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HOLLYWOOD
ISSUE

AUGUST 2004

game developer

THE LEADING GAME INDUSTRY MAGAZINE

» SIGGRAPH 2004

SNEAK PEEK:
DISCREET 3DS MAX 7

» DEVELOPER DEFENSE

LEGAL TOOLS TO
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» FAST RADIOSTY

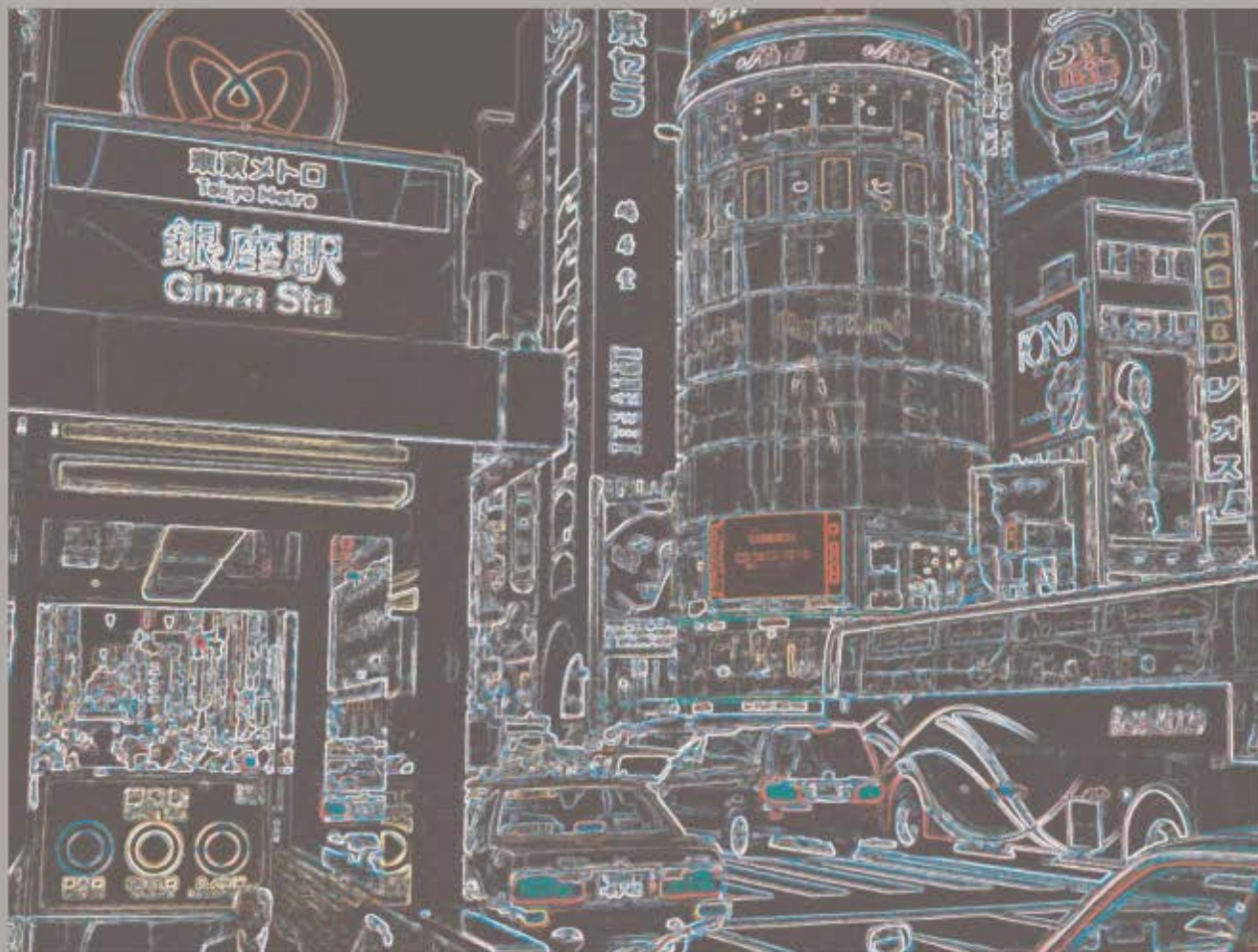
SPEEDING UP LIGHTMAPS
WITH PIXEL SHADERS



POSTMORTEM:
THE CINEMATIC EFFECT OF
ZOMBIE STUDIOS'
SHADOW OPS:
RED MERCURY



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SIGGRAPH 2004



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POSTMORTEM

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How do you give a player that vicarious presence in an imaginary environment—that “you-are-there” feeling that a good movie often gives? Zombie’s answer was to adopt many of the standard movie production practices. Find out what it takes to create a cinematic experience.

By Mark Long

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14 COPYRIGHT: THE BIG GUN FOR GAME DEVELOPERS

A one-of-a-kind game concept, an instantly recognizable character, a clever phrase—these are all a game developer’s most valuable assets. To protect such intangible properties from pirates, you’ll need to bring out the big gun—copyright. Here’s some free advice from a lawyer.

By S. Gregory Boyd

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With the latest advances in hardware, GPU, and graphics technology, it’s time to take another look at lightmapping, the divine art of illuminating a digital environment.

By Brian Ramage

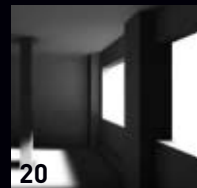
30 FROM BUNGIE TO WIDELOAD, SEROPIAN’S BEAT GOES ON

A decade ago, Alexander Seropian founded a one-man company called Bungie, the studio that would eventually give us MYTH, ONI, and HALO. Now, after his departure from Bungie, he’s trying to repeat history by starting a new studio: Wideload Games. Alex Handy sits down with this Alexander the Great to find out what new territories he intends to conquer this time around.

By Alex Handy



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HOORAY FOR HOLLYWOOD?

AT EVERY GAME INDUSTRY EVENT, THERE IS SOME panel, presentation, or keynote about the convergence with Hollywood. Since the film industry has been honing the craft of creative entertainment for three times as long as the game industry, Hollywood has forged a myriad of time-tested solutions to management, organizational, and marketing obstacles that can easily be ported over (see page 30). While some see film and game more as a rivalry, throwing suspiciously tailored revenue numbers about, others see parity as a source of intense cross-pollination and a growing single resource pool.

On the eve of Siggraph, the symbiosis between the industries becomes acutely clear in regard to digital content creation tools. The push to create compelling visuals for the next generation of consoles drives animation toolmakers to push their craft ever further. This effort, interestingly, is leading the way for film visuals, according to Discreet's Dan Prochazka, whose 3DS Max 7 has its world premiere at Siggraph (see page 4).

Even in less obvious areas, such as the art of pitching, there are numerous correlations to film methods. Marketing games to publishers these days means putting together a film-style trailer to sell the concept before you've actually made the movie, er, game. For example, TKO Software put together its trailer for SAHARA with precious few game assets in place, opting for more of a teaser approach, emphasizing the film, book, and actor licenses and concept art (see page 64).

The subject matter of games is also tracking with film. We have period pieces, action dramas, underdog stories, and even political documentaries. In the midst of the cinematic emergence of powerful documentaries such as *Fahrenheit 9/11*, *The Corporation*, and *Control Room*, Ubisoft greenlit Stardock Entertainment's THE POLITICAL MACHINE (see page 6), offering players the chance to control the course of actual presidential elections, complete with special interest pandering and smear campaigns. Whether hanging chads and partisan election officials come into play has yet to be seen.

And then there's the profitable and inflammatory subject of war. Steven Spielberg's *Saving Private Ryan* set off a flurry of World War II-themed films, which seem to have in turn spawned a flurry of World War II-themed games. Both filmmakers and gamemakers saw the opportunity to fast-forward to the present and bring the news to life—as Ridley Scott presented *Black Hawk Down*, and

Kuma Reality Games created KUMAWAR, an online tactical squad-based game featuring missions from events from the U.S. invasion and occupation of Iraq. As both entertainment industries veer toward greater and grittier realism, the definition of entertainment itself begins to shimmer, as if it were about to wink out of existence. Like most other developers dealing with modern warfare games, Zombie chose to back away from that point by taking the state of the world as a starting point, and superimposing a fictional story in SHADOW OPS: RED MERCURY (see page 34).

The symbiosis between film and game has a more systemic dark side, too. Many developers and even publishers will remark at the game industry's growing addiction to Hollywood licenses (for every TOMB RAIDER made into a film, 10 *Lord of the Rings* turn into games). The idea that publishers have no choice but to follow the sure thing in an inflated-budget world has the nagging ring of a self-fulfilling prophecy. Where does that leave a strategy of innovation? Is there an environment that would allow the next THE SIMS to take root and grow? We'll have more on that in the coming months, as a handful of publishers and developers set forth their ideas for rebalancing our world.

SPECIAL ENGAGEMENTS. We are very proud to introduce our newest columnists to *Game Developer*. Sean Barrett has worked as a programmer on several games for Looking Glass Studios, and is one of the architects of the annual Indie Game Jam, an experimental catalyst for brainstorming that aforementioned innovation. His dry wit and programming zeal more than qualify him to carry the banner of The Inner Product forward.

Furthermore, you may have noticed that the previously rotating audio column was penned by Alex Brandon, audio manager at Midway Games, for the last couple of issues. Alex has loved game audio since he first heard "those cool digitized instruments on LEGEND OF KAGE in 1984," and he plans to keep advancing it. Well, we're making it official now: Alex is our resident Aural Fixation columnist, and his mastery of and dedication to the field will give the column the resonance it deserves. ❖

Jamil Moledina
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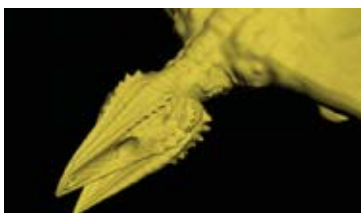
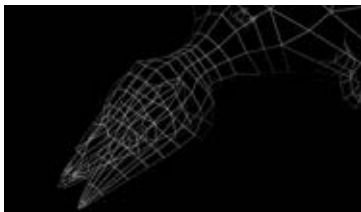
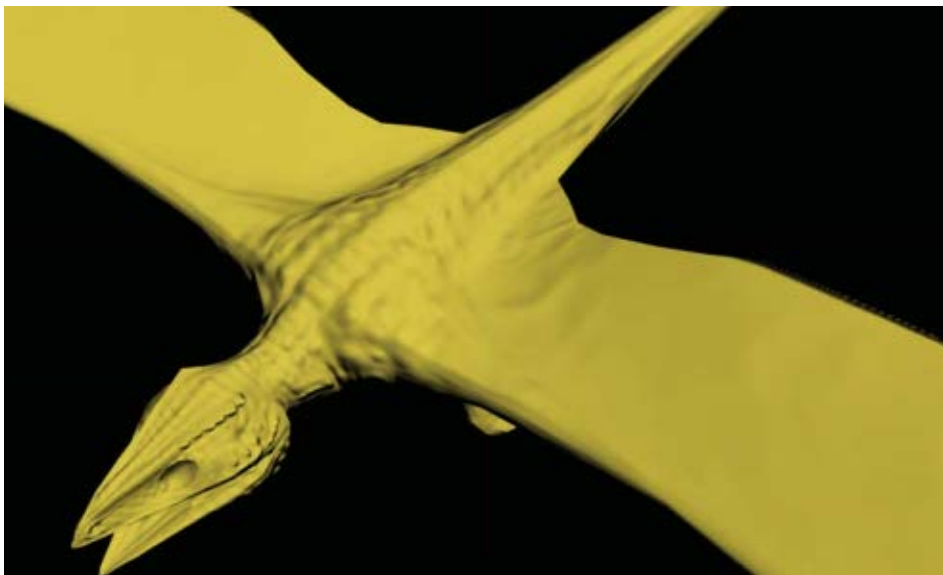
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SIGGRAPH

Discreet Unveils 3DS Max 7



A 2,068-polygon wireframe of a flying creature (left), a 384,074-polygon wireframe of the same creature (left middle), a shaded render of the high-poly model (left bottom), and the low-poly model normal mapped to resemble the high-poly model (above); all created by Discreet animation QA engineer John Stetzer using 3DS Max 7.

» SIGGRAPH 2004 ATTENDEES

get a first public viewing of the upcoming 3DS Max 7, scheduled to ship in Fall 2004. 3DS Max 7 touts, among other enhancements, normal mapping—an advanced function for wrapping high-resolution textures onto low-polygon objects. Aimed at producing highly detailed models without exhausting computing resources, this approach has the potential to save digital artists significant rendering time. Furthermore, it can also dramatically increase the performance of graphics-intensive games. While this implementation was created

with feedback from the UNREAL team at Epic Games, the feature is targeted at digital artists working across the digital content creation field, including game development, film production, and visualization.

The functionalities of Character Studio, an animation module for Max users, are now fully integrated into 3DS Max 7. This means popular animation tools—such as single-click parametric skeletons, kinematic blending, animated pivot points, and biped-head targeting—are available to Max users without additional purchase. To support the steadily expanding base of mobile-game developers, 3DS

Sh—A Cross-Platform API for GPUs and CPUs

THOUGH THERE ARE ALREADY

three high-level shading languages designed for programmable graphics processors (OGSL, HLSL, and Cg), there is apparently room and need for more. Developed in the Computer Graphics Lab at the School of Computer Science

Max 7 offers native mobile 3D asset-creation features with a JSR 184 exporter.

Game artists may want to examine other major features, such as the Custom Attributes Collector, for animating multiple custom attributes in character setups; Edit Poly Modifier, for editing complex polygonal surfaces; Skin Wrap Deformer, for applying props and clothing to pre-skinned models; TurboSmooth, for smoothing the algorithm of high-resolution models; and Smart Object Culling, for suppressing select scene-elements to achieve the targeted frame-rate.

According to product manager Dan Prochazka, “the innovations introduced in 3DS Max 7 anticipate the computing sophistication of next-generation PCs and consoles, which will in turn push forward film and visual effects as a whole.” 3DS Max 7 is expected to ship in early October and will be available for \$3,495. The upgrade from Max 6 is \$795 and from Max 5 \$1,295. The Character Studio module may be purchased separately for \$995.

—Kenneth Wong

PREVIEW

at the University of Waterloo, Sh will be officially launched at Siggraph with an open-source license.

The first implementation is a language quite similar to C++, but other bindings are planned for the future. Though the initial focus of Sh will be on shader programs, the intent of the API is much broader—to be optimized for shaders, vector-intensive or multipass algorithms, or general-purpose programs to be written that can run on CPUs, GPUs,

or an array of other processors (think PlayStation 3) without the programmer having to write different code for each.

Sh will be presented in a paper at Siggraph (“Large Meshes and GPU Programming: Shader Algebra,” Thursday from 10:30 A.M. to 12:15 P.M.), and in a forthcoming book from AK Peters, *Metaprogramming GPUs with Sh*.

—Peter Sheerin

Sensible Haptic Toolkit to Debut at Siggraph

KNOWN FOR ITS PHANTOM SERIES OF FORCE-FEEDBACK 6DOF INPUT devices and associated FreeForm modeling software, Sensible will begin shipping and demonstrating a new high-level haptics toolkit at Siggraph. Part of the 3D Touch SDK family, this new API builds on the company's existing low-level HDAPI, and is modeled after OpenGL, to make it easy for graphics programmers unfamiliar with the geeky details of haptics to add support for force-feedback (volumetric) and surface feel properties to their 2D painting, texturing, and 3D modeling tools, enabling direct interaction with the Phantom devices. Pricing was not announced at press time, but the SDK will be bundled with the Phantom Omni with 12 months of support.

—Peter Sheerin

Alias Brings Maya Unlimited to Mac OS X

Toussling Maya Hair in Mac OS X

AT APPLE'S ANNUAL WORLD Wide Developers Conference this June, Alias announced that Maya Unlimited would be available for Mac OS X. The product includes Maya 6 (currently packaged as Maya Complete, and reviewed on page 10 of this issue), and includes special effects features such as Maya Hair, Maya Cloth, Maya Fluid Effects, Maya Fur, and Maya Live.

According to senior manager Rob Hoffman, the OS X version is a “customer driven release, based on requests from individual users and those in a production environment.” He finds that 20 percent of Maya Complete and 50 percent of Maya Personal Learning Edition are Mac users, and so he considers them “an early adopter crowd that’s hungry for the latest and greatest.” Maya

CONTINUED ON PG 63

Motionbuilder 6.0 Features Dynamic Animation Editor

KAYDARA WILL BE SHIPPING VERSION 6.0 OF ITS MOTIONBUILDER CHARACTER animation tool at Siggraph. Many of the enhancements over version 5.5 are designed to improve existing functionality, such as adding keying groups to the keyframer, visualization of animation paths by showing trajectories in the viewer, and tweaks to the UI such as a more compact properties dialog box. But more significant capabilities include a new dynamic animation editor with intuitive adjustments of character poses within the keyframe controls, and multiple IK pivot points and switching between IK and FK, allowing better foot animation.

