"Encanto" - Let's Talk About Bruno's Visions

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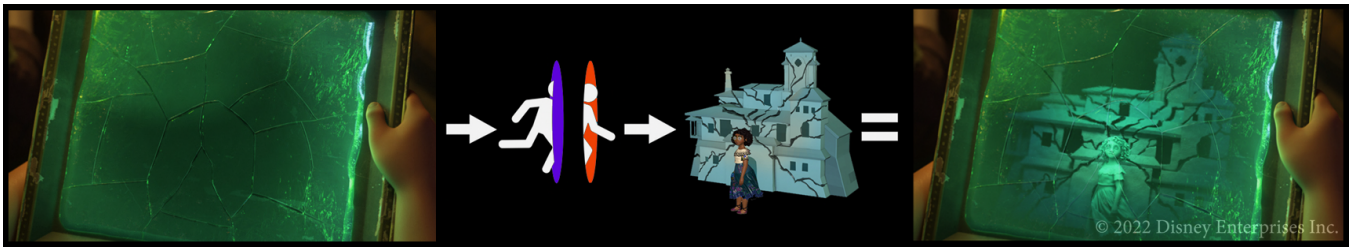

Figure 1: Creating the holographic look for Bruno's visions required close collaboration between visdev, look, lighting, and technology.

ABSTRACT

In Walt Disney Animation Studios' "Encanto", Mirabel discovers the remnants of her Uncle Bruno's mysterious visions of the future. Developing the look and lighting for the emerald shards required close collaboration between our Visual Development, Look Development, Lighting, and Technology departments to create a holographic effect. With an innovative new teleporting holographic shader, we were able to bring a unique and unusual effect to the screen.

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1 CONCEPT

"Encanto"'s script called for Bruno's visions to be embedded within an emerald block, but determining what this meant visually required a collaboration between early visual development and look and lighting to conduct early proof-of-concept tests. Initial tests embedded physical geometry directly within a block of glass, but the result felt too tactile and literal; the desire was for the visions to feel more like a window into the future instead of like geometry embedded in glass. Eventually, these tests led visdev to conceptualize Bruno's visions as more of a hologram; these holograms would be embedded within a tablet-like thin sheet of emerald, but contain more apparent depth and parallax than was physically possible given the thinness of the tablets.

To prototype this effect, our lighting team conducted tests with where Mirabel was pre-rendered from a specific match-moved angle and then camera-projected on a piece of geometry embedded inside the emerald to give the illusion of a 3D object; this test achieved the effect that the production designers and directors envisioned. However, since the emerald tablet would be broken into multiple shards in the final film, this process of manually camera-mapping each element per frame proved to be too laborious and complex to set up for every shard in every scene, especially as this element gained additional prominence within the film's story. Instead, we partnered with our in-house renderer development team to devise an optimized in-render solution that could be easily set up and shared across departments for visualization.

2 A TELEPORTING HOLOGRAPHIC SHADER

In the past, we used a slice-based approach to provide parallax effects on otherwise flat surfaces [Joseph et al. 2014]; however, the desired level of visual quality for our hologram effect required a more general approach utilizing real geometry. Our previous slice-based approach also came with considerable workflow and pipeline complexity, which we hoped to avoid. To achieve the hologram effect through an in-renderer solution, we extended our in-house renderer Hyperion's [Burley et al. 2018] surface shader with a new teleportation feature.

To prevent artists from having to separately rig each shard, we developed a system where artists specify meshes as portals to transform input rays from world space into an arbitrary reference space. Artists specify that rays hitting an emerald shard are to be teleported to a target space where the hologram geometry of Mirabel and the house are located. To account for the movement of the

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Figure 2: The assembled emerald asset with the hologram effect (top) and a close-up of three shards assembled (bottom).

individual shards, a best-fit orthonormal transform [Horn et al. 1988] from the the animated vertex positions to the rest positions is computed and added to the target space transform during shader initialization time. Once the teleportation transform is available, the actual teleportation approach used is similar to Coleman et al. [2018]: instead of spawning light sampling rays through next event estimation or indirect rays through BSDF sampling, the next ray's origin and direction are computed by transforming the current shading point's position and incident direction into the reference space.

The ratio of teleported and normal rays is controllable through "teleportation maps" (similar to opacity maps) and the type of spawned ray is stochastically selected based on a ratio evaluated at shading time. This map feature allows artists to paint areas of the hologram that should be appear more faded. To prevent the hologram effect from looking like it is contained within a box, we allow potentially teleported rays to first check whether or not they would intersect anything in the reference space before being teleported.

3 DEVELOPING THE LOOK

The look of the emerald shards came in two parts: the shards themselves, and the look of the holograms seen through the emerald shards. Both were largely driven by Bruno's green color scheme. The base look of the shards drew upon experience gained from creating the magical dragon gem from Disney's "Raya and the Last Dragon", but considerable modifications created a new, unique look.

Initially, the shards were given a large amount of internal detail, including complex embedded cracks. However, we needed to be able to visually distinguish between three different layers of cracks: internal cracks within each shard, cracks between shards in the assembled tablet, and stylized cracks on Casita in the hologram. Achieving a clear read between all of these different layers required paring back and simplifying the look; we eventually removed the internal cracks within each shard.

Creating the look of the hologram required balancing having sufficient parallax in the hologram to convey the effect and having too much depth within the hologram. After conducting many tests on pushing back Casita within the hologram, the solution settled on was to use a stylized, flattened model of the house. The final hologram contents also contained stylized technical animation on Mirabel's hair to produce subtle movement within the hologram, enhancing the mysterious prophetic look of the entire effect.

We used the aforementioned teleportation map feature to help the hologram image sit better within the assembled emerald tablet and blend into the edges of the tablet. This blend was then further polished in compositing.

4 LIGHTING

For simplicity, our teleportation solution requires the target hologram geometry to be in the same scene. However, we did not want lighting from the "real" world to impact lighting within the hologram, and similarly we did not want the lighting setup within the hologram to spill out into the "real" world in an uncontrolled manner. The most straightforward solution was to simply place the hologram world hundreds of units below the origin of the main scene. This way, the ground plane itself served to completely separate the lighting between the real world and the hologram world.

The hologram contents were set up as a separate asset that could easily be added to any shot using our studio's asset referencing system; this way, updates to the hologram asset could automatically propagate to every shot that needed to use the hologram. By building the lighting pipeline for the hologram effect on top of simple effective pre-existing solutions, reusing the entire setup for different visions later in the movie was easy and required little additional custom setup. As an example, this entire setup was reused to create Bruno's later vision of Isabela and Mirabel.

5 CONCLUSION

We are proud of the collaboration between Visual Development, Look Development, Lighting, and Technology that took place to produce this unique effect. Our studio's structure fostered a collaborative process where lookdev and lighting artists inspired visual development artists, and the visual design and prototypes challenged our renderer developers to create novel solutions that minimized authoring and pipeline complexity while providing a powerful, flexible toolset to achieve the final effect, all on a short timeline.

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