Pixels in motion

James Matson rounds up 3D artists, developers, and an extra large popcorn as Atomic lifts the lid on the world of cinematics for games.

Storylines and narrative are commonplace in modern games; epic tales accompany on-screen action to explain why we're planting C4 on walls, mowing people down with Flak-Cannons or hunting for the crystal/child of prophecy that'll save the world. Again.

Before PC and console platforms had the power to flex multimedia muscle, static bitmaps strung together from a limited palette and complimented by text dialog were the best devices around for getting the story across to the player. It seemed enough at the time to draw us into 16-bit greats like *Shadow of the Beast*, and the 90s stint of FMV (Full Motion Video) footage in games (starring actors best left to bootleg porn films) was quaint for a while, but in a world where Shader Model 3.0 can spit out luxury real-time 3D, cinematics have had to evolve to stay fresh.

Now games are preceded by incredible trailers. Cut-scenes between levels are emotive moving works of art, shaping our understanding of the in-game world. For this level of visual splendor, the tool of choice is often offline 3D rendering, allowing unlimited creativity. Game developers like Auran don't have the in-house capabilities to produce the kind of heavy duty 3D found in most game cinematics; instead outsourcing the work to a dedicated studio like Act3 animation in Melbourne to produce the trailer for its fantasy based Player-Versus-Player MMO, *Fury*.

"The trailer was something we don't have the rendering power to do time-effectively in-house," explained Bjorn Bednarek (associate producer, Auran).

"It made more sense for our team to work closely with Act3 producing a trailer that reflected the artistic direction of our team, using the talent and hardware of a specialist company."

To get the meat of how in-game movies are made we decided harassment of everyone from Act3 to NVIDIA was the best course of action.

Final Fantasy, a game inexorably tied in with beautiful CGI sequences.

Sketchy beginnings & art by proxy

Often artists will meet with game developers and spend time getting an understanding of the aim of the cut-scenes or trailer, pouring over concept art storylines and even the engine itself, taking note of anything that gives a strong indication of art direction and theme. From this, concept drawings are whipped up and placed into a 'storyboard' – a collection of rough sketches highlighting major points in the rendered film. These storyboards aren't the kind of stuff you could stick glass over and hang in your lounge room; we're talking extremely basic stick figures in a cartoon style, just enough to give an impression back to the client of where the artists think the clip should head. Nothing is in three dimensions yet, just loose ideas; the beginning of the road.

When CGI first leaps off paper and onto the screen it's using 'proxy' objects, crude models of the final work. This phase is about extending the rough storyboard into the 3D world, but is still bereft of any detail. While the opening sequence of the *Fury* trailer might be a toned and supple female warrior running between towering ancient pillars, the proxy scene will be a coarsely rendered human figure, without textures, mapping or animation, 'floating' on a path through a mock environment.

The artists at Act3 perform even this elementary work on PCs that could eat a high end gaming rig for breakfast and still have room for pancakes. Each work system houses a monster Core 2 QX6850, Geforce 8800Ultra 768MB GPU and a whopping 8GB of PC-6400 RAM, all designed to fuel 3D Studio Max for modeling/rendering. Just try and tell us they don't play *Crysis* after work.

Proxy animations and models afford artists the chance to play with camera angles, shot layouts and re-render scenes using a minimum of processing power and – more importantly – time. Without complex textures, lighting and special effects, the entire CGI sequence can be manipulated and re-rendered in a fraction of the time it would take the final production.

Show us your assets

Once the studio and the client agree on the proxy work, artists begin modeling the high quality objects, environments and characters for the final render. These are the 'assets', the guts of the production. While game developers and CGI studios both churn out initially complex 3D objects reaching into the millions of polygons, only the CGI team has the luxury of keeping these for the final animation. Game developers use techniques like normal mapping (where detail is taken from a high poly model, put into a normal map, then applied to a much lower detail model like a standard texture) to give the appearance of quality in models while avoiding a pixel hernia in the game engine.

"A lot of in-game assets start off as high-poly source models," explains Tom Drew, senior artist on *Fury*. "They're used to help render out textures, and are baked down into multiple low poly textures."

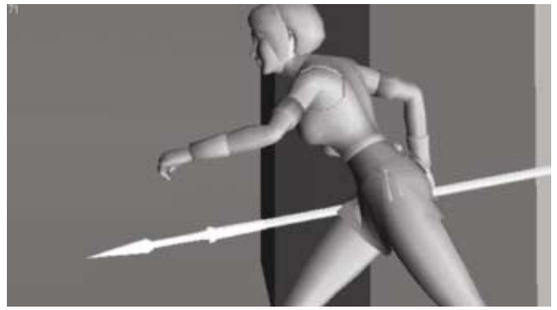
Concept sketches that end up as sexy 3D art.

