

The Lion King Virtual Cinematography

In the first creative meeting, before the film was even greenlit, director Jon Favreau put a spotlight on the biggest challenge we would face.

The Lion King was *already* a brilliant animated film.

There was *already* a successful Broadway musical.

There was nothing to be improved upon in those mediums and we shouldn't dare jeopardize people's memories of these experiences, by simply "updating" them. He felt strongly that we were in peril touching such an iconic work, and the only safe way to bring this story to a new generation, was to tell it in a completely new medium. Even if we had to create one that didn't exist.

The director's challenge to us all was to craft a film that was so real that the audience saw it as something new. Could we take them to a world like the reality we know, but with all the magic of an impossible story? Could we make the story feel like it was filmed as an installment of *Planet Earth*? Could the authenticity of every image and every detail of live action filmmaking be brought directly to the screen so that all these subtle, almost subconscious details, could carry the audience into believing that the world of the film was a place they could visit? After all, the film crew must have been there, right?

Our creative intent behind the virtual cinematography for "The Lion King" was to fully emulate the "live action" experience of shooting a conventionally photographed film. The experience that a seasoned cinematographer brings to the staging, blocking, lighting and ultimately the operating of the shot, depends on live real-time input and split second intuitive adjustments. Building a shooting environment that could take advantage of the collaboration between talented crew members, such as dolly and crane grips, assistant cameraman pulling focus, and steadicam operators was crucial in being able to offer up a different feeling to the multiple takes recorded per shot. Each take is unique and inspired by the confluence of the human touch.

The idea of "just going one more time" offers up a possibility of a happy accident where all input devices working in tandem create a shot that could not be created any other way, inheriting all the idiosyncrasies of practical photography. These multiple takes, angles, ideas, and explorations create a set of analog dailies that the editor chooses instinctually when the cut is constructed, identical to the workflow of a conventional film.

We felt we could build on the photorealistic rendering the team had achieved in *The Jungle Book* to hit the needed level of visual realism. But to give Jon the *wabi sabi* he was

looking for, the perfection of the shot through the imperfect nature of the human hand, we needed to put the cinematographer inside the world of the film itself, and to give him and the camera department live action tools so they could light and lens the entire film as though they were *there*.

We'd have no "previz." There would only be the production of the film itself.

We designed a complete film stage to support this vision, containing all of the traditional film gear you would expect to find on a live-action movie set. We heavily modified a real-time game engine for this purpose and built the entire world of the film in it, with all camera equipment modified to feed a "digital twin" of that gear in the virtual world. Almost twenty connected high-performance computers acted as "portals" to the shooting session, each one responsible for either data input from the physical equipment on stage, video output, or VR access to the set in Africa.

The day might begin with a location scout in VR, allowing the department heads to explore location options together, position the characters inside the environment, load and puppeteer animations, and customize the art direction, set decoration, and first-pass of lighting (setting the time of day, the position of the sun, etc). Everyone could see each other and the work they were each doing inside the VR world, giving them the opportunity to feed off each other's energy while designing the sequences.

When the scene was blocked, the film crew shot with a traditional live action workflow. The cinematographer would set camera positions for the scene (in VR), and direct the camera department crew to place virtual dolly track, or position the pedestal of the virtual Technocrane. When the shot was designed and rehearsed, the cinematographer would work with the gaffer in the scene, setting the clouds, lighting to camera, and advancing the sun in each shot.

During each take, the cinematographer communicated with his crew while the action played out inside the virtual set. The choreography became more refined with each take, giving a true feeling of discovery to the crew while they fed off each other's feedback and experience.

With more than fifty years of filmmaking experience, our cinematographer's toolkit had to be quite extensive. We modeled the camera package on the large format Arri 65 and we profiled the lens kit he preferred, even creating matching 3D models of the lenses from Panavision in VR. Additionally, we integrated a full camera support package including a dolly, slider, jib arm, geared head, fluid head, and FIZ.

When a big sweeping shot over the African Savannah needed the expertise of a helicopter pilot, we attached an active tracking system to a drone and had the pilot fly through the volume while watching the camera feed. When a long walk-and-talk required dynamic camera movement around the characters, a steadycam operator worked the scene freely, seeing the virtual world through the lens.

The virtual cinematography workflow was designed to carry every creative decision made on set precisely through the entirety of the VFX pipeline, to the final screen. The performances by the cinematographer on stage were the same keyframes used in VFX for final rendered images. Turnovers to VFX included approved camera data, the cinematographer's lighting direction, scene layout, all metadata, and the editorially-approved shots recorded in the volume.

Most importantly, the creative decision-making of all the filmmakers on stage created a fast creative feedback loop with editorial that allowed new coverage to be iterated same-day, previous day's sets to be loaded in 15 minutes so a pickup shot could be grabbed, and cuts to be quickly polished with new material before being locked. This allowed the visual effects animators, artists, and technicians around the world to focus their creative energy on making the finished material exceptional, rather than figuring out "what it should be."

Empowering the camera department to guide every pixel with their own hands, using their instincts instead of emails, meant audiences felt the human presence of the crew evident in every frame of the film.

The Lion King featured 1,490 photorealistic, fully computer-generated shots captured with virtual cinematography.

Except one.

Virtual Cinematography Toolkit:

- 70' x 40' stage comprised of multiple overlapping "volumes" that could support up to 8 separate units, or could be combined into one larger volume.
- Multiple performance capture systems were rigged into the ceiling including HTC Vive lighthouses, and one of the first active optical motion capture systems by Optitrack.
- Cinematographer's complete camera support package with each piece of equipment moving it's "digital twin" inside the virtual environment in the same relation as it's physical counterpart:
 - Geared head (encoded with precise gear ratios)
 - Fluid head (encoded OConnor fluid head)

- Dolly track (19' digitally-encoded and mapped to the virtual track)
- Jib arm (16' digitally-encoded arm with 150' virtual telescoping range)
- Focus Iris Zoom (mapped to the software in real time)
- Cineslider (3' & 5' digitally-encoded sliders)
- Manfrotto shoulder rig (with laser encoding)
- Steadicam rig (with Active LED mocap tracking)
- Phantom 4 Pro Drone (with Active LED mocap tracking)
- Movi Freefly Controller (focal length, boom, and position adjustment rockers)
- The precision of tracking was less than a millimeter in order to support critical applications like a 400mm lens on the end of a 100' crane, mounted on a dolly track, all being operated by the hands of the film crew.