Self Examination: Pixar's Adventures in Stop Motion

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Fig. 1. Self, © Disney/Pixar

Self is the story of a wooden doll who desperately wants to fit in and makes an ill-fated wish upon a star, sparking a journey of self discovery, leading her down a harmful path, and challenging her perspective of both who she is and where she belongs. It is also the most recent of Pixar's SparkShorts, and represented a number of firsts for Pixar: The first use of stop motion animation, the first collaboration with another studio, and the first use of a live-action visual effects workflow in Pixar's animation-centric pipeline. These presented some unique challenges and required us to restructure much of how we work in order to incorporate physical puppet fabrication and stop motion animation.

CCS Concepts: • **Applied computing → Fine arts**.

Additional Key Words and Phrases: Animation, Stop-Motion, Pixar, Tippett, Compositing, SparkShort

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1 STOP MOTION CONSIDERATIONS

Our character design process began with our usual 2d artwork, moving to a clay sculpt and then a digital 3d model. After the design was revised in 3d at Pixar, and the wood grain and chisel-mark textures were created, the model was handed off to Tippett Studio in order to begin puppet fabrication. As work on the underlying armature progressed, it became clear that a variety of changes to the model would be required in order to allow for the desired range of movement and compatibility with the 3d printing process. Joints were revised, eyes rescaled to prevent in-head intersections, hair was cast with embedded wires for animation, clothes hand-stitched and additional surface details were sculpted. The body parts were hollowed out and designed to attach to the underlying armature and a limited selection of facial expressions were chosen for the interchangeable face masks.

2 PUPPET FABRICATION VS. CG CHARACTER

Once puppet fabrication was complete, shots were determined to be either stop motion or CG based on proximity to the camera and the number of wooden body parts still remaining. This meant that our CG version of Self needed to match the revised physical puppet. Proportions of the digital model were adjusted and a new set of displacement maps were generated from the models that Tippett has 3d printed. With a puppet as reference, we revised our character to add hardware such as screws at the joints, 3d printing striations, subtle grain from sprayed paint, micro-scratches on the eyes, fuzz on the garments and even the slight specular variation caused by finger oils on the puppet.

3 ANIMATION

As animation began on our 19 stop-motion shots, we opted to push the stop-motion nature of the movement, with the Tippett animators animating only every second or third frame, instead of every frame. This helped differentiate our main character's staccato motion from that of the smoothly-moving secondary CG characters. Similarly, we restricted her facial expressions to just nine interchangeable faces and paired those with a variety of swappable eyelids. When animating the digital version of Self, at Pixar, in an additional 31 shots, we worked to replicate the stop motion style and kept ourselves restricted to the same limited set of facial expressions. It's only when Self has swapped on a golden face that we allow her to have a wider variety of smooth facial animation.

4 PIPELINE CONSIDERATIONS AND CHALLENGES

One major change made was to reduce the size of our digital world down to approximately one-fifth scale, in order to match the scale of our puppet. This put our digital world in line with the stop motion shooting stages, so that our digital camera optics and lighting physics would match the real things.

An unusual challenge for us was the addition of a digital hand on a stop-motion puppet in two shots. The first body part to be replaced, Self's golden hand needed to be tracked onto the puppet. Tippett Studio added tracking markers to the puppet for these shots, and delivered matchmove data that we imported into our proprietary animation software, along with the matchmoved camera.

Finally, our lighting process became something of a circular collaborative process, as we pre-lit our shots in order to provide creative lighting reference, the puppets and stages were then lit to match our CG, and finally our CG world's lighting was adjusted again to match the stop motion elements and all of it composited. A final round of color grading pulled all the elements together and ensured consistency across shots.