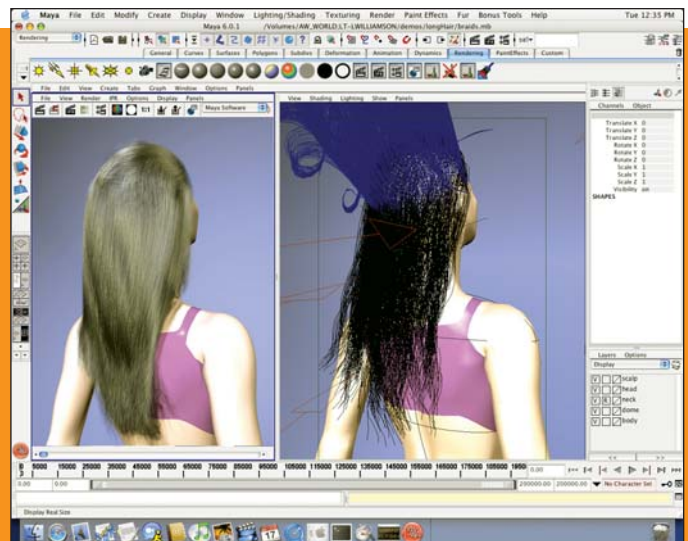
—Peter Sheerin

Programmable Features Highlight OpenGL 2.0

AFTER MORE THAN A DECADE IN existence, OpenGL is about to undergo its most significant change yet. At Siggraph this August, the OpenGL Architecture Review Board (ARB) will be announcing the ratification of OpenGL 2.0, which adds the OpenGL Shading Language (OGSL) core for the first time (it was an extension of version 1.5) and

adds a number of non-shader related programmable features to the core, designed to eventually replace many of the existing fixed-function features that had previously dictated graphics chip design. These changes morph OpenGL into a language closely aligned with the programmable, parallel, SIMD nature of the latest graphics cards, and

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Political Manipulation for Everyone

EAGER TO PULL SOME POLITICAL puppet strings? Think you're savvy enough to manage Franklin D. Roosevelt? THE POLITICAL MACHINE, a new PC game from developer Stardock Entertainment, puts players in the role of presidential campaign manager. The challenge: Raise funds, win endorsements, and gain support from the right states to win the electoral college vote on election day.

The game, published by Ubisoft and due out in late summer, straddles both strategy and tycoon genres and takes place against the backdrop of a realistic map of the United States.

Tony Kee, Ubisoft's vice president of marketing, says the game will stimulate people's interest in this November's actual presidential election. "Read my lips, THE POLITICAL MACHINE will get people motivated about elections while allowing them to gain insight into the behind-the-scenes wheeling and dealing of a modern presidential campaign." Emphasizing the importance of winning votes from the electoral college—and not the popular vote, strumming songs of remembrance about the presidential showdown of 2000—one can't help but wonder if the concept developers of this game

have an agenda, or at least a point, to press.

Players can fashion their own presidential and vice presidential candidates, or select from a list of pre-designed ones, including Sen. John Kerry, President George W. Bush, and former President Ronald Reagan. The strategy requires players to bestow various characteristics upon their candidates, endowing them with a delicate balance of intelligence,

stamina, integrity, minority appeal, charisma, military service, experience, and other attributes.

A single-player option is available, or users can join a multiplayer version online and smear other players' candidates into the ground.

—Jill Duffy



Comcast's Ante Into Games

IN JUNE, CABLE TELEVISION AND INTERNET ACCESS PROVIDER Comcast (with help from Exent Technologies) added Games on Demand to its list of services, which gave the company's broadband customers unlimited access to more than 60 PC games for \$14.95 per month.

Over the course of a year, Comcast's fee works out to be a little less than \$180. If one estimates a PC game on CD-ROM to cost between \$25 and \$50, gamers could purchase only about four to seven games over the same time period for the same total price. While the service may not offer the benefits of ownership or an unlimited selection of top titles, it may appeal to consumers choosing among other economical gaming programs such as the rental plans offered by Gamefly.com and Blockbuster.

Comcast is able to successfully implement the service in a short time frame due to its increasingly large and well-known footprint on the Internet access provider plane. The company's name-

recognition will probably give its game service the most weight. But the company also acquired TechTV not long ago and renamed it G4techTV, a 24/7 television channel devoted to interactive entertainment, which provides additional heft in the gaming credibility department.

Games on Demand promises subscribers monthly game title additions, parental controls, and remote configuration and support. Titles currently in the list of more than 60 games offered include DEAD MAN'S HAND, ATARI ARCADE, CLIFFORD READING, and FIM SPEEDWAY GRAND PRIX.

—Jill Duffy



Moore's Law Inspires Predictions

MOORE'S LAW ARGUES THAT THE transistor density of a silicon chip will double every two years, implying an eight-fold increase in processing power by 2010. For example, PlayStation 3, estimated for release in 2006, reportedly will process 1 trillion calculations per second, or 1,000 times faster than its predecessor. The consulting firm Deloitte Development, a member of Deloitte Touche Tohmatsu, used Moore's Law in a recent study (titled "Moore's Law and Electronic Games") on how the electronic games industry will adapt to changing technology in the next six years and to predict methods of success and failure therein.

As hardware technology advances, and as the number of homes with broadband climbs, the report states, publishers will be pushed to spend more money to create more sophisticated games, and small publishers will be forced out of the market.



Bill Swartz, Mastiff LLC

But is this as simple as it sounds: Will small publishers be forced out of the market? Or will they find their niche?

"If forced to make a single speculation, I'd say that medium-sized

companies without the flexibility and cost advantages of small players, or the resources of big ones, are an endangered species," says Bill Swartz, head of publisher Mastiff LLC.

"Barriers to entry are rising and companies are being squeezed out," Swartz says. "But in this business, a good idea, say, TETRIS, can survive 15 years of technological progress, and continued use of older equipment, and backwards-compatible equipment, means any complete transition will take five to 10 years."

Another overlooked complication in the study is the success of casual games.

"For my money, the big trend in the industry is not so much new hardware increasing production costs, though of course that is important, but the shift toward a mass market," Swartz says.

The report reasons that Moore's Law will hold true through 2010 equally for mobile phone technology. Increased power, increase download speeds, increased multiplayer capability all sound promising, but that forecast is beginning to sound like it's catering to the hard-core market, which won't let mobile phone companies hook the consumers they want: everyone.

"I'd put aside Moore's Law and stress that this is entertainment, and entertainment is about software, not hardware," Swartz says. "Betamax, anyone?"

—Jill Duffy

Viacom Chairman Circles Midway

MIDWAY GAMES, KNOWN FOR THE MORTAL KOMBAT SERIES, MAY BE IN A MORTAL struggle of its own. In April, Viacom chairman Sumner Redstone, who owned 49 percent of Midway (MWY: NYSE), made a filing with the SEC declaring his desire to increase his stake in the company to 80 percent or more. Around the same time, the media mogul hired a financial advisor to investigate the possibility of taking Midway private. Within two months, he acquired enough shares to increase his holdings to more than 70 percent. He has also agreed to purchase 1.25 million shares from the outgoing Midway chairman Neil Nicastro. Phyllis Redstone, Mr. Redstone's ex-wife who was awarded 3.2 million Midway shares in the divorce, has also been heavily trading, according to her SEC filings. In June, Mr. Redstone's daughter Sheri Redstone was installed as vice chairman of Midway. Several days after Sheri's appointment, at the Global Digital Summit sponsored by OglivyOne, Viacom's CFO Richard Bressler urged executives to "figure out if there's a market for advertising in videogames." Even though Mr. Redstone's purchases have been made either directly or through his own company, National Amusement, the business ties between Midway and Viacom appear to be strengthening.

—Kenneth Wong



Fork in the Online Road

PLAYERS HAVE TO PAY, BUT THEY DON'T NECESSARILY have to "play" anything. Persistent online worlds are diverging in terms of business model and gameplay, offering complex, virtual economies and social systems instead of masterfully crafted storyboards and epic quests.

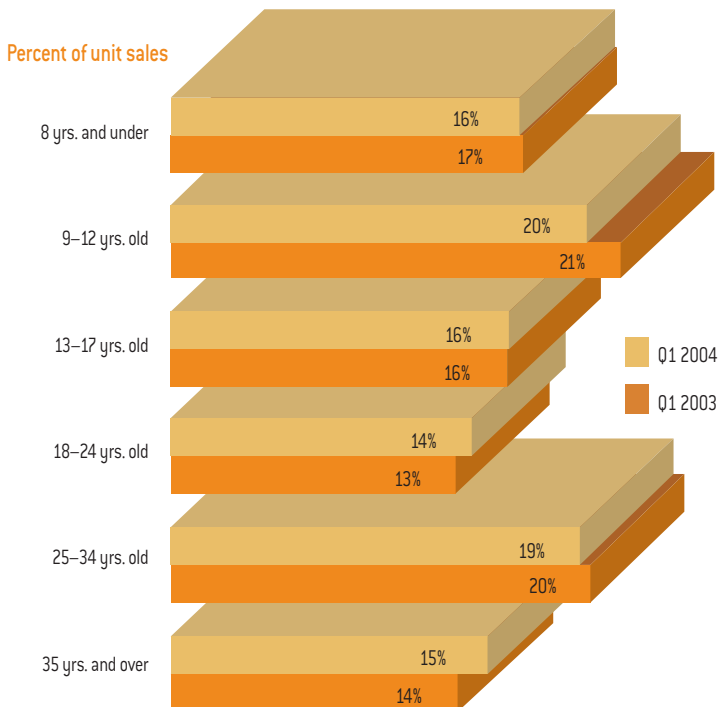
SECOND LIFE, a massively multiplayer online game, has established an online economy where total commerce for the month, about \$200,000, nearly meets the value of the economy in total—about \$248,000, or 54 million "Linden dollars," the game's currency.

The game from Linden Lab, which launched in late June 2003, is chocked full of members who own and operate businesses either directly in-world or online, selling goods and services that can be used in-world. And while it might seem as though **SECOND LIFE** is pushing boundaries by expanding the definition of gameplay to include entrepreneurial setups, e-commerce, and even charity auctions, Linden Lab can't take all the credit. The users drive the economy and the game company only provides a platform (and support) open enough to allow user ideas to become realities. Users—often graphic artists and game developers—are designing clothes, toys, muscle-textured

CONTINUED ON PG 63



Player Demographics: 2003 to 2004
Who game buyers are purchasing for



Based on total U.S. units sold
Source: The NPD Group/NPD Funworld@/Consumer Information

SNAP and Java Synchronize

AT THE RECENT JAVAONE DEVELOPER CONFERENCE, Nokia and Sun Microsystems announced their partnership to promote mobile multiplayer Java games. To that end, Nokia's SNAP technology will be integrated with Sun's Java 2 Micro Edition wireless toolkit, Java content delivery system, and Java enterprise system. Nokia and Sun started working on this in March to bring Nokia's mobile online multiplayer and community functionalities to Sun's wireless toolkit. The latest announcement signifies Nokia's plan to branch out into the wider mobile market, where Java is the lingua franca, to foster more interaction between N-Gage handset users with other mobile device users. Given the fragmentation of mobile platforms, Nokia's Ryoichi Shiratsuchi, vice president, strategy of network game and community, wants to "offer developers the ability to create innovative mobile multiplayer experiences on the standard of choice," referring to Java.

—Kenneth Wong



the toolbox

KHRONOS GROUP AUNCHES TWO NEW APIS

KNOWN MAINLY FOR ITS

ownership of the OpenGL ES standard (OpenGL for embedded systems), the Khronos Group has begun development of two new APIs that will be of interest to mobile game developers. OpenVG is an API for accelerating Mobile and Tiny SVG, Mobile Flash, and any other Bezier curve-based vector image format on low-power processors with Bezier curve acceleration built in. OpenMAX will provide the same sort of hardware-independent API for media processing accelerators. Targeted at library developers, it will allow the creation of components for YUV conversions, CLUTs, motion

compensation, audio processing, graphics, and imaging operations that will run on a variety of mobile and other processors.

PCI EXPRESS BECOMES REAL

THE LONG-AWAITED PCI EXPRESS bus, ultimately designed to replace both the PCI and AGP busses, is now a reality. Intel-based workstations are now available with 16-channel PCI Express slots, AMD is not far behind, and the three major graphics card vendors—3D Labs (Wildcat Realizm series), ATI (FireGL Visualization series), and Nvidia (GeForce PCX series) have all announced or begun shipping PCI Express graphics cards. Thus, gamers and content creators can now buy a computer that should last

another couple of graphics card generations. The serial, star topology nature of the bus will have implications beyond just graphics cards, but the primary interest for the game market will be the 16-lane slot, which offers a 4GB/second bandwidth—in each direction—and a greater power capacity (150W) than even the rare AGP Pro 110 (110W) slots.

The three graphics card vendors have initial PCI Express strategies ranging from just supporting the consumer market (Nvidia) to offering only cards for content creators (3Dlabs and ATI),

relying on new AGP cards for the consumer market and other content creators, though these strategies will surely merge as the new bus gains a larger installed base. Since the initial PCI Express chipsets offer only 24 lanes and a high-performance graphics card needs 16 lanes, first-generation systems will feature just one of these slots, with perhaps a 4-lane and one or more 1-lane slots for other peripherals.

—Peter Sheerin



Get Online and Vote!

The 2004 Game Developer Top 20 Publishers feature is coming soon, and part of the ranking will be based on our survey on Gamasutra.com. So speak now, or forever hold your peace: www.gamasutra.com/survey.htm

Perforce 2004.1 Improves Visualization of Changes

PERFORCE BEGINS SHIPPING

version 2004.1 of its content management system. Many of the enhancements focus on providing better methods of visualizing changes that are made to the source and its structure. The revision graph

features a chart that clearly indicates the relationship of revisions to the various code streams, and a visual diff system for both folders and files that uses color to clearly indicate where changes, insertions, and deletions have been made.

Pricing for Perforce 2004.1 is \$750 per seat up to 20 (with several discounts based on volume, with a floor of \$450 for 1,001 or more seats), and the pricing includes one year of support and maintenance [\$150 per year, per seat thereafter].

—Peter Sheerin

calendar

INTERNATIONAL CONFERENCE OF ENTERTAINMENT COMPUTING 2004

Eindhoven University of Technology
Eindhoven, The Netherlands
September 1–3, 2004
Cost: EUR 150–750
www.icec.id.tue.nl

2004 AUSTIN GAME CONFERENCE & WOMEN'S GAME CONFERENCE

Austin Convention Center
Austin, Texas
September 9–10, 2004
Cost: \$85–\$175
www.GameConference.com
www.WomensGameConference.com

TOKYO GAME SHOW 2004

Nippon Convention Center (Makuhari Messe)
Tokyo, Japan
September 24–26, 2004
Cost: JPY 1,000
<http://tgs.cesa.or.jp/english/>

>> first person

HERE'S THE CHALLENGE: A WOMAN WITH TWO

young kids who wants some social/recreation time, can't leave the house most evenings, and has money to spend. This is the target demographic that core market game developers are frequently ignoring, and casual game developers are cashing in on. It is also, coincidentally enough, my own demographic. But why should a game designer care? Maybe

because as an industry, we're tapping out our core market, and if we want more sales, we need to expand. Online casual games are already succeeding at this with their combination of brief but satisfying gameplay and social networking.

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—Ellen Beeman,

Live Team Producer, Monolith Productions

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ALIAS'S MAYA 6.0

TOM CARROLL

MAYA 6

DA BOMB

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(upgrade from 5: \$899)

SYSTEM REQUIREMENTS

Windows 2000 SP1 or XP; Irix 6.5.15;
RedHat Linux 9.0 or Enterprise
Linux WS 3.0; or Mac OS 10.2.4.
Pentium II or higher, AMD Athlon
or better; or Mac G4 or G5, 512MB
of RAM, graphics card with
OpenGL acceleration, 450MB of
free disk space.

PROS

1. Increased support across the board for the Photoshop PSD, multiple audio tracks in the Trax editor, MEL scripting, application of deformers to particle streams, and more.
2. The Maya Hair Toolset is powerful and flexible.
3. Refinement of the connection between Maya and Mental Ray.

CONS

1. Lacks voice activation for various common functions.
2. Maya still leaves far too many invisible nodes and other trash within its saved files (why else would Alias have to continually improve Clean Scene?).
3. Maya's .PSD support doesn't include layer styles or adjustment layers, just the composite images that result.

WITH MAYA 6, ALIAS HAS TARGETED improvements for several industries, including game development. For our market, the key improvements are in the areas of integration with other tools, better scripting and programming support, and performance. (When rating the significance of any software upgrade, it is often important to count the number of buzzwords that occur in the official release notes. Alias managed to introduce "advance the state of the art," "single workflow solution," and "impact user performance," all into the first page alone.) All cheekiness aside, however, this version provides a host of tools and features that Maya users have been seeking for a long time.

