**Animation Production – Assignment 1 – November 2018**

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*Pre-production and planning*

Much of the inspiration for this animation sequence came (unsurprisingly) from work by Pixar studios, whose commercial and critical success speaks volumes about their approach to animation. A particular film I feel is of relevance here is Wall-E, a film centred around the various exploits of the eponymous character. When considering emotive subjects to base a film around, a robot does not spring to mind, yet Pixar have managed to craft an incredibly expressive character, seemingly through careful consideration of the more emotive aspects of human facial movements. Since this assignment asks for only the use of primitives, a robotic character felt like a logical decision, and so formed the focus of my character designs.

Pixar are also renowned for their short films, and consideration of their approach to these is of great use. Though often only between 5 to 10 minutes long, these films very effectively convey the personalities of the main characters in that short space of time, whilst remaining visually stimulating throughout by very carefully considering cinematography and pacing. The general feel of these animations is something worth trying to replicate considering the animation length constraints I’m working to, and I feel that there is much more to animation than just creating realistic movement and pretty effects.

Figure 1 (see appendix) displays the various characters considered. Initially, basic skeletal structures were sketched out to allow for comparison, and many factors were accounted for at this point. The general proportions of the character would play a large role in the later assignment, and greatly affect how the character is *expected* to move by the viewer; tall, thin characters have a very different movement dynamic than short, fat characters, with speed of motion and apparent weight forming key aspects of movement style. Also explored were asymmetric skeletons, since their uneven distribution of mass could make for some particularly interesting movement and dance dynamics.

Many of the character designs were cut at this early stage (hence the variance in detail in figure 1, since I felt that their proportions were largely rather dull, and a particular design had already jumped out at me as an interesting character (Bottom left of figure 1). The dumpy main body, paired with the long legs and stubby arms, added a great deal of personality to the design even before animating, whilst adding a degree of comic value to the later assignment. A small amount of asymmetry was added to the arm lengths, since I felt this would add something to the dynamics of the character, whilst not forcing me to constantly consider the weight distribution, as would be the case for an asymmetric body. I also noted that it would be great if (where possible) I could make many of the body parts somewhat recognisable as real-world objects, and hence the idea for a ‘sputnik’ satellite as a main body, and a radio for a head. The radio could also be made to link in to the later dancing, perhaps switching on to play music.

In hindsight the proportions remind me somewhat of another Pixar character, Mike Wazowski, of Monsters Inc fame, and I shall certainly observe how Pixar have approached the movement of that character for the later assignment.

The approach to scene building once again took account of the assignment brief; only primitives are to be used, so any scene created would do well to capitalise on this. Initially I had considered creating a sort of virtual world, of similar ilk to that of the film series ‘Tron’, since the primitive shapes would look at home in such an environment. This idea was dismissed, as I felt that it would be very difficult to inject any character into the scene itself without further lighting and particle effects. I felt that a desert or snow field scene would lend itself well to this assignment, since the sparsity of such scenes would make my life much easier when building the scene, whilst also making any scenery items I do place far more prevalent as story elements.

The character and set design came together quite well at this point, since the main body of the robot (a satellite) could drop from the sky into the desert/snow scene as if having fallen out of orbit. I rather liked the idea of the satellite simply falling from orbit and bouncing to a stop – in no way realistic, but rather comical, again drawing inspiration from the slightly whimsical Pixar shorts.

For the parts constituting the rest of the robot, I figured that pieces of scrap metal could be used, built from basic primitives, all originating from a pile of junk some distance away from the fallen satellite body. A few basic scenery items would provide some rationale for their existence, perhaps representing an old building or research station out in the desert. The movement of so many parts from one place also gives the opportunity to display the differing tumbling motions expected of the varying geometries of the parts.

The storyboarding process also provides an opportunity to consider the camera placement and movement within the scene. I tried to provide a variation in the style of shot in an attempt to keep the viewer engaged (specifically static, panning and tracking shots were used frequently), and try to replicate film and animation cinematographic techniques. In particular, a lot of thought was put into the placement of the action within the frame, often drawing on the ‘rule of thirds’ so frequently used in photography to create aesthetically pleasing shots. I also considered changing the aspect ratio, as I felt a wider frame would suit the sprawling, barren desert scene well. A few shots from the storyboard were changed throughout the animation process; the final shot was cut and replaced with a wide static to tracking shot, whilst the first scene was replaced with a tilted ground-level wide angle shot, to provide a good angle for the initial satellite re-entry.

*Challenges and Highlights*

With regards to the building of the character and set, simplicity was paramount, to allow maximum time to be spent of animation, reduce clutter, reduce the load on the processor (This turned out to be of utmost value, since Maya 2018 proved to be rather unstable). Everything in the scene was built from a combination of spheres, cylinders, cubes and tori, the only changes being made to the dimensions and subdivision counts to provide further variation in geometries (and removing a few vertices from s sphere for the satellite dish). I feel this approach worked rather well, with the simple primitives providing a suitable placeholder for the intended object geometries, that could be fleshed out further at a later stage without too much trouble. In future it would even be worth simplifying even further, in effect replicating the early draft animations used in industry to convey ideas.