THE HARDWARE

Act3 has plenty of processing power but time constraints can lead the company to seek out bigger render farms to get the job done quickly. 'The Green Machine' supercomputer at Swinburne University Astrophysics & Supercomputing department in Victoria provides a monstrosity of a setup to chew through CGI. Liaising with Russell Scott (part of the Swinburne faculty and himself a 3D artist for educational short films about space and physics) Act3 on occasion outsources rendering work to Swinburne's resident uber box. The tech specs speak for themselves…

Render Farm	Nodes	CPU (per node)	Memory (per node)	Storage (per node)	Operating System
Digic Pictures	34 (Mixed SBXL52 & SR1530CL blades)	Dual CPU Intel Xeon 3.2GHz	4GB	160GB	Windows
Act3 Animation	12 (Dell SC1425 blades)	Intel Xeon 5355 Quad-Core 2.66GHz	16GB	160GB	Windows
The Green Machine	145 (Dell 1950 blades)	Dual CPU Xeon 5138 Quad-Core 2.33GHz	16GB	2 x 500GB	Linux (CentOS 5)

While primarily used for generating scientific models of spiral galaxies and dark matter, the Green Machine supercomputer occasionally chews through cinematic 3D.



Proxy versus the finished product.

Gerard Roche, production manager at Act3, sees a tangible benefit in both industries working with detailed 3D models in the beginning,

"Normally for in-game characters a games company will create high resolution characters then lower the res until they have the optimal model for in-game. If we're lucky we can get our hands on the original model, saving us a bit of time. Usually we'll receive models between 8K-15K polygons. Our final models will end up anywhere from 100K-200K. With offline rendering we can have heavy poly count models, apply a wider range of effects and composite over the top that can't be done real time as it's too heavy on the hardware."

While plenty of creative spark goes into the modeling and texturing, it's only half of the visual workload. The other half is animation. As far as techniques go, there are two main methods for animating objects in 3D space, the more traditional of which is 'Keyframing'. Imagine you want to animate a ball rolling along a floor as part of a 1000 frame sequence. Rather than manually moving the ball a fraction in each single frame, Keyframing allows the artist to put the ball at the start of its journey in frame 1, the end of its journey at frame 1000, and the software will calculate all the movement in between. While that's tidy for some sequences, what about more complex stuff like the human form? That's where Motion Capture (or 'mocap') comes into play. Using small reflective spheres placed at strategic points on a live actor's body, mocap relies on special cameras placed around the actor that pick up the coordinates of each sphere as the subject

Random lunatics impersonating Christmas trees, or motion capture? You decide.

moves, and translates them into animation data, which is then applied to the 3D model.

The power of mocap lies in the creation of a heightened sense of reality in animation, directly copying real movement down to the sub-millimeter level. For the *Fury* trailer, Act3 used motion capture for the major movements of two characters fighting, and blended in Keyframing for the facial expressions and hand gestures.

The final fantasy

With the world modeled and animation rigged for characters and objects, the heavy-duty work towards a final render begins. Rather than operate on a complete scene, CGI studios store scenes in 'layers', each one representing certain 3D elements like models or particle effects. Varga Tamas, artist at Digic-Pictures and part of the team behind the *Warhammer: Mark of Chaos* trailer elaborates:

"A typical shot gets decomposed into several layers, which are re-assembled in a 2D compositing package. This way we can devote all processing power to rendering particular elements, allowing flexibility in editing without re-rendering an entire scene."

Gerard from Act3 concurs. "We have separate shadow, diffuse, occlusion and reflection filter passes for the geometry and textures. On top of that maybe another 15 to 20 FX passes comprising of fog, smoke, blood and so on."

Act3 use a combination of VRay Render Elements and RPM Manager software to arrange layers; the scenes will then be processed on their in-house render farm. 'Backburner' – a part of the 3D Studio Max suite of software – looks after distribution of frames for rendering over the various networked servers and each separate machine works on its own frame, one at a time. The render

With mocap applied, detail seeps into the *Fury* trailer.

times can vary between a few seconds to a few hours per frame depending on the complexity of the scene, with a single second in a typical cinematic sequence comprised of 50 to 100 different rendered layers.