MODELING IMPROVEMENTS. One of Maya 6's most powerful modeling features is the Soft Modification Tool and Deformer. 3DS Max users know this as Soft Selection, but Maya's is much more versatile. This tool allows the user to manipulate (move, scale, and rotate) a selection with customizable curve-based falloff. The falloff allows these manipulations to subtly blend with surrounding geometry. Thus, it's possible to expand Gwyneth Paltrow's dainty nose until it assumes Cyrano-like proportions without distorting the rest of her face (that is, if she were a Maya model). Performing the same transformations under Deformer creates a history that can be edited later and even animated.

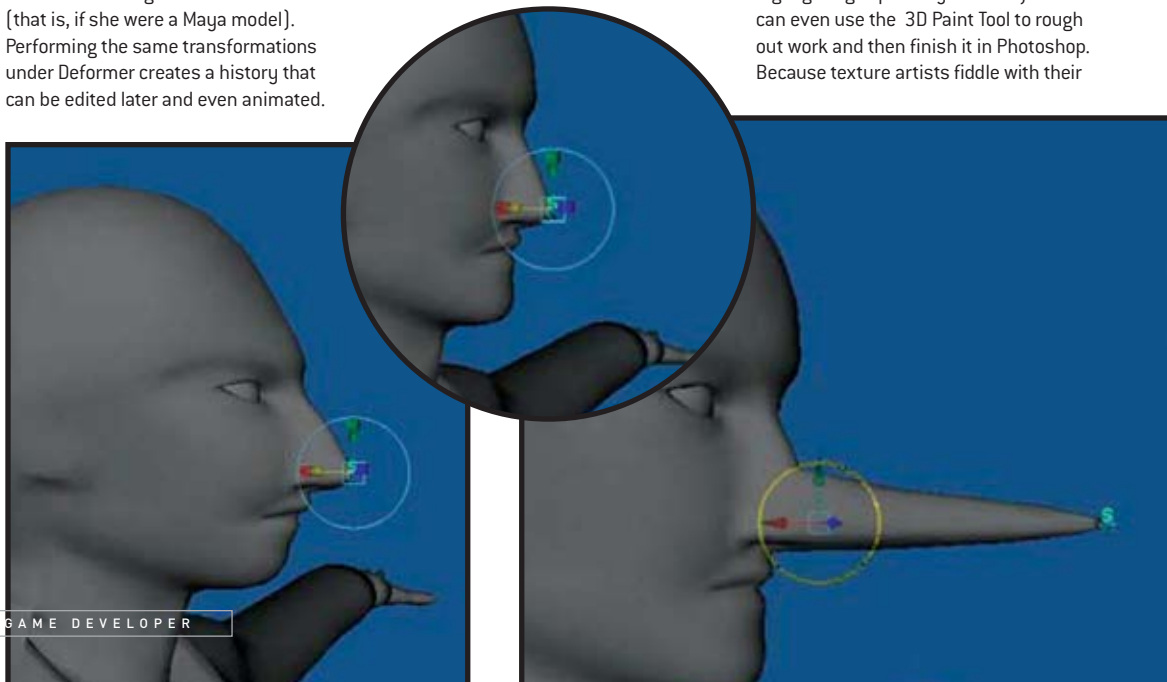
A new feature called Polygon Mirror Cut (also a popular feature of 3DS Max) creates a plane of symmetry across which geometry is mirrored. Users developing characters or scenes that require symmetry can work on one side of the mirror cut and have their changes reflected on the other side.

Polygon Bevel, which has long been the bane of Maya modelers because it was unpredictable, has new options that give cleaner results. For example, by increasing the Angle Tolerance value, unwanted edges are removed from a bevel. Also, selecting Fractional in Offset Type prevents inside-out bevels from happening. The V.6 Bevel also preserves the UV information of surrounding non-beveled faces and as new roundness and worldspace functionality. While still not perfect, it's come a long way, baby.

Lastly, various everyday functions, such as merging vertices, work much more efficiently, and file referencing has been enhanced, allowing you to choose whether references load automatically or manually; and nested references now work reliably, so you can actually use them. Bound files for videogames are often composed of numerous coincident

sub-scenes that are imported into the same file. Such files are vertex hogs until they are merged and optimized. When five city blocks and seven roads—31,805 vertices in all—were merged down to 28,675 vertices, Maya 4.5 took 3 min. 40 sec. on my modest Pentium 4 with 1GB of RAM. Maya 5 did the same merge in 3 min. 5 sec. And—ta dah!—Maya 6 took just 1 min. 42 sec. This backs up Alias's claims of performance gains and will make a real difference for developers.

ADDING TEXTURE. Stop the press! Maya 6 has embraced .PSD! Maya 6 users can now read a native Photoshop file in as a texture node, making it much easier to experiment with all that layered graphical goodness. For example, the user can employ any existing Photoshop file from version 6.0 (or higher) as a texture in Maya without having to first convert it to some other file format. Maya can also export to Photoshop, so you can convert a .PSD file to a Layered Texture in Maya to help visualize and work with the individual layer sets, or create a layered .PSD file from within Maya in order to paint color, bump, and create specular highlighting separately on an object. You can even use the 3D Paint Tool to rough out work and then finish it in Photoshop. Because texture artists fiddle with their



Extreme makeover, made possible by Maya 6.0's deformation capabilities

.PSD files almost as much as mechanics tinker with a high performance engine, this capability will be a huge improvement for workflows, as changes will automatically be updated without having to import the images again.

The Photoshop support is not perfect, however. Since Maya only imports raster or vector content, adjustment layers and layer styles are not supported. You either need to link to the main composite image of the .PSD, or rasterize the layer styles and effects if you're linking to a single layer or layer set.

Another boost to image quality is support for creating and editing normal maps, allowing you to add a great deal of realism to low-poly models. This will become very important as companies begin developing for PlayStation 3 and Xbox 2; each is expected to support normal mapping technology. Maya 6 also extends full support for Portable Network Graphics (PNG) and Microsoft DirectDraw Surface (DDS) image file formats. Both are relatively new: PNG replaces the GIF in many applications and DDS can be used to store textures and cubic environment maps.

ANIMATION. Maya's Trax Editor is better than ever. In fact, it is now the central focus for animation within Maya, bringing previously scattered items such as attributes from the channel box, the graph window, and visor all into one place. It gives animators new ways to edit, combine, and repurpose various types of animation data. The ways it is used to group, scale, trim, cycle and blend clips have also improved.

The Animation Retargeting feature can transfer existing animation data (such as motion capture data) from one skeleton to another (including both joint rotations and expressions, for example). Amazing results can be obtained even when the hierarchies and proportions of the skeletons don't match. With Motion Redirection, existing motion data can be given a new direction; for example, you can make a character that's walking in a straight line to walk in circles, descend a hill, or climb stairs. And with the Trax editor's Character Mapper feature, you can map animation clips from one rigged character to another, even if the control attribute names don't match, simply by selecting both control names and adding them to a mapping table.

A part of the updated animation capabilities is the Hair and Dynamic Curve feature (available in Maya Unlimited only, see the image on page 5), which is good for more than just hair creation and styling. It can be used to give dynamic properties to any NURBS curve. Thus, it's possible to simulate ropes, chains, and wires—as well as wire deformers on particle systems or objects that follow when a Spline IK chain is made dynamic, like a dangling tail. The possibilities are endless.

FAREWELLS & LAMENTATIONS. Twelve-hundred words are simply not enough to cover all the cool new features in Maya 6 (the reviewer's guide from Alias alone is 22 pages). There's only space to hint at new MEL scripting functions, default scene capability, the Hypershade sorting bin feature, and the ability to attach deformers to particle streams. The vast number of improvements and new features, along with the

key workflow and improved model realism they enable, make me recommend Maya 6 for existing users without hesitation.

Tom Carroll is a 3D environment artist working on MIDNIGHT CLUB III for Rockstar San Diego. He is also putting the finishing touches on Dread Naught, an original 2D graphic novel. Contact him at tcarroll@gdmag.com.

RTZEN RT/SHADER 1.0

SPENCER LINDSAY

IN EVERY GAME PROJECT I'VE BEEN

involved in, there's always a moment when the graphics programmer, harried and exhausted, wishes that the effects artist would just leave him alone for a while and let him get his work done. We spent more time developing the shader system on my last project than we did actually creating shaders. Unless you have an effects artist who can create shader code (some studios are lucky enough), valuable artist and programmer time is spent waiting for the graphics programmer to create custom shaders. Once these shaders are in place, there begins the long process of artist wanting a tweak in the shader, programmer tweaking, artist wanting another tweak...you get the idea.

RTzen has come up with a tasty little application that seems to solve this problem. If you're using advanced shading effects in your engine and you don't mind a few of the typical version 1.0 glitches, RT/shader 1.0 is the effects artist's supertool.

FIRST LOOK. Upon starting the program, I found the interface to be pretty straightforward. Laid out much like a WYSIWYG HTML editor, it shows a graphical representation of the shader code—what RTzen calls a "wiregraph." Very similar to other hierarchical graph viewers, it shows inputs and outputs of the various modules of the shader code. Below this is an editing window that

RTzen RT/shader 1.0

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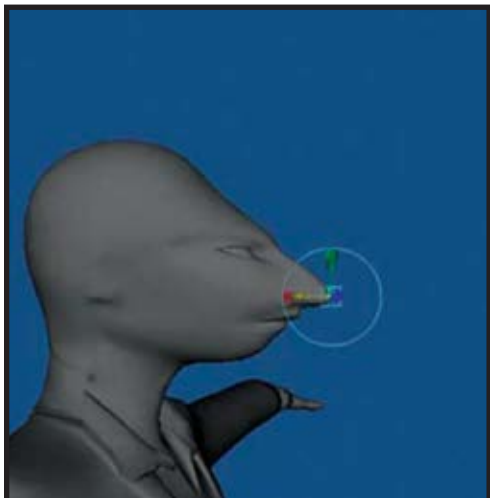
Pentium III, Pentium 4, or AMD Athlon PC at 1GHz or greater, with 256MB of RAM, 90MB of free disk space, an Nvidia GeForce 4 or ATI Radeon 9700 Pro (or better), Windows XP with .NET Framework 1.1 or higher, and DirectX 9.0a or higher.

PROS

1. Similar to WYSIWYG HTML editors in that you can create code by assembling blocks of art.
2. Makes creating complex shader code a breeze for artists with little technical or programming experience.
3. Real-time shader updates from both code and wiregraph changes.

CONS

1. This 1.0 version crashes occasionally.
2. Some interface features don't follow UI standards and conventions.
3. Complex shaders can get a bit slow in the wiregraph viewer.

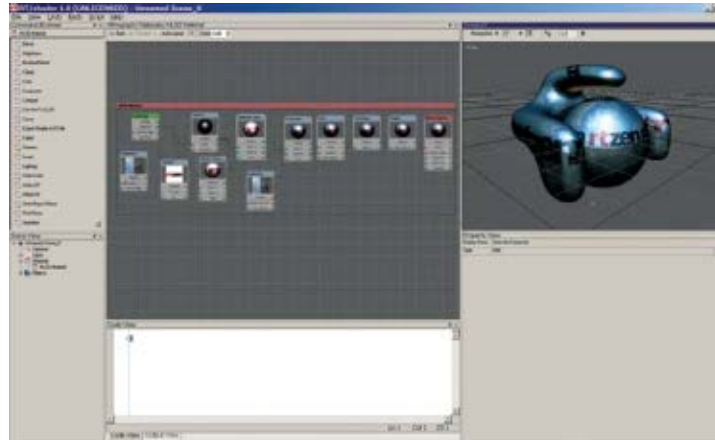


displays the actual code generated on the fly as you bring the myriad of available structures into the workspace and wire them together. In addition to these two main windows, RT/shader provides several other data windows and a real-time 3D view of the shader so you can get feedback instantly.

DEEPER. RT/shader offers three types of top-level material nodes: Code Material, High Level Shader Graph (HLSG), and Low Level Shader Graph (LLSG). In the two shader group types, code representations are defined as “Nodes” and “Assemblies.” Nodes are usually some kind of filter. Filters are the basic elements of the wiregraph system. They take input properties, process those inputs, and provide a single output. Filters can perform a multitude of functions on data coming from the mesh (including vertex normals and x, y, z position, for example), texture map values, or on other data generated internally. Wiring these nodes together is done in a very straightforward way; pulling wires from an output socket of a node to the input socket of another node makes the connection, which is then highlighted (and run at right angles so it doesn't get too confusing).

Once a series of nodes is wired together, you see the results of the connections instantly in the render window. Remember what I said earlier about the artist and the programmer? This makes fast iterations possible for the artist and keeps you fiddling with it until it looks just right. No more hanging out in the programmer's office, drumming your fingers and staring at him while he codes and silently plans a way to kill you. But I digress.

A BIT DEEPER. In addition to the HLSG, RT/shader allows a lower level of construction and tweaking with the LLSG. Using this mode, you can create pretty much anything that you could if a capable programmer coded the shader by hand. Access to Vertex Shaders, object component query functions (such as



RT/shader's interface makes it easy for an artist to create sophisticated real-time shaders, simply by connecting the outputs of building blocks to the inputs of others, applying filters and other operations, while the program generates the actual shader code and displays the results of the shader immediately.

vertex normal, color, position, and so on), and a huge list of standard mathematical functions permits the user, with a bit of practice, to create really complex and beautiful shaders.

USING IT FOR REAL. After completing the tutorials, I created a simple mesh in 3DS Max, exported it as both .3DS and .X, and then started playing. Using just the HLSG material, I was able to quickly create several of the shaders that I always ask for first from my graphics programmers: scrolling material (for electronic arrow signs or rivers), blinking material (for control panels and warning lights), and a sweet reflective material with specular highlights. On my last project, just these three shaders took months to create and perfect. If we'd had this program back then, we might have saved the team a few late nights of eating cold pizza and chugging Mountain Dew.

RT/shader will also work in conjunction with both Discreet's 3DS Max 6.0 and Alias's Maya 5.1. The integration seems a bit more solid on the Max side, but since I was working with an unlicensed copy, I was unable to verify the functionality of either plugin.

SOME GLITCHES. Every piece of version 1.0 software I have ever used has had a few glitches, and RT/shader is no exception. While the interface is laid out very nicely and I was able to navigate with ease, it does not always keep with the standard windowing conventions I'm used to: instead of scroll bars in the

Command Browser, there are up and down buttons, and the Property View uses arrow keys to move between fields instead of the tab key, which I found frustrating while editing text. I crashed the program a few times but that was mostly during my first “button-mashing” phase of testing the software, and when I reported this to RTzen, they were prompt in responding (even though they didn't know that I was reviewing).

FINAL WORDS. Although not the first application produced to solve the problem of artist/programmer communications, RT/shader is an extremely solid tool that I will definitely be buying for our studio. Even with the tool's high price, every game development team working with CGFX shaders should at least look at this tool. I figure, if I can spend two grand and save a month of programmer time, I'm making a great investment. ❖

Spencer Lindsay is an independent consultant who works with game development teams and design firms. He can be reached at slindsay@gdmag.com.

RT/shader 2.0

RTzen will introduce the next major release of RT/shader at Siggraph 2004. Code-named Ginza, this release will incorporate a number of new features, such as render-to-texture functionality, custom shader-filters, Shader model 3.0 support, GLSL support, shader templates, and workflow improvements.



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THE BIG GUN FOR GAME DEVELOPERS

» WHAT ARE GAMES MADE OF AND HOW SHOULD DEVELOPERS PROTECT THEM?

As more money is involved in game development, protecting games from competitors and pirates becomes increasingly important. As simplistic as this statement is, the questions generated by it are immediately more complex. This article addresses some of those questions and includes a short introduction to all forms of intellectual property (IP) protection, with particular attention paid to copyright. Copyright is emphasized because it is the most powerful and versatile IP protection tool for game developers—it's your big gun against thieves and competitors.

What are games made of? For the purpose of legal protection, games are made of ideas. It's a wonder of the information age that "property" no longer necessarily means a chest of gold or an acre of land. Game property is IP, meaning it is a property comprising ideas. This is true of the game code, story, art, and even the music. It is important to note that this type of property, this collection of ideas, is a type of property that is more valuable than almost any material wealth. Given its value, IP also needs fences and guns to protect it, but not the same kind used to protect traditional property. Game IP needs the protection afforded by legal means such as patents, trademark, trade secret, and copyright.