Collisions and complex motion played a huge role in the animation, and both presented a myriad of problems. The motions of the parts in the 2nd scene, in which the body parts come tumbling out of a pile of trash/equipment could all have been simplified by ensuring they moved on trajectories that suited their geometry; parts could have just been made to roll around one axis and bounce a little as they move out of the shot. This would have led to a rather dull, artificial looking animation. Either each part would either not be moving as expected, or they would have needed to have been placed in suspiciously coincidental starting positions. Instead, the parts were placed at various starting heights and orientations, with some leaning against or placed on scenery items.

The subsequent motion of these parts was a significant challenge. In an ideal world, some form of dynamic simulation would be far more suitable, in which each item had a collision box, weight, friction etc. This would also suit this animation particularly well, since the field dynamics of magnets are particularly difficult to animate. This is likely far more demanding computationally, but produces very attractive animations. Taking my approach certainly gave an appreciation of the efforts made by early 3D animators to produce films of quality.

Many of the objects in this scene required grouping with themselves, to create a sort of nested set of rotational axes. This was to allow for the more complex tumbling motions of a few of the parts; often, I wanted the object to be rotating about its main axis, whilst also tumbling through the air, in the way that no symmetrical objects do. It does require a great deal of tweaking within the graph editor to gain the desired affect however. These multiple axes/pivot points also provide me with the ability to rotate about one end of the object, important for certain objects that would not naturally roll in a straight line.

Another interesting aspect of this scene is the oscillation of the two poles (or legs, as they will soon be). Initially, the poles were just going to bend, then snap off. I quickly realised that this motion lacked a certain springiness, so oscillations were added to the key framing of the bend parameter, as if a constant driving force is putting them under great strain. Less obvious from the video is the key framing of the placement of the bend; before snapping off, the bed originates near the base, with the bend only happening up the pole, and at the moment of breakage the bend control point moves back to the centre of the pole, and now happens in both directions as the bend continues to oscillate back and forth (a sort of wobble effect). This was to try and replicate the dynamics of a springier material, and I feel this worked rather effectively.

In hindsight, a more careful consideration of the needs for character movement early on would have saved a vast amount of time. The nested, hierarchical structure used to create the collisions was a spur of the moment solve for the problem of conveying collisions with sticking parts that have momentum. It worked at the time for the most part, though created and extremely messy and confusing object list for me to deal with, and would likely only be possible with individual successive collisions (noticeable in the outliner as body\_mag within body\_mag\_rleg, within body\_mag\_legs etc.). A far more logical approach, that was used for much of the later scenes (upon realising how much easier this was), would be to simply key frame the visibility of the body parts; as a part reaches the point of collision with the main body, visibility of this unconnected part could be switched off, whilst the visibility of the connected part could be switched on, leaving somewhat of a disconnect between the skeletal structure of the character and the ballistic parts that form it. Not only does this keep things neat in the outliner, but it also keeps the two animation elements separate, something that could have saved a lot of grief further down the line. A particular example of the problems caused by the aforementioned oversight came with an unexplained shifting of the timings between two scenes - somehow, I had managed to cause an overlap in the animations between two scenes, which then of course forced the shortening of one scene to compensate. Had the parts been better organised within the outliner, this should have been a case of simply shifting all the animation along in one direction on the time slider. With the messy hierarchy this had too much potential for screwing up the many nuanced animation elements in the scene, and would have been too time consuming to rectify.

This structure for the hierarchies caused further problems down the line when animating the limbs, simply because it could be a pain to find the part within the part outliner. Were all the parts parented correctly, in a hierarchical structure down the limbs, the animation process would have been streamlined considerably. In hindsight, I’m amazed something didn’t go wrong with the play between different coordinate axes.

It was however considered that by having separate parts for the connected and unconnected limbs, this does increase the number of overall parts. This may not have affected the stability my scene too much, but I imagine that the incredibly intricate models used in commercial animation would not be well suited to being replicated this way, particularly when computational strain is a factor. I feel therefore that there must be better suited methods for creating these types of collisions, though possibly not within the bounds of this assignment.

Conveying the effects of magnetism formed an interesting challenge throughout. As magnetism is a reactionary force, any pull towards the attracting object would cause a movement in the attractor too. At various points I tried to emphasise this, with the attracting object jumping towards the point of collision, to try and recreate that ‘snap’ together that is so identifiably magnetic.

On top of this magnetic effect, and often in unison with it, is the effect of momentum on collisions. People have a fairly solid understanding of how objects will collide, even with varying masses, shapes etc. I therefore tried to convey a semi-realistic level of momentum exchange when objects collide, taking into account the direction of movement of the colliding object, and how momentum would be expected to imparted to the final combined object. A further challenge here was the consideration of rotational momentum; often the colliding object would be attaching at speed to a point on the main body way off axis, and therefore required a rotational element to be added, again to create a more natural, physical looking interaction. All of these moments of collision required a great deal of tweaking in the graph editor to ensure the that momentum change looks instantaneous, rather than slowly coming up to speed. I feel this consideration of momentum exchange is most noticeable in the final scene, where the high speed, colliding head creates an interesting linear and rotational momentum reaction

*Conclusions*

I felt that the animation has gone quite well, and I made it most of the way towards the aims I set myself for the finished sequence. A great deal of time was wasted however due to a lack of foresight, and any future animation work would lead me to strongly consider how to approach the process intelligently and methodically.

*Appendices*



Figure - Initial Character DesignsFigure - Storyboard



Figure - Storyboard continued