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It's All In the Eyes: Disney Technique Captures Unique Eye Characteristics to Produce Photo-Realistic Faces

Generic Eye Geometries Fail to Account for Marked Variation Between Individuals

The eyes are arguably the most important features of an individual's face, if not a window to the soul, so the use of generic eye models when creating digital faces can have disappointing results. Scientists at Disney Research Zurich, noting the significant variation in eyes between individuals, have devised methods for faithfully capturing those features.

The researchers developed a technique, using multiple cameras and varied lighting, to capture the shape and texture of the white sclera, the shape and refraction of the transparent cornea and the shape and coloring of the iris, including how it deforms as the pupil narrows and widens.

This unprecedented level of detail enables the creation of an eye model that both captures the look of the person's eye and can duplicate how it responds to changes in lighting.

"Creating a photo-realistic digital human is one of the grand challenges of computer graphics, but despite intense research on capturing actors' faces, especially for reconstruction of the skin surface and features such as hair, little attention to date has been given to the eye, particularly its shape," said Pascal Bérard, a Ph.D. student in computer graphics at Disney Research Zurich and ETH Zurich.

"Generically modeled eyes may be sufficient for background characters, but it now takes significant effort to manually create realistic eyes for heroes and other leading characters," he said. "Our reconstruction technique can greatly reduce the time spent and help increase the realism of the eye."

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Bérard and his colleagues will present their findings at SIGGRAPH Asia 2014, the ACM SIGGRAPH Conference on Computer Graphics and Interactive Techniques, Dec. 3-6 in Shenzhen, China.

Though the eye is generally perceived – and modeled generically – as spherical and uniform, the eyeball actually exhibits strong asymmetry and includes microscopic surface details and imperfections, the researchers noted. The microgeometry of the iris, far from a simple planar or cone-shaped feature, is as unique to every person as a fingerprint.

Capturing the details of the eye is difficult; the eyes are small, much of the eye is occluded by its small opening in the face and the sclera, cornea and iris each have different visual properties that require different capture techniques. The set-up, data acquisition and calibration required for the capture technique takes about 20 minutes; to keep the person still, the subject lies on the floor with head in a headrest.

In addition to capturing the geometric and appearance variations between individuals, the methods developed by the Disney Research team also enable data-driven animations of the iris, replicating how the muscle deforms in each individual as the pupil widens or narrows in response to light. Other eye motions have not yet been replicated by the team.

The Disney Research team, which includes Derek Bradley, Maurizio Nitti, Thabo Beeler and Markus Gross, demonstrated their techniques by reconstructing nine different eyes from six different actors, highlighting the marked differences in shape, coloring and iris deformation between them. They also combined both of the captured eyes of one actor with a face scan to show how their method could be used to create artistic digital doubles.

“Such a result would traditionally take significant artistic skill and man-hours to generate, in particular if it was meant to closely resemble a real actor,” Bérard said. “Our result was created with very little effort.”

More information, including an explanatory video, is available on the project website <http://www.disneyresearch.com/publication/high-quality-capture-of-eyes/>.

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Disney Research (www.disneyresearch.com) is a network of research laboratories supporting The Walt Disney Company. Its purpose is to pursue scientific and technological innovation to

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