Protecting IP is much more complex than protecting traditional property. It is fairly easy to know when a diamond necklace is missing, but it's harder to know when code is leaked or when a foreign company is making an unauthorized sequel to your game. The notable difference is that stealing the necklace leaves behind a missing necklace, but IP can be stolen without a trace. Any abuse, theft, and misuse of IP is generally referred to as infringement. To protect against it, the first step a game developer should make is to find an attorney who is familiar with IP, preferably an attorney with experience with IP as it relates

specifically to game companies. IP protection also depends on a solid plan within the company, and an attorney is a necessary part of that plan. Developers need attorneys both defensively and offensively. Attorneys should be involved in planning IP protection before any portion of the game exists. Defensively, developers can work with attorneys to build a

protective IP structure and portfolio that aggressively prevents pirates and competitors from illegally exploiting the developer's IP. Offensively, developers need attorneys to litigate infringement suits, write cease and desist letters, and obtain injunctions to stop infringing parties. However, the positive effects of a perfect IP protective structure and advice are substantially diminished if the developer lacks the resources or motivation to combat infringement.

Accepting all of the above, namely that IP is complex and an attorney is a necessary part of the process, why read the rest of this article? First, a knowledgeable game developer can ask good questions when dealing with IP advisors, saving everyone time and money. A game developer familiar with IP may recognize the warning signs of IP infringement in game development early, before money is wasted on creating an infringing character, story line, or feature. In addition, much of IP protection requires planning and structure within the development company. An educated consumer of IP advice is best situated to understand that advice and implement structure within the company that protects IP. Most importantly, all the contracts and licenses surrounding games deal with IP, from the work-for-hire contracts for employees to publishing deals, royalty structures, and even movie rights. Finally, the developer knows that the ultimate responsibility for protecting and selling the game rests on him or her. Given everything discussed above, that burden requires an understanding of this extremely important topic.

NON-COPYRIGHT IP PROTECTION: PATENTS, TRADEMARK, TRADE SECRET PATENTS

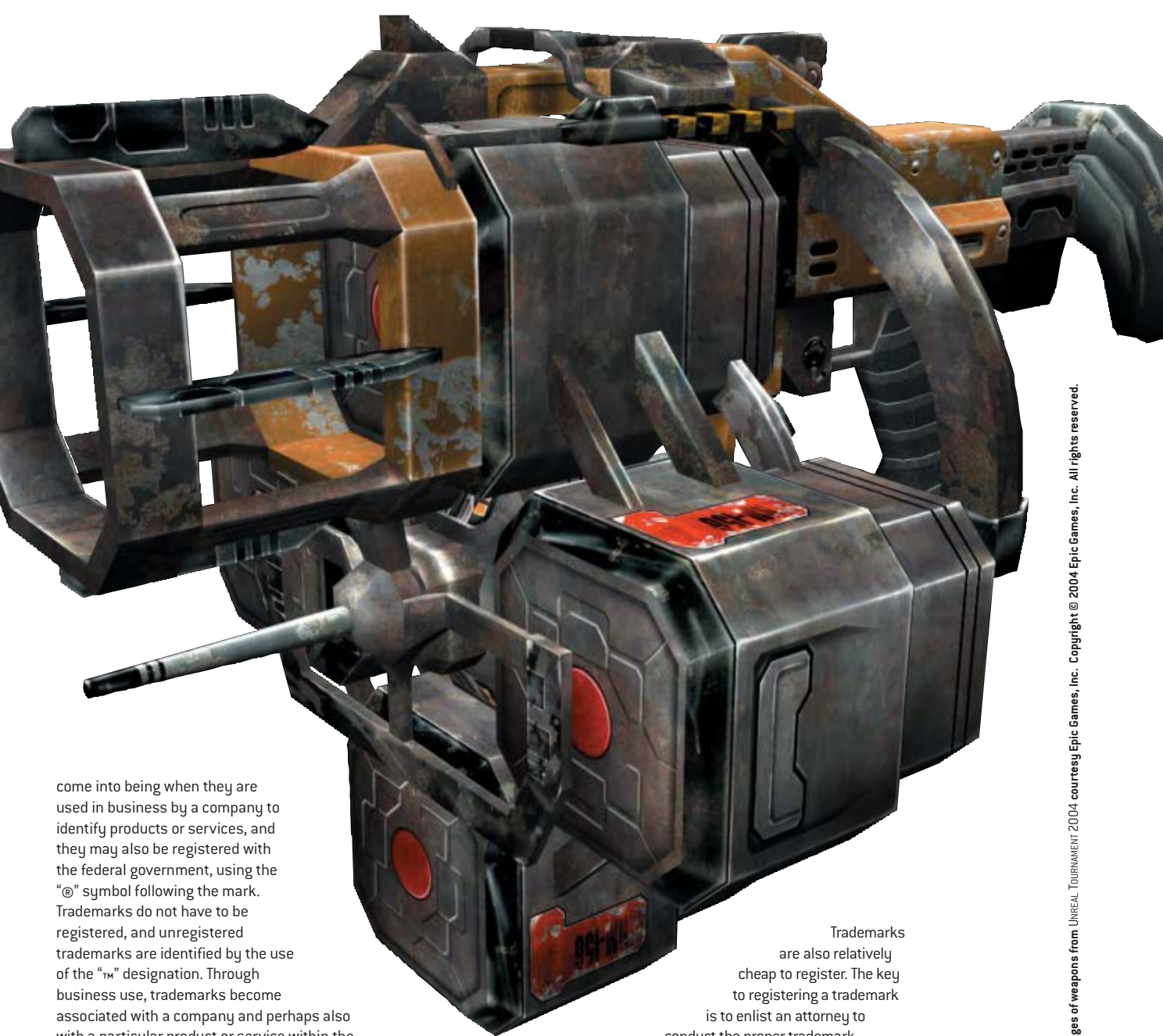
Although extremely important for some software and other inventions, patents are not used often in the game context. Patents protect inventions that are both new and useful. Examples include machines, pharmaceuticals, medical equipment, video cards, or a better mousetrap. Patents do not usually protect games because games do not usually meet the statutory criteria. Patents are also relatively short lived compared to other forms of IP protection. They have a term of 20 years in the U.S. and most other countries. In addition, the application process can often take more than a year and cost between \$5,000 and \$15,000. Given the short life, complexity, and expense, it is fortunate that patents are almost never needed in game development.

TRADEMARK

Trademark is a word, name, symbol, or short phrase used in business to identify a specific company's products. Trademarks



S. GREGORY BOYD has degrees in both law and medicine and has published articles in each field. His experience in the game industry includes serving as an author of the IGDA white paper on IP. In September, he will be an associate with the law firm Kenyon & Kenyon, which represents several companies with game development and publishing interests.



come into being when they are used in business by a company to identify products or services, and they may also be registered with the federal government, using the “®” symbol following the mark. Trademarks do not have to be registered, and unregistered trademarks are identified by the use of the “™” designation. Through business use, trademarks become associated with a company and perhaps also with a particular product or service within the company. Microsoft, Nvidia, and Atari are all trademarks which cause consumers to conjure up specific associations between the company and its products.

Although trademarks are not the primary focus of this article, they are arguably the second most important IP protection for game developers after copyright. A good trademark can set a company and its games apart from others in the minds of consumers. The strongest trademarks are words that have only the meaning that a company has given to them. They do not mean anything alone. In short, the more imaginary the trademark, the stronger the trademark. Don't name your next computer game and development company, “Computer Game” by “Game Development Company.” Those terms are too generic to become good trademarks. Names such as Exxon, Eidos, Intervolve, and Kodak are great trademarks because they do not have any other meaning besides the meaning the company generates in them. This is another fascinating aspect of how IP respects and promotes creativity. The strongest trademarks are purely fanciful, with all meaning derived from the company. Moreover, trademarks can be immortal. Almost all other forms of IP protection will expire eventually, but a trademark that is properly used, protected, and registered can last forever.

Trademarks are also relatively cheap to register. The key to registering a trademark is to enlist an attorney to conduct the proper trademark searches to insure that the mark your

company seeks is original. Microsoft has learned this lesson the hard way, not once, but twice in the game context. The Xbox trademark was in use by another software company when Microsoft started marketing the Xbox. Worse, the competing company was a publicly traded company that should have been easy to find. This case was eventually settled out of court and probably cost Microsoft a substantial amount of money. The most recent trademark lesson for Microsoft came with the planned MMORPG MYTHICA. As you probably know, one of the most popular games in that market, DARK AGE OF CAMELOT, is made by Mythic Entertainment. This potential trademark conflict was so obvious it could have been uncovered simply by asking just about anyone familiar with the genre. Whether causally related or not, Microsoft canceled the whole MYTHICA project earlier this year. After the game cancellation, Microsoft settled the suit with Mythic, agreeing not to use the term “Mythica” and to drop its U.S. applications to register “Mythica” as a trademark. As part of the settlement, Microsoft also assigned Mythic the rights to international trademark applications and registrations for “Mythica,” as well as the associated domain names.



TRADE SECRET

Trade secrets are essentially exactly what the name implies. They are company business secrets. The most famous example of a trade secret is the formula for Coca-Cola. The formula is known by some people at the company, but it is not known for certain anywhere else. Other examples of trade secrets include customer lists, notes on game development, and other internal business items that are valuable to game development, but not protected with the other IP tools.

Two advantages of trade secret are that they have no registration cost and can be protected relatively quickly. Trademark requires using the mark, and patents require an application. Both also require federal registration fees. Compared to the other forms of IP protection, only trade secret and copyright can obtain instantaneous protection. While there is no registration fee for trade secrets, it would not be entirely fair to say that their protection is free. A company must make structured efforts to keep valuable business information a secret if that company wants to claim that information as a trade secret. Obviously, this includes not telling anyone unless they need to know the information, but it also can include other internal security measures to protect the information.

A final important quality of trade secret law is that it is state law, not federal law. Therefore it can be more variable and complex than other IP laws, such as patent or copyright law, because it can differ from state to state. A developer should be certain that he and his attorney are familiar with any state nuances that affect their trade secret protection structure.

COPYRIGHT IP PROTECTION THE BIG GUN FOR GAME DEVELOPERS

In the area of game IP, copyright easily qualifies as the big gun in protecting game property because of its ease of use, power, and versatility. Generally speaking, copyright protects the fixed expression of ideas. As far as games are concerned, copyright covers stories, characters, places, music, graphics, and even the software code itself. Moreover, it also protects the entire game as an audiovisual work.

COPYRIGHT IS EASY TO INVOKE

Copyright is also easy to invoke. Copyright instantly attaches to a work as soon the work is created. In contrast, patents and trademarks have important and complex application processes with registration fees. Trade secrets require that certain steps be followed within the company, and constant vigilance to protect the secrets, but copyright comes into being as soon as an original work is fixed in a tangible medium. Even though registration is not

necessary, it is still be a good idea. Getting a copyright is cheap and easy, and also required to fight over infringement in court.

Another key element of copyright is that the definition of art is surprisingly broad beyond the most minimal standards of original expression. From Botticelli to *BREAKOUT*, all fixed original creations can be protected by copyright. The game *BREAKOUT* is appropriate to mention here because that game was the subject of a series of cases surrounding the minimal level of creativity necessary for copyright. Atari tried at least twice to register the game for copyright. Registration was initially rejected because of the simplicity in the artistic display in the game. *BREAKOUT* was merely a rectangular object moving in one plane that reflected a small ball into a multicolored wall of rectangles. The ball eliminated a portion of the wall of rectangles and rebounded toward the bottom of the screen, where the player attempted to move the lower rectangle to redirect the ball back toward the wall of rectangles. Atari had to fight a series of cases over the application rejection from 1989 to 1992, eventually winning the fight. This series of cases is important, not only to game IP, but to copyright in general. They stand for the proposition that courts or the Register of Copyright will not judge the creativity or artistic quality in copyright. Any original fixed work in a tangible medium is protected.

COPYRIGHT PROTECTION IS LONG

The length of copyright is another element that makes it attractive for game developers. Copyright is long, not immortal like trademark, but long enough to outlive their creators. At different times, copyright has varied in length, and the history of copyright contains enough different lengths for such protection to make it seem comical. Luckily for computer games, the length of copyright for works created after 1978 can easily be remembered as 95 years after publication or 120 years after creation. This means that no one can copy *PAC-MAN* until about 2100. The length of protection is intimately tied to potential revenue generation. Game developers can use copyright to protect their ideas, build new games, and sell related products for a century.

COPYRIGHT VIOLATION CARRIES MAJOR PENALTIES

Heavy potential punishment is a necessary part of any IP protection worthy of the label big gun, and copyright has it. Punishment for copyright infringement allows game developers to prevent infringing parties from selling works that include the developer's copyrighted work. Developers can also sue for damages and profits equal to the profits the infringing parties made from selling the illegal works. There are also criminal penalties that can result in prison time when people are caught violating copyright by selling or distributing games over the Internet. An instance of this came to light in February of this year

protecting IP while presenting a game to publishers

DEVELOPERS CAN USE THREE STEPS TO protect their game IP while shopping that game to publishers.

1. HAVE A RELATIONSHIP WITH EXPERIENCED IP COUNSEL

This relationship is the beginning of educating the development team about IP rights surrounding their game project and building protections for those rights.

2. PROTECT IP IN ADVANCE

Register trademarks and from then on, use the appropriate symbol (™ or ®) when they are used in documents. Keep trade secrets when pitching a game and understand that sharing those secrets can jeopardize their protection. Write game design ideas out in detail and save concept art, early screen shots, and other documents for copyright

protection. Discuss patent registration possibilities with your attorney. For all types of IP, keep good records to document the earliest possible ownership, development, and use of the idea.

3. UNDERSTAND THE NON DISCLOSURE AGREEMENT (NDA)

Understand that publishers want to limit

their legal exposure and many "standard" NDAs are essentially one-sided documents to protect publishers. The development team should have its own NDA, and ask if the publisher would consider signing it. This negotiation can take some time and should be done before the pitch day.

understanding the subject of IP contracts

IP CONTRACTS HAVE IMPORTANT

differences from standard contracts. Goods, services, or tangible items may change hands through IP contracts, but they are not IP. Usually IP contracts are granting rights to another party to do "something" that would normally be a violation of the IP owner's rights. Put another way, the IP owner has

patent, trademark, copyright, or trade secret protection over some intellectual property. The IP owner is going to trade the right to sue over an infringing use of that property for something valuable. This may be cross-licensing with other IP, money, goods, services, or some combination of those items.

More than any other type of property, intellectual property is nearly infinitely divisible. The developer could be allowing other parties a continuum of rights from temporary licensure to permanent assignment. Developers could allow a mere use of game trademarks, book/movie rights, or even selling the

entire game IP outright or anything in between.

Finally, developers should be clear about the term and exclusivity of rights granted. How long is the contract in force? Can the developer continue to freely use/resell the IP or is the developer barred from some uses of the IP?

when Sean Michael Breen, leader of the Razor1911 warez group, received a four-year prison sentence and was ordered to pay nearly \$700,000 in damages for copyright infringement. He was one of 40 people arrested in a sting operation by the U.S. Customs Service "Operation Buccaneer."

In a pending law suit filed June 24, Midway is suing Sony Ericsson for violating its copyright on DEFENDER from 1980. Midway claims that Ericsson is using the game on its mobile phones without permission. Midway has requested that the court award damages, reimbursement of its legal fees, and require Sony Ericsson to turn over all mobile phones, software, and other materials in its possession related to the alleged copyright violation.

COPYRIGHT AND THE PUBLIC DOMAIN

What happens to protected IP after the protection expires, and how does that affect game IP specifically? The short answer is that formerly protected work that loses its IP protection passes into the public domain. This is a particularly exciting idea because it means that anyone, including game developers, can use the material to create new works. As a rule of thumb, the older a work is, the more likely it is to safely be in the public domain. Law professor Laura Gasaway has produced one of the most cited tables for determining the expiration of copyright. This chart is a good starting point for investigating copyright expiration and can be found at www.unc.edu/~uncclng/public-d.htm. Before making any final decision, it is prudent to check with IP counsel before using works assumed to be in the public domain. There may be special circumstances surrounding a particular work that limit its use in a game. A common example is when public domain works have been previously used to create new works. The new works will have their own new IP protection, but the underlying public domain works remain in the public domain.

The story of Robin Hood is an excellent example of this situation, in that it's practically a fairy tale. By this, I mean that there may have been someone that performed similar feats in medieval England, but the myriad of stories do appear a wee bit exaggerated. It is also true that there have been countless books and movies using the Robin Hood story. There have also been several videogames based on Robin Hood, his merry men, the Sheriff of Nottingham, and Maid Marian. The main point here is that the underlying story and characters are part of the public domain, but when creating new stories using this inspiration, developers should be careful not to infringe on modern works that still have copyright protection. The license-hungry game

developer should be encouraged by a secondary point implicit here: there are many popular stories and characters now available for free game development, including much of the great art and literature from the 19th century and earlier.

