Familiar Feelings: Emotion Look Re-Development on Pixar's *Inside Out 2*

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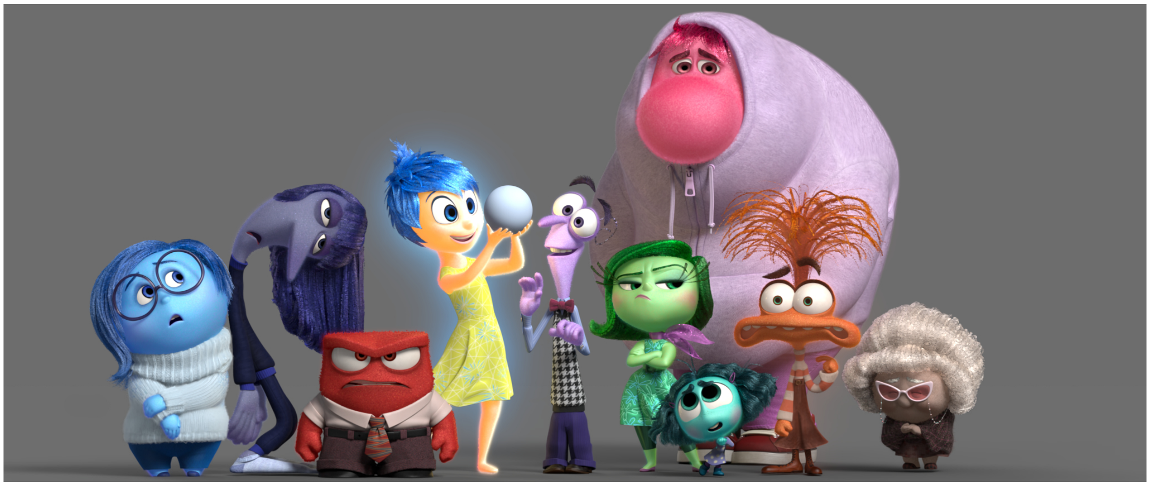

Fig. 1. The full cast of emotion characters in *Inside Out 2* ©Pixar

The emotion characters on Pixar's *Inside Out* (2015) were composed of multiple elements that gave them an ethereal look. They were an ingenious composite of a core volume that behaved and illuminated as a glowing surface, moving particles that hovered over it, an edge volume tinted differently based on the lighting direction, and strands of dots that resembled hairs from a distance but sparkles up close. On Pixar's *Inside Out 2* (2024) we had the challenging task of bringing these well known, technically complex characters back to life. We recreated the core five emotions, straddling the delicate balance of upgrading them to take advantage of newer technology while still maintaining their familiar look. We also created a whole new cast of emotions for Riley's adolescent mind.

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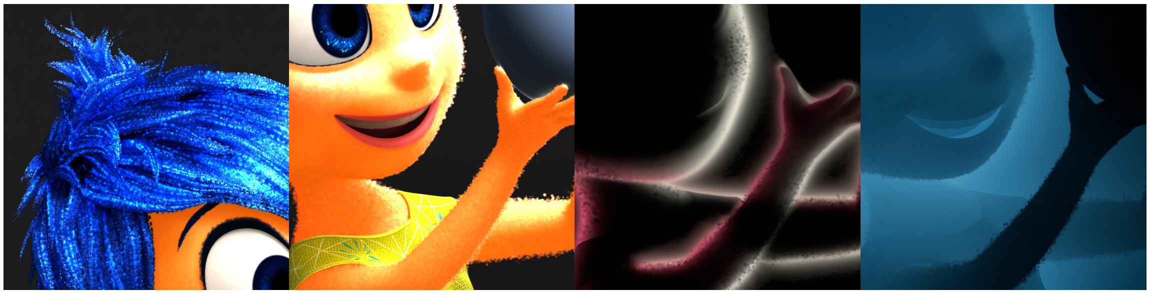
1 INTRODUCTION

Our visual goal was to preserve the familiar look of the five original emotions characters [Angelidis et al. 2015] and extend that look to Riley's new emotions. The look was developed using RenderMan's REYES [Cook et al. 1987] mode, which made non-physical behaviors easy to implement and control. We encountered a number of challenges re-implementing these behaviors in RIS, RenderMan's newer path tracing framework. The first film used RenderMan



(a) Hair Dots (b) Skin Particles (c) Edge Glow (d) Outer Glow

Fig. 2. Joy's Design Elements ©Pixar

procedural primitives to generate point geometry for hair dots and skin particles. Enabled by our Hexport system [Coleman et al. 2020], we chose to re-implement these procedurals in Houdini and gained improved inspection and debugging as well as more dynamic behavior.

2 DESIGN ELEMENTS

Hair. The emotions' hair consists of "dots" rather than strands. The light response resembles hair but with variation for a glittery effect (Figure 2a). *Inside Out* employed RenderMan procedurals and a Kajiya-Kay hair model [Kajiya and Kay 1989] with extra non-physical components. We used Houdini Engine and combined two instances of the Chiang hair model [Chiang et al. 2015] with added diffuse and emissive lobes. We integrated the MaterialX Lama system, enabling artists to break energy conservation rules to achieve non-photorealistic looks.

Skin Particles. The emotions' skin is covered in a layer of randomly displaced, pulsing particles, and has a light response that is broadly surface-like, with higher frequency per-particle variation to give a textural quality (Figure 2b). We used our Hexport system to generate the skin particles in a Houdini pre-pass, making it easier to implement more complex particle behavior, including rigging-driven deformations and dynamic de-intersection with hair and garments.

Volumetric Glow. The Emotions are surrounded by layers of emissive auras that convey an ethereal "life force" (Figures 2c and 2d). The aura algorithms were designed to be efficient and temporally coherent for global illumination. We derived the auras from volume field arithmetics, combining weighted solid angle fields and density fields induced from camera ray transmission, combined with a voxel resolution heuristic derived from human perception of the human body. To shape the auras, we developed a system that is reusable and editable across characters in minutes.

Core Softness. Joy's design called for her to be soft and translucent near her silhouette edges, with a more solid and opaque core. On *Inside Out* this was achieved by rendering her body using a heterogeneous volume with a density falloff near the surface of the underlying model, and a traditional surface shading model extrapolated to the volume. We found it difficult to achieve this behavior in RIS and instead rendered her body as a traditional subdivision surface with an opacity fall off near the silhouette edges.

Lighting. Given the non-physical design of the emotion characters, extra close collaboration was needed between the Shading and Lighting departments to achieve their final look. Joy, by design, is like a bright yellow light bulb, but she also needs shaping for her appeal and the readability of her expressions. A separate lighting rig was created for

Joy, incorporating glows (edge and outer) to control how she appeared in different lighting scenarios of the film: from the brightly lit headquarters to the dim back of the mind sets. Shading had to ensure that the illumination of the body geometry of each character (under the particles and glows) matched closely with the final illumination. This sped up iteration in shot lighting, where the lighter didn't have to wait for the expensive, full particle generation and shading.

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