"If you have lots of geometry with hair and cloth simulation it's a heavy render," says Gerard. "Particle effects, like fire, also take time."

Time is – at every stage during the development process – the most critical factor. Everything from the way scenes are handled to the careful selection of rendering hardware is designed to make sure maximum quality can be achieved in the minimum render time. In that respect at least, the balancing act in offline rendering is no different from real-time, only that CGI studios have more hardware to play with.

Once rendering is complete, and the footage receives art and technical sign-off, audio and music is synced in,

"Audio is one of the last things we do" says Gerard, "we send the final video sequence along with a brief of the types of sounds required to a dedicated audio studio and they appropriate sounds for us. We'll sit down with them and make sure we get something that matches the feel of our film. It's the same process for music; we usually hire a composer to create something original."

The length of footage seen in the end production doesn't really do justice to the time and effort expended. To put things in perspective, after all the blood, sweat and tears put into the production of the *Fury* and *Neverwinter Nights 2* trailers (both Act3 creations) it took over month to render out the one and a half minutes of footage for each of them, separately.

The final piece, after the arduous journey through concept art, modeling, texturing and animation is breathtaking. Cutting edge real-time engines like CryENGINE and Unreal3 still can't hold a candle to pre-rendered animation in terms of complexity and detail. But the real question begging to be asked is for how long will that be the case? When will real-time software and hardware be powerful enough to do away with offline rendering for good, instead utilising in-game footage to produce cut-scenes and cinematics? Larry Gritz, NVIDIA developer and ex Pixar technical director thinks there's still plenty of life in CGI.

"Games lag about five to ten years behind film, in terms of look, quality, and complexity. I don't see that changing soon simply because games must render each frame in 1/30 or 1/60 of a second and will settle for whatever quality fits into that time constraint. Offline rendering can set a quality limit and take as much time as necessary to hit it. So I think within a few years games will be routinely using basic ray tracing and global illumination (as film has been doing for five plus years), but by then film will have moved on to even more advanced techniques, or be using those global effects on scenes that are much more complex."

Whatever's on the evolutionary horizon for game cinematics, there's no easy way to impart the amount of dedication, talent and pure imagination that goes into the production of those few precious minutes of CGI eye candy. If you've never really stopped and paid attention to some of the beautiful pre-rendered 3D woven into today's games, take some time out and do it. *Hellgate: London* (despite being an average game) has an intro movie made of pure digital sex, so there's a good place to start. Like us, you won't be disappointed.

After all the person hours and heavy processing, the final *Fury* cinematic is born, horns and all.

WE ALL SCREAM FOR... GELATO?

The bridge between human talent and the hardware comes in the form of 3D rendering software. While 3D Studio Max (and to a lesser extend Maya 3D) forms the bulk of the industry standard, NVIDIA has been busy cooking up an alternative renderer – called 'Gelato' – which is primed to find a home on the hard drives of CGI studios. We caught up with Larry Gritz, senior developer of Gelato for some Q&A.

atomic In the development cycle of film or game CGI, where does Gelato fit in?
Larry: Gelato generates final production renders for film or other high-quality animation. It also has a mode where it can be used for rapid previews of lighting, where for a single frame, changes to just the lights can be re-rendered more rapidly than doing a full render. For coming releases, we're also working on a truly interactive mode, where shadowed lights can be moved or altered with image updates taking no more than a second, at nearly final quality.

atomic Is Gelato complimentary or competitive to other programs like 3D Studio Max?
Larry: Complimentary. Maya and 3DSMax are full suites of modeling, animation, effects and rendering. Gelato isn't meant to take their place, but be an add-on that replaces those suites' rendering components, creating more complex scenes at a higher quality than the built-in renderers of the well known packages.

atomic NVIDIA touts Gelato as having the capability to leverage the NVIDIA GPU as a floating point math processor; can you explain?
Larry: Gelato is not a real-time application that draws images to a live screen; instead it's a computational application and relies in part on NVIDIA GPUs for math calculations in rendering, along with the CPU. To the best of our knowledge Gelato is the only renderer on the market that leverages the GPU for 'final frame' calculation.

atomic Where has Gelato been used in the industry?
Larry: Recently completed or in-progress films that use Gelato include 'Journey 3D' (effects by Frantic Films) and 'Resident Evil 3' (effects by Anbirain Digital). NVIDIA also completed its first animated short film 'The Plush Life' which highlights the rendering features of Gelato.