Another important example of the public domain comes in the form of myths, history, and cultural lore. Anyone can use these as familiar settings to build games because they are so old and their authorship is collective and forgotten. Consider place names as story elements in myths and modern copyrighted works. Place names alone are not subject to copyright, but they may be subject to trademark. However, place names, especially story-critical place names, are important story elements and may be protected with copyright as story elements. Specifically, using place names in a way that evokes associations with a previous story may or may not contribute to copyright infringement, depending on the several factors discussed below.

Before the trademark dispute and subsequent cancellation of MYTHICA, the game was going to use the place name Muspellheim. DARK AGE OF CAMELOT and MYTHICA were both MMORPGs set up using Norse mythology. DARK AGE OF CAMELOT also used the name Muspellheim. They can both do this because Muspellheim is a place from Norse mythology. That story is not under copyright protection because the author or authors are long dead. Contrast this with using The Death Star or Tantooine for game development names. This would be an entirely different case because these places, as story elements, are the intellectual property of the Star Wars universe. These names were created recently by an author and are protected by copyright as story

IP SUMMARY FOR GAME DEVELOPERS

	PATENTS	TRADEMARK	TRADE SECRET	COPYRIGHT
LENGTH	20 years	Potentially immortal	Potentially immortal	95 years from publication
COST	Expensive	Inexpensive	Inexpensive	Inexpensive
COVERAGE AREA	Medium	Narrow	Large	Large
EASE OF OBTAINING PROTECTION	Difficult	Moderate	Moderate	Easy
FREQUENCY OF USE OF DEVELOPERS	Infrequent	Frequent	Frequent	Frequent
REGISTRATION	Mandatory	Important	Unnecessary	Important for litigation
OVERALL IMPORTANCE FOR DEVELOPERS	Less important	Important	Important	Paramount

COPYRIGHT—THE BIG GUN

FOR FURTHER INFORMATION

The IGDA web site address listed contains a number of free guides for game development, including a link to the IP white paper discussed in the article. The second address is a link to the wonderful monthly column written by veteran game attorney, Jim Charne. The articles frequently deal with IP issues.

www.igda.org/biz

www.igda.org/columns/lastwords

The United States Patent and Trademark Office maintains a comprehensive site.

www.uspto.gov

The United States Copyright Office is a good first stop to answer all copyright questions.

www.copyright.gov

This site contains introductory IP law articles and news geared toward technology professionals.

www.gigalaw.com/index.html

HISTORICAL LENGTH OF COPYRIGHT PROTECTION

The complicated story of the length of protection for copyright has been summarized very neatly by Professor Laura Gasaway of the University of North Carolina School of Law.

www.unc.edu/~unclng/public-d.htm

elements. Even though they are such a pervasive part of our cultural consciousness and even more well known than Muspellheim, they cannot be used in games without permission, because the stories they are part of are still protected by copyright. Any use of these names in new and similar stories would contribute to copyright infringement.

Historical events are also not subject to copyright, but the stories created out of them are. An example is World War II, a fertile era for game development. Numerous games were created featuring this time period in the last two years alone. No one can copyright the specific events of that or any time period. *BATTLEFIELD 1942* and *MEDAL OF HONOR* can both use tanks, weapons, and uniforms that are historically accurate. Furthermore, they are not infringing each other's copyright because the games are merely representing historical facts. Copying a story inspired by historical facts is still copyright infringement, but merely copying the historical facts is not. For instance, a developer cannot make a game based on *Saving Private Ryan*, the movie, without the appropriate license. A developer can however, make a game about Pearl Harbor as long as she or he is creating the game around the historical event and not the movie of the same name.

SCENES A FAIR DOCTRINE

The Scenes a Fair Doctrine is similar to public domain property. This doctrine recognizes that some expressions of ideas are so often used that they cannot be copyrighted by themselves. An example

of this is the fairy tale beginning "Once upon a time." So many fairy tales begin that way that a fairy tale-based game could certainly begin that way, too. Other Scenes a Fair Doctrine examples would be the generic elements of a fantasy story including wizards, dragons, dwarves, and elves. These races and their general stereotypes are not copyrighted, but specific instances of these races that are clear characters such as Gandalf or Drizzt would be.

THREE STEPS TO PROTECT YOUR IP

Even the largest game development companies can make trivial errors in IP protection that cost mountains of money or, worse, the whole game. These errors could easily be avoided with an introductory understanding of IP and a relationship with a competent, experienced attorney. Failing to

take these steps is the metaphorical equivalent of leaving the city gates open and letting the Visigoths rush in. Game developers can take three steps to avoid these potentially disastrous IP pitfalls. First, developers should have a basic understanding of IP, especially the areas that are most important to the creation of games. An invaluable, yet free resource for this type of information is the "IGDA IP Rights White Paper." This work was written by an international collection of attorneys and game developers with the goal of spreading beginning IP advice to the game development community. It is available for download free from the IGDA web site. Second, developers should have an attorney with broad experience in IP, especially trademark and copyright. This attorney is invaluable in setting up the most efficient and protective internal structure to protect IP and in negotiating the myriad of game contracts that are literally bubbling over with IP-related language. Third, developers should ensure that their employees and contractors sign appropriate agreements assigning all the IP they produce to the company. These are the steps necessary to build solid legal defenses around valuable game property. It is not an understatement to say the life and future of your game depends on it. ❖

This column is intended for general educational and entertainment purposes and is not legal advice. Every situation is unique. Anyone entering into a contract should have a lawyer who can provide counsel.



how IP contracts work

DEVELOPERS CAN UNDERSTAND the basics of IP contracts using the framework below. This involves knowing the answer to three questions. Admittedly, it is simplistic, but functional.

MONEY IN

When and how is money paid to the developer?

Money can be paid as a percentage of revenue, flat fee, or some combination of these. The payment may change based on units sold. It is critical to understand how exactly these figures are calculated and where the check comes from.

MONEY OUT

Do the developers ever have to pay money?

The answer to this question covers the ways a developer could have to pay money to the other party. The developer may somehow breach the contract and owe damages. The developer may be entering into a joint agreement to promote or develop products that require an investment.

CONTROL

What exactly must happen before money, rights, or burdens shift within the contract?

Understanding "money in" and "money out" is not enough without an understanding of who or what ultimately approves the flow of money. Are payments calculated quarterly, monthly, or annually? If the contract is based on some milestone system, who makes the final approval decision before a check is cut?

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FAST RADIOSSITY USING PIXEL SHADERS

>> **LIGHTMAPPING HAS BEEN A POPULAR METHOD FOR LIGHTING** since even before multitexture hardware made it a fast way to render environments in a single pass. There are still several advantages to using lightmapping today when we have some other lighting options. It has the flexibility of lighting an environment in any way imaginable, from a bright room with many lights, to a dimly lit corridor—with equal speed. It works well with the latest hardware, taking up a single texture stage, thereby allowing it to be easily combined with other lighting effects. Lightmapping also provides a nice fallback to older hardware that doesn't have all the latest per-pixel processing. Perhaps the biggest advantage of lightmaps, though, is they enable the use of sophisticated pre-calculated lighting such as radiosity and other forms of global illumination.

For all its advantages, lightmapping has its drawbacks as well. Lightmaps take up a significant amount of texture space because they cannot tile the way a base texture can. They can also require more texture changes in a scene than might otherwise be necessary with other lighting techniques. These are relatively small problems compared to one of the largest drawbacks of lightmapping—processing speed.

Global illumination looks great but it can take a long time to compute. Processing time can take hours or even days for large levels. Placing lights and tweaking light factors can be an agonizingly slow process. With ever increasing texture space available on consumer graphics chips, higher detail lightmaps and therefore slower lightmap processing is inevitable in the future.

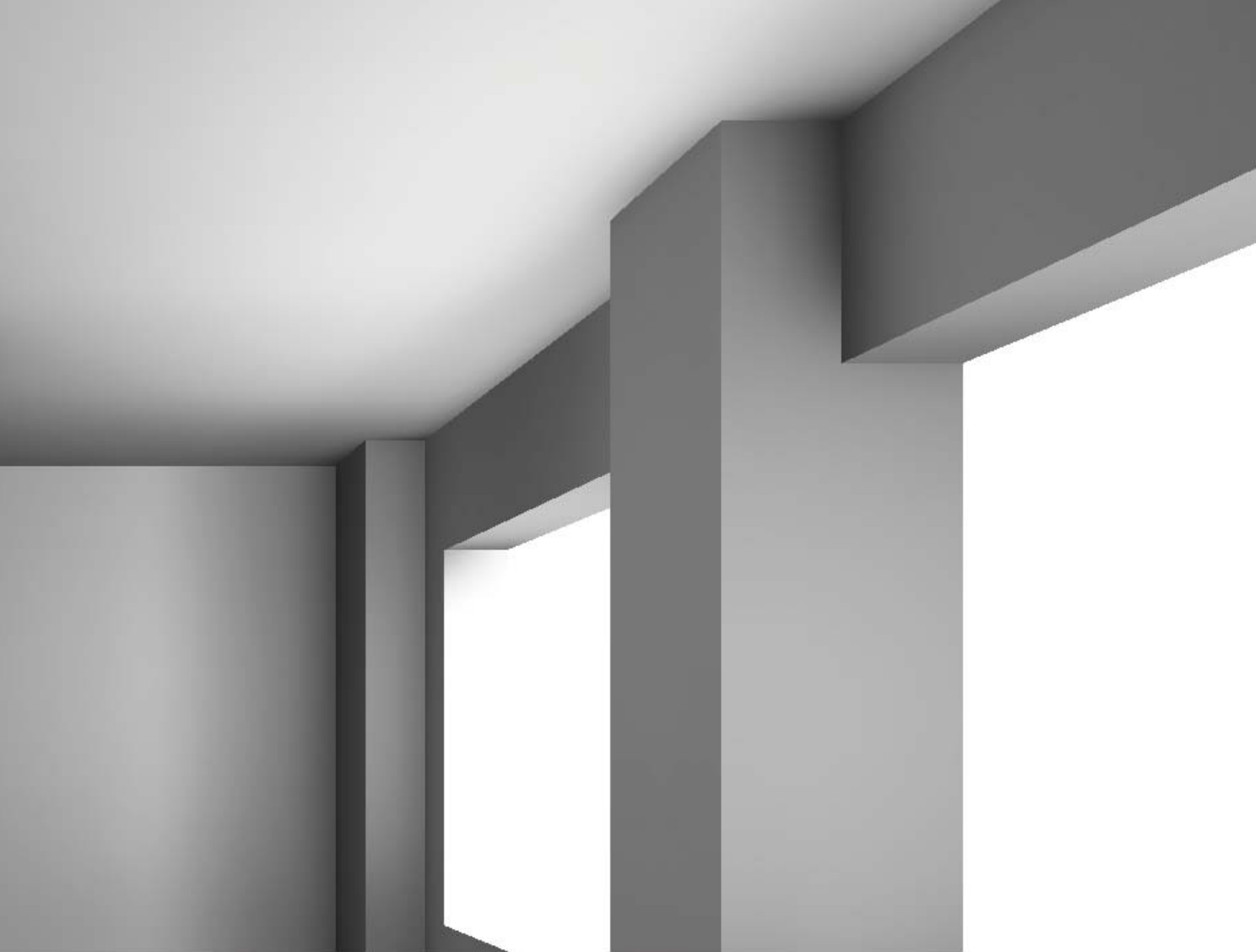
How do we process lightmaps faster? What about using the lightning fast rendering power of today's GPUs to render out the lightmaps instead of the CPU? This article explores that very question and describes a technique that can speed up the process by at least an order of magnitude.

Moving the lightmap generation process onto the GPU has several speed advantages. High fill rates mean large lightmaps are much less of a problem. Parallel pipelines and pixel shaders that can handle radiosity form factors allow processing of several light patches at a time. Finally, frequent hardware revisions mean that GPU power will continue to increase at a rapid rate—almost certainly faster than CPU processing power.

USING THE LATEST HARDWARE

There are two important improvements to DirectX 9-compatible hardware that make this technique possible. The first is the capability of pixel shaders to perform full vector operations that were previously only available to DX8.0+ vertex shaders. The new pixel shaders can also execute many more instructions compared with previous versions. The second improvement is the high precision surface, which supports up to 32 bits of color

BRIAN RAMAGE's most recent published title is *TRIBES 2* from (now closed) Dynamix. He has since gone independent and now works with Garage Games to provide cutting edge technology. E-mail him at bramage@gdmag.com.



per channel. This is very useful as an accumulation buffer for radiosity, where small amounts of light are gathered over thousands of passes.

Note that this technique is possible using OpenGL as well. DirectX 9 was chosen because of its high-level shader support across many cards, and the ease with which it can render to a texture and access high precision surfaces.

LIGHTMAPPING ON THE GPU

Let's go over how to create a lightmap from a single light source using the GPU. The basic idea is to render the surface to be lightmapped from the perspective of the light source. The camera is placed at the position of the light and oriented facing perpendicular toward the surface. The camera will need to be rotated such that the lightmap, when rendered out, matches the mapping convention being used.

Once the position and orientation of the camera are set, the projection matrix needs to be set up such that the surface fits exactly within the view frustum and fills the entire viewport (see Figures 1A–D, page 22). The viewport width and height match the size of the lightmap so that it can be directly copied from video memory later when it is stored to disk. In most cases the projection matrix will need to be skewed, or off center, unless the light source is perfectly centered above the surface—a rare case. The DirectX utility function `D3DXMatrixPerspectiveOffCenter()` can be used to set up the skewed matrix.

The reasoning behind placing the camera at the position of the light is to simplify rendering shadows. Geometry other than the lightmapped surface is simply colored black and rendered normally with the zbuffer turned on. From the point of view of the light, any geometry between the light and surface essentially becomes a shadow projected onto the surface (see Figure 1). The lightmap could also be rendered orthographically with shadow volumes, but this method is simpler to implement and faster to render.

The surface itself is fairly straightforward to set up. The vertices are passed into a vertex buffer and rendered normally once the camera is set up properly. The surface size should not be the actual surface size, however, but the size of the lightmap, which will always be larger. It's okay if the larger surface extends into other geometry in the scene. It just translates to that part of the lightmap being in shadow.

With the world and projection matrices, viewport, and geometry all set up, the only thing left to do is load the vertex and pixel shaders for the lightmapped surface. The high-level shading language (HLSL) code for the shaders can be found in Listing 1 (page 22). Note the unusual lighting calculation in the pixel shader. The attenuation model and the requirement that the light source have a direction aren't typical for point light sources that are commonly found in real-time lighting. It's what is called a form-factor in radiosity calculation and is meant for lighting between surface patches in a scene. This will be explained in more detail later, but the calculation works fine even for direct lighting, especially from volumetric sources.

ACKNOWLEDGMENTS

Thanks to John Folliard and Mark Frohnmayer for many interesting lightmapping discussions and for providing the inspiration for this article. Thanks also to the Garage Games crew for their support, which made this research possible.

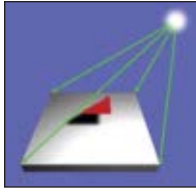


FIGURE 1A



FIGURE 1B

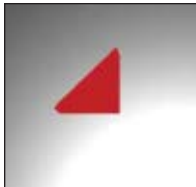


FIGURE 1C

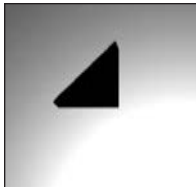


FIGURE 1D

FIGURES 1A AND 1B

Setting up the view frustum. Place the camera at the light source. The green lines in FIGURES 1A AND 1B indicate the view frustum. Note how it exactly fits the surface to be lightmapped.

FIGURE 1C

Once the perspective matrix has been set, the remaining geometry is placed correctly for shadowing. Note how the red triangle in FIGURE 2D now matches the position of the shadow in FIGURES 1A AND 1B. Color the red triangle black and it becomes the shadow on the lightmap.

FIGURE 1D

Color the red triangle black and it becomes the shadow of the lightmap.

Note that squeezing the form-factor into a pixel shader is the key to speeding up this whole process. Having parallel pipelines in this graphics technology means that several form-factors are being calculated at the same time.

ACCUMULATION OF LIGHT

Lighting a bunch of surfaces from a single light source is nice, but to have a robust lightmapping solution, it must support multiple overlapping lights. To accomplish this, an accumulation buffer is used for each surface.

The accumulation buffer is a high precision texture with 16 or 32 bits per channel that is flagged as a render target. It must be a power of 2 in width and height, and it essentially serves as the lightmap until the light accumulation is complete. A high precision surface is used because radiosity requires the accumulation of thousands of light sources that emit tiny amounts of light that would not fit within an 8-bit range.

If high precision surfaces supported blend operations, they could simply be set as the render target, and each light source could be additively blended to it until done.

Unfortunately, they do not support blending, so it must be done with a pixel shader and some render target juggling.

