: Position:

Approver: Independent Scrutiniser for UG and PG Taught/ PGRs RD1 Scrutiniser/ Faculty Head of Ethics for staff.

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