Three textures are needed to pull off blending with a pixel shader (see Figure 2, page 24). One texture is a scratch buffer of normal precision, and the other two are high-precision accumulation buffers. All of the textures must be the same width and height. For each light source, the scratch buffer is rendered to first. Then the results of that render are combined with one of the accumulation buffers and stored in the other accumulation buffer. The two accumulation buffers are alternated between as source and render target with each light source. When all the lights are processed for a surface, the last buffer rendered to is combined with the accumulation buffer for the surface in the same manner.

The rendering to the accumulation buffers is done by performing an orthographic (2D) render of a quad that exactly fills the frustum. Since the viewport is the same size as the textures, all the pixels line up and a pixel shader can be used to blend the two input textures. The Cg code for the accumulation pixel shader can be found in Listing 2 (page 28). Note the light intensity is multiplied by the value $\frac{1.0}{\text{numLightSources}}$ that is passed into the shader. That value is $\frac{1.0}{\text{numLightSources}}$ and is used to average out the intensity of all the lights absorbed on that surface for that particular lighting pass.

PLANAR LIGHT SOURCES

For the sake of this article, a planar light source is a flat 2D light source that lies along a plane in 3D. A simple way to simulate a planar light source is to break it up into lots of point sources in a grid pattern that evenly covers the light source area. The more point sources used, the finer the grid and the more realistic the light appears. See Figure 3 (page 26) for an example of how a flat square light source can be approximated. Note each light point uses a radiosity form-factor as a lighting equation and points in the direction of the normal of the planar light surface.

Now imagine that each surface in an environment can be used as a planar light source. That's the basic principle behind radiosity—each surface accepts and reflects light

back into the environment. With lightmapping, each surface in the environment is already split up into a grid of lightmap texels (or lexels, if you will). To turn a surface into a light, all that must be done is to create an emitter for each lexel with the intensity of the lexel used as the intensity of the emitter (modulated by the reflectivity of the surface).

PROGRESSIVE REFINEMENT

Before the radiosity process is covered, it should be noted that the direct lighting model outlined so far in the article can produce excellent results and can also be used as a quick way of roughly lighting a scene before radiosity is applied. Even if

CONTINUED ON PG 24

LISTING 1

```
//-----
// Structures
//-----
struct FragOut
{
    float4 color : COLOR0;
};

struct Vertex2frag
{
    float4 HPOS : POSITION;
    float4 pos : TEXCOORD0;
};

//-----
// main
//-----
FragOut main( Vertex2frag IN,
    uniform float4 lightPos : C0,
    uniform float4 lightDir : C1,
    uniform float4 surfNorm : C2,
    uniform float intensity : C3
)
{
    float4 dirToLight = normalize( lightPos - IN.pos );

    float distFactor = distance( lightPos, IN.pos );
    distFactor = sqrt( distFactor ) * 3.14159;

    float ang1 = dot( dirToLight, surfNorm );
    ang1 = max( ang1, 0.0 );

    float ang2 = dot( -dirToLight, lightDir );
    ang2 = max( ang2, 0.0 );

    float brightness = ang1 * ang2 * intensity / distFactor;
    brightness = clamp( brightness, 0.0, 1.0 );
    float4 color = brightness.xxxx;

    FragOut OUT;
    OUT.color = color;
    return OUT;
}
```


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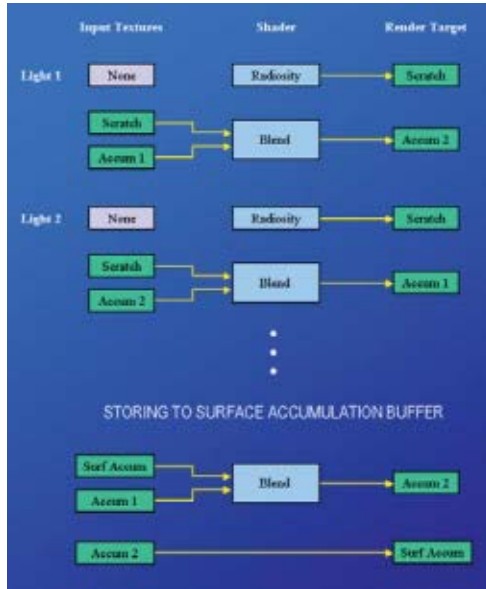


FIGURE 2 The light accumulation pipeline.

accordingly. Then the light energy would be cleared from the light source and the next “brightest” surface would need to be chosen. Because the floor underneath the light both has a large surface

radiosity is not used, this is a way to have artists or designers place lights and see the lightmapping results in near real-time.

Progressive Refinement radiosity is an iterative process where each iteration represents a major light bounce in an environment. At the beginning of each iteration, a single brightest light source is chosen and its light is distributed into the scene. The light source will change based on which surface has absorbed the most light energy that hasn't yet been distributed into the scene. When a surface becomes a light source, it's simulating the effects of light being reflected from the surface.

For example, an empty room that has a light surface on the ceiling would start out completely dark. The first iteration would choose the light source itself as the brightest surface and would light the room

area and is directly facing the downward light, it would likely have absorbed the most light energy and therefore be the next chosen light surface. After the light is distributed from the floor, the next brightest surface might be a wall that has now absorbed light from both the ceiling light and the floor. The next surface after that may be the opposite wall, and so on and so forth. Figure 4 (page 28) shows a room that is iteratively filled with light by this process from sunlight streaming in from two windows.

As the process continues, the light distributed rapidly falls off and has less and less of an impact on the scene. It can take a long time to completely distribute all the light energy in an environment. One of the advantages of progressive refinement radiosity is that there are a number of conditions that the user can set to save time or observe calculation partway complete. For instance, the user could choose to stop calculation after 100 iterations, or when 90 percent of the light energy has been distributed. This allows the user to get an initial view of how a scene would look in a few seconds without having to wait minutes or hours for the complete distribution.

FINDING THE “BRIGHTEST” SURFACE

Each surface has its own high precision accumulation buffer that gathers light through all the progressive refinement passes. That accumulation buffer also indicates how bright the surface is. To find the brightest, each surface that was lit during the last lighting iteration must be examined.

The determination of what quantifies the intensity of a surface can be done a number of different ways. The process I use is to

CONTINUED ON PG 26

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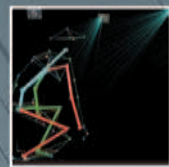
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FIGURE 3

The green rectangle indicates a planar light source that is subdivided into 1, 4, 8, and 16 point light sources in each image box, respectively. Imagine we are looking down on a room with a small wall section just to the left of the light source that is casting a shadow across the floor of the room. Note the sharp shadow that the single light source casts, and the banding that occurs with 4 and 8 light sources. With 16 light sources, the result is a soft shadow with very little banding.



CONTINUED FROM PG 24

sum the brightest color component of each level on a surface, keeping track of how many are non-zero. Then I use this formula to get an intensity value between 0 and 1:

$$\text{intensity} = \frac{\text{sumSurfaceColor}}{255.0 / \text{numLitLevels}}$$

Naturally the surface with the highest intensity is the "brightest." Once a surface has been determined to be the brightest, its accumulation buffer is added to its final lightmap output and then cleared. That way the surface will not be chosen again as the brightest unless it really gathers relatively more light.

OPTIMIZATIONS

There are many books and papers out there filled with ways to optimize the radiosity process. Unfortunately, many of them do not apply to this technique as they usually involve inter-patch relationships (hierarchical radiosity) and adaptive subdivision of surfaces. Blasting out an entire surface at a time has the advantage of processing several patches at once, but the drawback is doing extra processing on patches that might not need it.

There are some optimizations that can be done, however. The most obvious would be the

use of a binary space partitioning (BSP) or other spatial subdivision to break up the environment. The BSP is most useful for determining which surfaces are visible to a light and keeping track of which surfaces have recently been lit.

Another useful optimization is the use of sub-patches and patches. A patch in this case would be a collection of sub-patches beneath it rather than each patch being a lightmap level. The sub-patches would be the lightmap levels themselves. The patch color is simply the average of the sub-patches beneath it. Patches are only relevant to the calculation when a surface is chosen as a light source. Instead of lighting from each level, the process lights from each patch position, color, and intensity. This reduces the number of lighting passes necessary to light from a surface.

This can speed up calculation quite a bit, but it can also produce banding artifacts if the patch size is too large and/or the lighting surface is fairly bright. To get around these problems, some radiosity processors start out with small patches, and slowly grow the patch size as the amount of light energy decreases in a scene. Combined, the sub-patch optimization can increase performance by several times.

CONTINUED ON PG 28



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FIGURE 4 Progressive refinement—light comes in only through the window and bounces around the room, brightening it.

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CONTINUED FROM PG 26

HOW FAST IS FAST?

The theory behind rendering lightmaps in hardware is good, but is it really faster and by how much? To answer this question, several tests were performed using the exact same geometry and lightmap scale with various software lightmapping tools on a 1.6GHz Athlon XP CPU and a Radeon 9700 Pro GPU. The tools were: the Torque (commercial version of the TRIBES 2 engine) interior processor, Paul Nettle's free radiosity processor (www.fluidstudios.com), and gtkRadiant, the editing and lighting tool for Quake3 powered games.

Direct lighting from a planer light source was used in the test to keep the times down to a reasonable amount (less than 5 minutes). The test room consisted of more than 100,000 lexels with a lightmap resolution of 1 lexel per 16 units in Quark (a free map editing tool). This comes out to 1 lexel per half meter for the first two systems and 1 lexel per 2 feet in QUAKE.

The Torque's lighting engine required minor modification to support planer light sources and to use the radiosity style lighting formula. QUAKE's lighting supports planer light sources and the correct lighting formula, but has a very low number of light sources created across large brush areas. A separate test was used on QUAKE and the planer light source (brush) was manually subdivided to force it to generate 1,152 "material" lights.

The results of the tests showed that this technique is much faster than software processing. It was 12 times faster than the Fluid radiosity processor, 13 times faster than Torque, and 18 times faster than gtkRadiant. The hardware processing was able to compute the 100,000 lexels in the room over 1,150 times in 14 seconds. The actual number of lexels processed was 387,392 because the lightmap surfaces rendered to were required to be in power-of-two dimensions and therefore larger than the actual lightmaps.

CONCLUSION

Lightmapping in hardware is fast. It's a good way to take advantage of the latest graphics technology. Taken further, it offers relatively high-resolution radiosity processing in a reasonable amount of time. Radiosity is an efficient application of pixel shaders—the patch calculations are complex enough to require 2.0 pixel shaders, but simple enough not to push the limits on number of shader instructions.

Graphics technology can be used for applications other than lighting. Already, academic teams are using the new occlusion query features to quickly detect collisions between high polygon meshes (see References). The next generation of graphics hardware will support longer

operations, flow control, and more parallelism. Physics calculations such as approximated fluid dynamics may even be possible.

This is just the beginning; it will be very exciting to see the possibilities that GPUs have to offer in the next few years. We may see an evolution of the GPU into a general parallel processing tool rather than a specialized rendering solution. ❖

LISTING 2

The accumulation pixel shader in HLSL

```
//-----
// Structures
//-----
struct FragOut
{
    float4 color : COLOR;
};

struct Vertex2frag
{
    float4 HPOS   : POSITION;
};

//-----
// main
//-----
FragOut main( Vertex2frag IN,
              uniform sampler2D newRender : TEXTUNIT0,
              uniform sampler2D accum : TEXTUNIT1,
              uniform float passFraction : CO
            )
{
    float4 newColor = tex2D(newRender, IN.tex);
    newColor *= passFraction;

    float4 accumColor = tex2D(accum, IN.tex);

    float4 final = clamp( newColor + accumColor, 0.0, 1.0 );

    FragOut OUT;
    OUT.color = final;

    return OUT;
}
```

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FROM BUNGIE TO WIDELOAD,

SEROPIAN'S BEAT GOES ON



» **IN 1991 ALEXANDER SEROPIAN CREATED A ONE-MAN COMPANY** called Bungie to publish his second game, *OPERATION: DESERT STORM*, a Macintosh war game. Soon after, Jason Jones joined the company to publish *MINOTAUR*, a networked multiplayer-only role playing game. Next came *PATHWAYS INTO DARKNESS*, *MARATHON*, *MYTH*, *ONI*, and *HALO*. When *HALO* was first announced, Bungie was one of a handful of development/publishing/distribution houses left in the industry, a breed which is all but extinct today. When Microsoft purchased Bungie in 2000, Alexander announced that he would be leaving the company after *HALO* was completed. It's been almost three years since he left, now, and we chatted with him about returning to Chicago and starting Wideload Games, what it's like to be a sell-out, and how he thinks the development process should work.

Alex Handy: *You and Jason were a bit like Sonny and Cher, or Abbott and Costello. So, do you feel like a rock star going solo now?*

Alexander Seropian: We've been a team for a long time, and a great team we were. It's going to be weird. There are a lot of guys there at Bungie who are extremely talented, and I'll miss them. Some of them are here with me, so that makes for a small sense of continuity. The way the industry evolved made being an independent very difficult. Games are more expensive to make, and all that pressure comes to bear on the developer. I started Wideload to resolve those issues.

AH: *What are you doing at Wideload to resolve modern development problems?*

AS: The way that we're set up, we have a small team, 10 going on 11, and we're the core design team. We come up with the game ideas, intellectual property, and prototypes. We take it from inception to viability. When we do put it into production, when it's ready, we staff up with independent employees. That way, I don't have to carry a 50- or 60-person payroll throughout the whole development cycle.

AH: *How did you come up with this model?*

AS: It's not very different from the way films are made. In reality, if you have 60 people on a project, not all 60 people can be the visionary. And not everybody wants to be. We can keep this group here that's internal and keep that creative culture you have when you only have a dozen guys in a room. It's hard to get that atmosphere in a large company.

AH: *It sounds like you want to do the fun parts, then hire grunts to do the hard stuff.*

AS: Everything you do is all to produce a tool to make a game. Software's a big part of it, and programming is a fun and cool endeavor on its own; but all that code and building of engines are put into producing a robust set of tools to allow you to tell a story, to create an escape. From my perspective, at Bungie we did this all the time. We spent years making the tools and the software to let everyone create stuff. It's not that I see tech becoming a commodity, but I would rather spend two years coming up with a cool new set of characters, rules, and worlds. I'd rather do that than spend four years making a tool. I think we're getting to the point where, with consoles, you don't need to reinvent the wheel every time. You certainly want to change it, move it forward, and make it better, but that's another part of the goal of this company: to not reinvent the tech every time.

ALEX HANDY is a freelance gaming and security journalist. He blogs at www.gism.net/blog, enjoys creating weasels, and can be contacted at ahandy@gdmag.com.



PHOTO BY ALEX HANDY

AH: You sound like a total console convert.

AS: I am. The experience with HALO taught me a lot about interfaces and accessibility and what the consumer's experience really is. I find it much more compelling to have control of that experience from end to end and of making a consistent set of interfaces. You go to a movie, you understand how to do that. You sit in a seat and maybe buy a drink. You can't screw it up. If you have that kind of control over the environment, you can do cooler stuff.

AH: What can you do to make a development process succeed?

AS: There's a few ways you can address that. First, you want to get yourself into a situation where everyone working on the project has the same goals. Clearly in ONI, the three interests involved in that project did not have the same goals. Microsoft wanted the project done so the guys on it could move to Seattle for HALO, Take-Two wanted it released in their fiscal year, and we wanted to make a good game. You want to be set up so that you have lots and lots of time to do nothing but make the game right, at the beginning and the end. At the beginning you want to get in a situation where you can build the game and make what makes it fun. The way we're set up now, because we have the small team, we can take as long as we want to make the prototype.

AH: How do you set difficulty in a game?

AS: I remember with HALO, Jason would play through the game with only his left hand, and if he could do that it was easy enough. That's not exactly scientific. Difficulty is one facet of what I would call accessibility. As gamers get older and new ones come to the market, we've been forced to make the games more accessible and more challenging, to make it so that anyone can enjoy it. Traditionally, games have been played by programmers, guys who can type really fast, or the guys who are making the game. MYTH had that problem, and its difficulty was pretty steep. Your dwarves would blow up your guys all the time.


AH: What makes a game fun?

AS: Experiencing the unexpected is something that's really important. When someone starts playing a game, they have a set of expectations. If you can, give them an experience that supersedes those expectations. They think, this is an action game, and then they find the Jeep and see that they can drive too.


AH: So, what do you say to the fans that think you sold out when you went to Microsoft?

AS: We did sell out. When I started Bungie, the idea of selling out didn't even come into my head. I was so naive that we never thought that was an option. We never ran the company with an exit strategy; it was simply never thought of. ❖


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THE CINEMATIC EFFECT OF ZOMBIE STUDIOS' SHADOW OPS: RED MERCURY

SHADOW OPS WAS BORN AT THE 2002 GAME DEVELOPERS CONFERENCE

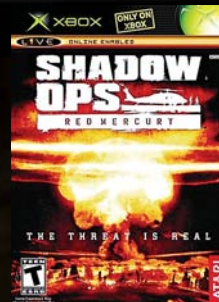
when Zombie's agent at RED, Jeff Brunner, set up a meeting between us and Atari producers Matt Powers and Steve Ackrich. Powers and Ackrich were looking for a developer to launch a new FPS franchise for Atari, one that shared their vision for the title and who had an expertise in military shooters. We immediately clicked, realizing that we had all been thinking about the possibility of an extremely intense FPS experience since seeing the Ridley Scott film *Black Hawk Down*—which we agreed was unique in its unrelenting action and gritty realism. The more we talked, the more I realized that they wanted to make the most cinematic game I'd ever heard of—one with a compelling story and extraordinary production values. We quickly began topping each other with set piece ideas until I suggested we detonate a nuke and roll an aircraft carrier in a 100-foot wave in the first 15 minutes of the game and they said, "Yes! That's what we're looking for!"

CONTINUED ON PG 36

WRITTEN BY:

MARK LONG is co-founder of *Zombie Studios* and the producer/designer of 14 titles, including *ZORK NEMESIS*, *SPEC OPS*, *RAINBOW 6: COVERT OPS*, *DELTA FORCE: TASK FORCE DAGGER* and *SHADOW OPS: RED MERCURY*.

GAME DATA



PUBLISHER:
Atari

NUMBER OF FULL-TIME DEVELOPERS:
Average of 37, peaking at 45

CONTRACTORS:
Attitude Studios, Bill Black Audio, Gentle Giant Studios, Ric Waugh and Tag Mendillo, Northwest Sinfonia, Soundelux Design Music Group, Inon Zur

LENGTH OF DEVELOPMENT:
24 Months

RELEASE DATE:
June 15, 2004

TARGET PLATFORMS:
Xbox/Xbox LIVE, WinX PC

DEVELOPMENT ENVIRONMENT:
P4s with 1GB RAM, XP Pro, Source Safe

SOFTWARE:
Unreal Ed, .NET 7.1, 3DS Max, Kaydara Motionbuilder, Pro Tools, Photoshop

MIDDLEWARE:
Unreal vers. 2.199, Xbox XDK, Karma, BINK, LipSinc

CONTINUED FROM PG 34

Atari also loved the scripting in *MEDAL OF HONOR* and wanted a similar treatment of scripted events. Our producers, Jean Philippe Agati and Rafael Curulla, thought state-of-the-art non-player character (NPC) interaction crossed with the cinematic intensity of *Black Hawk Down* should be our design goal. We all agreed that the simple innovation of communicating level objectives in situ through characters, rather than the standard military FPS loadscreen or cinematic briefing would be a critical element in our cinematic goal.

We toss the term “cinematic” around a lot in the game industry. A friend of mine who owns a Los Angeles-based special effects company says, “Everyone in the game industry wants their game to look like a movie, and everyone in the movie industry wants their movie to look like a game.” It’s funny and it’s true. But other than interstitial videos between levels, what does cinematic mean exactly, and how do you design for a cinematic look and feel?

For *SHADOW OPS*, it meant consciously adopting movie production techniques and striving at all times for a greater sense of presence—the you-are-there feel that makes you forget you’re playing a game. Some of our attempts, like a cinematic score and sound design, worked better than we could have hoped for. Some were a lot of work for little effect and others were an unfortunate waste. But in the end, we achieved exactly what we set out to do—an FPS that at times is so loud and chaotic you can barely keep up with the action. On a big screen TV with 5.1 surround sound, you’re not playing a game; you are in combat as much as we can put you there.

WHAT WENT RIGHT

1 SCREENPLAY. Movie pre-production begins with a screenplay and we decided that a game that aspires to feel like a film should start with one, too. I like working with comic book writers for a number of reasons. They tend to be game players first of all (screenplay writers, in my experience, don’t play games), and since they have to put their book out once a month, they have a real get-the-job-done mentality, which can be good and bad. But since game pre-production is much shorter than a film’s, we prefer it.

For *SHADOW OPS*, we ended up hiring both comic and movie writers. We outlined the original story with comic book writers Micah Wright and Jay Lender (*Stormwatch*). Atari then decided to

hire movie writers Ric Roman Waugh and Tag Mendillo (*Last Apostle*) to write the screenplay. Ric and Tag are A-list action writers, expert in nailing a plot point in a single line. Rafael Curulla worked directly with them, giving them recommendations and notes on the various rewrites and integrating, when appropriate, my ideas and the ideas of the cinematic director, Antoine Charreyron, into the plot. I can’t stress enough how important I think a great



writing team is. It’s time developers quit thinking they can write everything themselves and hire the best writers they can afford.

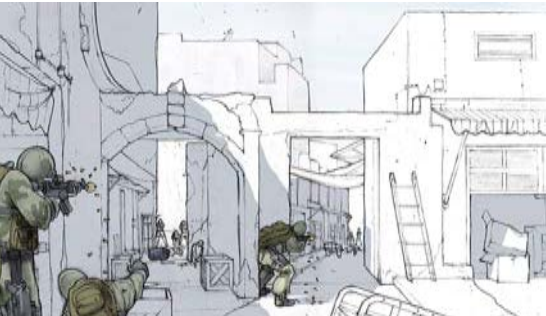
Writers Guild of America members (television and theatrical movie writers) work in a fixed five-step structure: 1) story, 2) first draft, 3) two rewrites, 4) final, and 5) polish. Like game development contacts, you’re buying their time—WGA contacts specify the number of weeks for writing and reading—and the quality of the work product is related to the amount of time you give your writers. One bit of advice: send one set of screenplay notes back for each draft. It’s a common mistake to pepper writers with additional thoughts.

2 UNREAL. Even though Atari publishes *UNREAL*, they gave us the option of licensing any engine that best fit our cinematic design requirements. And in the end, that was *UNREAL*. *UNREAL*’s native cinematic tool and real-time facial animation system allowed us to match game graphics and cinematics to seamlessly transition back and forth.

We’re engine-agnostic at Zombie. *UNREAL* is the seventh engine we’ve used, but it is easily the best. Epic is dedicated, more than any other licensor we’ve worked with, to supporting its licensees. Beginning with a technical training session that they held while they were in beta themselves for *UNREAL CHAMPIONSHIP*—the Epic team extended themselves personally and professionally to get us set up and trained.

Using a successful FPS engine like *UNREAL* also meant there was a large inventory of experienced level designers and scripters available to hire and contract. This allowed us to evaluate level designers at a distance and staff up quickly, fine tuning designers’ strengths relative to our requirements.

3 SOUND DESIGN AND MUSIC. We hired Soundelux to do the sound design for *SHADOW OPS*—the same studio behind *Gladiator* and *Kill Bill*. Peter Zinda had been one of the designers on *Black Hawk Down* and we asked for him specifically. Soundelux has been a pioneer in game sound design since the early 1990s. The company is also a licensed Xbox developer and so its staff was familiar with the Xact audio tools, allowing us to work in a homogeneous environment when we went down to Los Angeles for mixing.





Sound design was done in four steps. Weapons were first, since they're really the heart and soul of an FPS. We provided Peter a list of weapons and their associated effects: fire, reload, dry fire (empty). A gunshot is a very short, dynamic sound that gets its character from the way it bounces off of the environment it's fired in, so Peter produced three of each: indoor, outdoor, and urban versions. Next, we designed the individual sound effects and ambient sounds for each level. Sound effects were created in Pro Tools, FTP'd to Zombie, then placed in the levels with UNREALEd (UNREAL Editor). Final adjustments for reverb, reflection, and randomization were done in Microsoft's Xact audio tool for Xbox.



Midway through the project, it became clear that we had something special in our sound design and Atari decided to apply for THX game certification. THX for games is relatively new, and I was surprised to learn that THX is both an audio and a visual standard. The process involved technical tests of our studio, calibration of monitors, and a list of required modifications to meet THX certification. Once you're certified, any game "mixed" at your studio is eligible for the THX logo.

Our score was written and conducted by Inon Zur, a prolific and talented composer who has scored several games including SOCOM II and BALDUR'S GATE. We wanted a heroic orchestral score, but we also asked Inon to include a "voice" for each campaign in the game—Syria, Congo, Kazakhstan, France—something evocative of the region. We recorded with the Northwest Sinfonia and the result was an emotional amplification of the action made possible by scripting movements to be triggered by player actions—a very cinematic effect made possible by UNREALSCRIPT (UNREAL scripting tool).

4 MOCAP AND ANIMATION. Mocap is de rigueur in a military FPS. Fans of the genre have a sophisticated eye for animation realism and titles in the genre are judged on the fluidity and diversity of realistic character motions.

We ran tests on data from several mocap studios and selected Spirit Studios, a small local studio that used a magnetic capture system. Unlike multi-camera IR systems, magnetic rigs require the mocap actor to be tethered to a bundle of sensors that allow for moves of only short distances. But the magnetic data was rock solid—without any of the jitter and gaps that IR mocap normally has. And because the majority of the in-game animation was close-quarter combat—short, precise moves that were well suited to the limited tether range—we elected to contract Spirit.

To get the most realistic close-combat moves, we also contracted a former Special Forces operator who now trains counter-terrorist and SWAT teams. Because of the depth of his experience and training, he was able to replicate start and end positions closely—reducing data cleanup afterward.

The raw motion files we edited in Kaydara's Motionbuilder—a stand-alone animation tool that we found to be highly flexible. The finished



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animation files were then imported to UNREAL and linked to behaviors in UNREALSCRIPT. Additionally, we created a state blending function that modified animations, so that a hit to the right leg blended a wounded walk cycle to firing and ducking cycles.



5 TESTING. QA doesn't have a direct connection to a cinematic design, but the testing and localization teams have a hard time of it and are often overlooked, so I wanted to give them a shout out. QA works long hours under the conflicting pressures of getting the game to gold master as fast as possible and ensuring no disastrous bugs ship with the game. SHADOW OPS breezed through Microsoft's certification on first submission because of the hard work of Microsoft's and Atari's QA teams.

Beginning six months out from submission, we took advantage of Sam Charadin's offer from the Xbox Advanced Technology Group to submit our alpha for four reviews by his group: 1) technical, 2) art, 3) audio, and 4) gameplay. Sam's group identified technical certification requirements (TCR) violations and made several helpful suggestions, allowing Zombie to address TCR issues early on.

When we hit beta, Atari installed the QA lead in our studio. The full QA team was based in San Jose, and having the lead in our studio reduced regression time and allowed him to anticipate his team's workload.

At gold master, Atari flew out a localization team from its Glasgow studio—one tester for each language. UNREAL made their job easier with its native localization tools. You can, for example, output all in-game text to a single file, translate the file, and import it back to complete localization. Not quite push-button translation, but pretty close.

Having the test leads on site to make quick changes and decisions resulted in the smoothest localization Zombie has been through.



WHAT WENT WRONG

1 CYBERSCANNING. Zombie has designed a number of SPECIAL FORCES titles, and a signature of our designs has been the accuracy of character uniforms, equipment, and weapons. We decided early in pre-production that the player would be from an "Other Government Agency" (OGA) unit—the Pentagon's euphemism for its most highly classified special missions units. These teams are made up of Delta, Seal, and CIA operators—not exactly the kind of guys who like to be photographed in their gear for a game. Fortunately, we found a world class collector of spec ops uniforms and gear, and he advised us and provided the costumes for cyberscanning.



Cyberscanning is the 3D laser scanning of characters at high (about 1mm) resolution. We contracted Gentle Giant Studios (MATRIX RELOADED and MATRIX REVOLUTIONS) on Shiny's recommendation and did the scanning in Gentle Giant's mobile van at the advisor/collectors storage site. Our original goal was to derive normal maps from the high resolution scans, but as we implemented normal mapping in the UNREAL rendering pipeline, we found the framerate hit to be prohibitive and had to abandon normal mapping the characters. So the cyberscans were done at great time and expense, when ultimately all we needed was high resolution photographs of the characters in hero poses.

2 LOCATION SHOOTS. Another component of accuracy is scene realism. To achieve the highest possible scene fidelity for SHADOW OPS, we decided to travel—as a film crew does—to real world locations to capture high-resolution digital photo source for textures and binaural ambient audio for sound design. Different members of our team traveled to Morocco, Bosnia, Croatia, Moscow, Paris, and Kauai.

Some of this source material—the photos from Rabat Morocco, where the movie *Black Hawk Down* was shot for example—produced extraordinary texture source that resulted in richly detailed levels. But the source from Moscow led us down a tortured design path that we eventually had to abandon.

The second campaign of SHADOW OPS was set in the Russian Cosmodrome—the former Soviet Union's space complex outside Moscow. Our President, John Williamson, came back from Russia and told us, "You're not going to believe they launch rockets from this place when I show it to you." And he was right. The Cosmodrome looked more like a dilapidated high school science lab than a space facility. But we designed the campaign to look like the real thing anyway, reasoning that the realism would carry the design. Atari felt strongly that the fun of the gameplay and level design should be more important than realism. They decided to put together an action plan to allow Zombie to redesign this campaign properly. We ended up scrapping the levels and redesigning them to look more like an underground super-weapons complex, when we finally conceded there's not much inherently dramatic gameplay in a school science lab.





3 REAL-TIME CINEMATICS.

While hiring the movie writers, Atari decided to outsource the game's cinematics to Attitude Studios in Paris to ensure the best quality of cinematics possible and allow Zombie to focus its resources on the gameplay. Attitude had recently completed the cinematics for *TOMB RAIDER 2* and was specializing in real-time cinematics. *UNREAL* has an integrated real-time cinematic

unique content, but we should have designed separate sets of maps from the beginning of production.

PRE-PRODUCTION CONVERGENCE

Focusing on the screenplay, sound effects, musical score, and character/scene realism was how *Zombie* attempted an overall cinematic design. The convergence of movie and game production values is happening in productions like *SHADOW OPS*, but I think it's more accurate to think of games having more in common with animated movies than with live action productions. Animated films, like games, take years to produce. They are labor-intensive activities that, once begun, are difficult to change without affecting the schedule or overall production values.

Longer pre-production cycles are one answer to the post-alpha and beta changes game productions typically experience. Movies have pre-productions of a year or more—three to four times the duration of most games. Adding more time would increase costs but ultimately reduce the hidden costs in schedule slips and result in a better game. ❖



tool called *Matinee*, and Attitude had developed an art pipeline that extended *Matinee* and provided the potential for much more sophisticated cinematics than *Zombie* was producing.

But the time zone and language difference immediately became a problem. We were reassured, however, as Attitude delivered test animatics. The camera treatments and extended mocap-takes produced cinematics that looked like a big budget action movie. But Attitude was plagued with technical problems with *Matinee* as it made delivery of the final cinematics, the most intractable being a difference in floating point precision between its pipeline and *UNREAL*, which produced a number of unacceptable artifacts. A clever hack—rendering the cinematics at a lower framerate to allow the engine to catch up with the mocap animations—saved the cinematics in the end.

4 RATING CHANGE. We wanted a gritty action movie feel, so *RED MERCURY* was originally designed for a mature rating. But in focus group feedback, Atari became convinced that the game had a wider appeal and could sell more units if it had a teen rating. This meant removing blood and adult language.

The blood was trivial to turn off, but the decision to change rating came post-alpha. The voice-over had already been recorded and integrated. It was laborious, but straightforward, to remove the swearing. We couldn't help but feel that the game had been diminished. Your teammates screaming colorful obscenities in a firefight was something that made the game that much more fun, and the replacement dialog sounded flat in comparison.

5 MULTIPLAYER. *SHADOW OPS* was designed for two SKUs—Xbox and PC, with Xbox as the lead SKU. We designed the multiplayer maps in sets that were optimal for groups of eight, 12, and 16. But as we got into Xbox Live beta testing, we found unacceptable latencies over Live with more than eight players. At that point, we had done all the graphic optimizations possible, so we were forced to cut several maps and redesign others for the lower number of players.

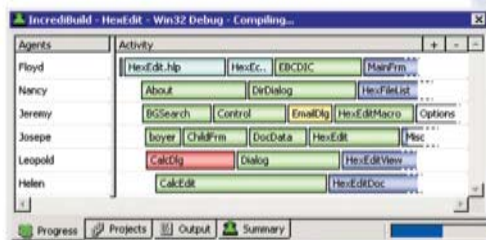
As we moved to the PC beta, we found the multiplayer maps to be too small for the larger capacity PC multiplayer games, so we redesigned again and produced new, larger maps for the PC version. We wanted a content difference between the SKUs and had anticipated that the multiplayer maps would be that



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SEAN BARRETT

» THE INNER PRODUCT

INTERACTIVE PROFILING REVISITED

ALTHOUGH THE NAME OF THIS COLUMN hasn't changed, the columnist has. I hope to live up to what Jonathan Blow has done with the Inner Product since December 2001—to deliver advanced material that's both relevant and novel. My focus will be slightly different, but I'll be just as ranty.

One thing that frustrates me—and Jon—is the limitations of commercial tools. A year and a half ago, Jon bemoaned the state of commercial profilers; in the three columns published between December 2002 and February 2003, he introduced an interactive profiling tool. After the first covering low-level profiling issues, the later ones introduced some novel, high-level analysis tools, like the Self-Organizing Map. While this was a valuable experiment, I think there's a lot more low-level information we can easily gather, process, and usefully report to the programmer.

Jon wrote, "I want this profiler to be effortless to use. It should be so fast that you can always leave it enabled in every build of a game," and, "I'd like it to be easy to detect the kinds of performance problems we care about with the profiler." He offers an example of an AI path-finding system that's periodically spiky, a case batch profilers can't detect. I share these goals; let's see if we can do even better.

PROFILE HISTORY BUFFER

ONE SCENARIO HE TESTED was moving through a rendered world and looking into the sun that caused slowdown due to excessive lens-flare fill-rate use. A problem with this example is, while rendering may be an important thing to profile, it's also the least typical of game systems, being output only. You can see performance drop, pause the game, turn on the profiler, and perturb the camera until you discover what's causing the speed hit. If there's a glitch causing the AI to spike, you can't pause the game and perturb the AI to discover the problem. In this case, the best you can do is run the game and pause the profiler frequently; hopefully, one of the pauses will land on a spike.

A better strategy for dealing with such cases might be to record the history of profiling times over the last n frames and allow the user to pause the game (and profiler) and browse that history. Figure 1 shows a screenshot of such a profiling system inside a game with continuous level of details (CLOD) terrain: on the left is the profiling data (in milliseconds) for the current frame; on the right is an unlabeled graph of recent history (the last 128 frames). The huge spikes at the left of the graph show the program starting up and settling during the first few frames; 30 frames later, a mystery routine has a spike and the terrain renderer slows down. I can figure out what's going on here by using hotkeys that let me navigate back in time, so to speak; the data on the left changes to show data from the buffered frames, while a vertical bar cursor moves across the graph, so navigating back to the

frame of the spike will show the spiking culprit.

Since the profiler is always enabled in all builds, I also leave it always gathering data and putting them in the (circular) history buffer. That means I can sit down at any build of the game, pause it, and look back over the last 2–4 seconds of profiling information. (The history could be longer, but it requires extra storage, which might cause excess processor cache slowdown.)

When displaying the current frame, I use Jon's variable-frame-rate moving-average code (The Inner Product, December 2002) to display the numbers, keeping the display coherent as he described. But when viewing the history, I display the raw, un-averaged data, since that data is accurate and there's no bouncing-display issue.

HIERARCHICAL PROFILING

I WANT TO BE able to use this profiling system in as many cases as possible: "high-level" zones around the main-loop's calls to AI, physics, and rendering; "low-level zones" around the ray caster, the pathfinder, or a texture-building subsystem. I unify these cases and measure information about the correlations between them using hierarchical profiling.

The standard in UNIX profiling is the batch-tool gprof, which reports a lot of valuable hierarchical information; I'll use that as my starting point for what the interactive profiler should do. Of course, gprof measures both "self-time" and "hierarchical time" for each function. Self-time is time actually spent in the function, as traditionally measured by

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FIGURE 1. An in-game interactive profile overlay

sampling profilers. Hierarchical time is time spent in each function and any other function it calls, any functions they call, and so on.

But gprof goes beyond this by also presenting information about the run-time call graph hierarchy. For each function, gprof produces a list of the functions that called it and the functions it called. These lists include the amount of time spent in child functions on behalf of the caller, making it easy to see where effort needs to be focused if a function has a high hierarchical time but low self-time. Unfortunately, while gprof computes accurate hierarchical call counts, it just estimates the time spent in children on behalf of parents based on the call counts and separately sampled timings. I want accurate data. Consider a ray-casting routine called frequently by physics (with short casts representing per-frame travel of small objects) and infrequently by the AI (with long casts for visibility tests). I'd like to measure and report the different performance of the ray-cast routine in these cases.

INDUSTRIAL-STRENGTH DATA GATHERING

DISCOVERING THE RUN-TIME hierarchical call information requires detecting at run-

time which function has called other functions. I'm not writing a compiler, so rather than profiling functions, I profile zones: code regions explicitly instrumented by the programmer with an entry and an exit. (These are described in detail in Jon's first profiling column, which you should also refer to for discussion of the use of the RDTSC timestamp counter instruction, the dangers of SpeedStep, and his variable-time-step moving-average technique.)

To get the information necessary for basic call-graph run-time analysis, the program runs special code at zone-entrance and zone-exit time. On zone entrance, the code hashes a pair of zones—the entered zone and the calling ("parent") zone—to find a unique statistics record for that pair. To determine the parent zone, the program keeps a "zone stack," updated on every zone entry and exit. The program uses RDTSC to measure self-time and accumulates it for each unique zone pair; if zone x calls zone y calls zone z, and spends t time in zone z, the profiler updates a record for the pair <y, z> to indicate +1 call count and +t time. This produces exactly the data needed to attribute time spent in zones on behalf of their callers, so it handles the ray-cast example correctly—unless there's an intermediate zone between them.

It would be nice to do better, and it turns out we can—with no speed loss. However, my actual implementation is *not* what's described above. Instead of keeping track of just zone-call pairs (entered and parent), I record the state of the entire zone stack. The trick here is doing it "for free." Instead of using the pair <current zone, parent zone> as the unique identifier for a statistics record, I use the pair <current zone, unique ID of rest of stack> to hash and find a unique identifier for the current stack. The "unique ID of rest of stack" was previously computed when the parent zone was entered. The unique stack ID is just a pointer to a structure with the zone ID and the unique ID of the rest of the stack; effectively, we're just representing the state of the stack as a linked list, and inductively constructing that list so it uses the same pointers every time it deals with the same stack. (The array representation of the stack is no longer required.) During data analysis, we can traverse the linked list to find out all the information about the current state; during data gathering, the details don't matter, just the hashed IDs.

Although full-stack recording is no more expensive than parent-child recording, the basic hashing strategy is still fairly expensive, since it occurs every time a zone is entered. To satisfy the goal of being able to leave the profiler on in every

build, I can't afford all those hash lookups. Fortunately, C's static variables allow a trick: a "hash lookup cache." Instead of calling a function to hash the zone and the parent-zone-stack each time a zone is entered, I use static variables, defined at the zone entry point, to cache the parent zone-stack-ID from the previous time this zone was entered, along with the associated statistics record. Instead of hashing, an inline test checks whether the zone stack is the same as it was the last time; if so, the statistics are updated inline. If they are not the same, the cache "misses," and a separate routine is called, which hashes and returns the result so the static variable cache can be updated.

In most cases, functions are only called by a single parent and zones are only called with a single unique zone stack; after the first call fills the cache, the hash cache always hits and the profiling overhead is low. For zones called by multiple parents (like the ray-cast example), a full hash lookup occurs every time the parent changes; if all the AI runs first, then all the physics, the ray-cast zone's hash cache will miss twice per frame: the first time the AI calls it that frame and the first time the physics calls it that frame.

Because a full stack trace is kept, it's easy to identify and analyze recursive zones. The gathered self-time can be distributed straightforwardly up the entire stack to compute accurate hierarchical times, even for the recursive zones. Unfortunately, the hash-cache technique does not work well for recursive zones. A single set of cache variables is used for the recursive zone every time it's called, whether by another zone or by itself. Each recursive call at a different recursion depth occurs with a different zone stack, so the cache will miss; for example, a recursive tree traversal of a full binary tree will always hash-cache-miss except for half the leaves. So, even with the cache, I can't afford to be inefficient in the hashing routine; in my implementation, I keep the hash table fairly sparse, and tune the implementation so it minimizes time spent if the first hash-probe hits.

Overall, my gathering system performs well enough that I simply leave it on all the time. Some care is necessary because the

overhead isn't entirely insignificant; you don't want to put a zone around a dot-product routine or a string-compare. Zones should take at least a few hundred cycles to keep the overhead reasonable. To prevent mistakes of this sort, I gather data on an "empty" zone; the analysis routines multiply its self-time by the total number of zone calls to estimate the total overhead. If this estimated overhead gets too large, a warning is displayed. I can always disable the profiling system at compile time to check if it is causing more overhead than the estimated amount.

PROFILE DATA PROCESSING AND REPORTING

GATHERING DATA solves only half the problem; to be useful, the data must be viewed by a human. While Jon explored looking for modalities in program behavior, I'm sticking to "directly" viewing the data. Even with just a low-level reporting of the collected data, the fact that we have hierarchical and historical information makes this data directly useful in a "high-level" way.

There are actually two steps after gathering: processing and reporting. Processing requires the application to "tick" the profiler to tell it when one frame ends and the next begins. Reporting crunches the numbers and displays them to the user in some useful fashion.

During the processing phase, the code computes zone hierarchical times by propagating the measured zone self-times up the zone stacks to all ancestors. Self and hierarchical time moving-averages are computed. The circular history buffer is updated. All of this takes time, but, unlike the gathering code, the processing code is inside its own profiling zone, so it's easy to see how much overhead it introduces. In Figure 1, it's off the bottom of the table, as it took only 0.02ms of time per frame. (It will grow as there are more zones and unique zone-stack configurations, but I doubt it would ever become significant.) As described, I leave this

processing step on all the time, so even if I'm not actively profiling, the history buffer is full of valid data.

For reporting, I have four modes, two flat and two hierarchical. The flat modes just show a list of zones, sorted by self-time (as in Figure 1) or hierarchical time. The hierarchical modes allow you to browse a single zone and get a list of all of its parents and either all its children or all its descendants, then browse those parents and children. The display routines can actually take a noticeable amount of time; in Figure 1, `iprof_draw` is nearly a millisecond, which would be nearly 5 percent at 60fps. I've optimized it somewhat, but more could be done. I haven't bothered because it doesn't matter when you're not displaying the profile or when you're only viewing historical information.

I've only touched the tip of the iceberg for reporting data. I don't actually make much use of the full zone stack information; for example, I have no way to look at only the statistics for zones called by `z` called by `y`, although that could be easily determined. Also, the history buffer could be used in many ways. A spike detector might prove useful, and a game that's never supposed to drop below 60fps could detect which zones take longer than normal when the frame rate constraint isn't met. I'm sure there are many more possibilities.

My profiler, available at www.gdmg.com, is a heavily modified version of Jon's original interactive profiler. It provides simple interfaces for both C and C++; it's written for Win32 and OpenGL, although those dependencies are modularized. ❄

FOR MORE INFORMATION

"Interactive Profiling," Blow, Jonathan, *Game Developer*, December 2002–February 2003:

<http://number-none.com/product/>

"GNU gprof: The GNU Profiler," Fenlason, Jay; Stallman, Richard: www.gnu.org/software/binutils/manual/gprof-2.9.1/html_node/gprof_toc.html

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STEVE THEODORE

PIXEL PUSHER

NEVER HIRE ANYONE OVER 30

LATELY, THE GAME BUSINESS HAS COME to remind me of the glitzy shopping-mall utopia in *Logan's Run*. It's a fabulous playground for young people and we've all got blinking crystals in our palms, ticking away inexorably toward extinction (though, to be fair, the game biz is short on free love and polyester unitards). While we may not be facing the fiery Carousel at 30, it seems very few of us stay in the business past 35. Take a look around at your next GDC or IGDA meeting: there will be a lot of pink and blue hair, but not much gray. As one recruiter told me, "Companies definitely want us [recruiters] to ask a lot of the questions that the law won't let them ask. Age discrimination would be the industry's dirty little secret, if somebody would bother to keep it secret."

The reasons for the demographic skew in games are very complicated. After all, it's not as if the game industry's attitude toward age and experience is dictated by some sinister young boys network. So let's start by saying what should be obvious: simpleminded discrimination based on age is stupid and shortsighted. Our industry has always had a lot of adolescent traits—particularly when it comes to deadlines and professionalism—and we'll never grow up if we don't find ways to retain experienced, mature people.

That said, it's important to look at some common reasons employers and recruiters give for putting a discount on experienced artists. I'm not defending these attitudes, but you'll need to understand them if you want to manage your career effectively through your 30s—and hopefully beyond.

THE PRICE OF EXPERIENCE

ONE OBVIOUS HANDICAP that veterans face is cost. Artists with a lot of titles and long resumes expect to command salaries that reflect their experience. Obviously, studios always have one eye on their budgets when making hiring decisions, so this makes changing jobs and chasing raises harder for a vet than for younger, cheaper talents. In addition, many employers feel old pros will be tougher negotiators than new hires. They are less likely to believe in stock options or bonus packages and more interested in cold cash. Worst of all, from the employer's perspective, a pro is relatively immune to the glamour of simply being in games. Whereas a lot of young talent is willing to work for peanuts just for the chance to be close to the games they love, the romance wears a bit thin when it's time to pay for the kids' braces or a new dishwasher.

Does this mean an experienced artist is generally a bad bargain for a company?

Not at all. But it does mean that an eight- or 10-year vet needs to be able to tell a potential employer exactly why he or she is worth more money or deserves more responsibility than a younger artist with only one or two titles shipped. Like a manufacturer in a high-wage area, a veteran artist needs to identify the things that he or she can do well because competing on cost is not an option when you have a family and a mortgage.

FIRE IN THE BELLY

WE ARE IN THE ERA of the rising star! *Rising stars are hungrier—they don't have a family to feed, they don't have outside commitments, and they're able to work longer hours and spend their free time benefiting their career. They observe what others are doing, how they can do it better, and quickly catapult ahead of the pack.*

—P, games industry recruiter

The line between investment and gambling is often hard to find. Everyone faced with a hiring decision fantasizes about catching a talented newcomer with great potential but a short resume—the rookie of the year who will come at a big discount and mature into a star performer. Of course, only a fraction of new hires will turn out to be stars, but like all forms of gambling, hiring thrives on hope. Companies yearn for great discoveries the way FPS players bash crates in search of hidden goodies. In a perverse way, this optimism undercuts what should be a veteran's biggest asset. The same track record that proves you're reliable, hardworking, even extremely talented, also gives a pretty good indication of your future performance, which might be very good but isn't going to change the industry overnight. It's easier for a search committee to project the fantasy of brilliant learning,



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Logan 5 (Michael York) and Jessica 6 (Jenny Agutter) begin to question the lethally ageist society of *Logan's Run*.

STEVE THEODORE started animating on a text-only mainframe renderer and then moved on to work on games such as *HALF-LIFE* and *COUNTER-STRIKE*. He can be reached at steve@thedox.com.

professional growth, and whole-hearted devotion on the blank space at the end of a short resume.

Moreover, the notion of the “rising star” also brings up the question of lifestyle, which may be the most damning liability the veterans face. The movie-montage version of game development (cue cross-fades over empty pizza boxes, empty coffee cups, and bleary animators wincing at the rising sun) is a young person’s game. Roommates or parents might tolerate you coming home from work at 2 A.M., but spouses and kids have a legitimate right to be unhappy about it. Since game companies typically see potential employees primarily as mythical man-months on legs, they’re inclined to go for the young.

In this context, veteran artists need to be able to articulate clearly how they can get as much work done in a livable 40- or 50-hour week than their gonzo colleagues do in 80. They need to prove to potential bosses that they are more, not less, likely to make the milestones than the pizza-and-coffee crowd. The key to effectively dealing with employer preconceptions is understanding what employers want—productivity—and showing you can deliver it without last-minute heroics. Producers like man-hours, but they really love reliable scheduling and completed assets.

KEEPING UP WITH THE TIMES

WHEN I WAS 25, *I'd stay up until three or four in the morning just playing with the new features in the latest version of Max, doing little side projects. Nowadays, between meeting my deadlines at work and having a family life, I don't have the time—or, frankly, the interest—to check out anything new. I know I'm in danger of falling behind, but I've got other priorities.*

—T, artist, 33

With the astounding rate of technical progress in our business, obsolescence is a permanent threat. An artist approaching mid-career will always have a few painfully acquired skills that have become completely useless. Even worse, the combination of production pressure in the office and family life at home makes it harder to keep up with new tools and techniques. The stereotype of



Becoming an art director—the perceived next level up for a game artist in the career RPG—means you’ll lead your colleagues into battle. But personnel management and project supervision don’t necessarily appeal to every artist (image from DUNGEON SIEGE, Gas Powered Games).

the older artist with rusting tech skills is not really fair, since an experienced artist can often see through the details of a new tool or idea to the core concept more quickly than a younger person who has read the manual but hasn’t learned to really think in 3D. But fair or not, the stereotype is a fact of life and experienced artists have to combat it.

The cumulative weight of all these preconceptions makes the professional environment for artists in the decade bracket—the “Children of Doom” who got into games in the early 1990s—a tough one. In the early stages of a career, practically the only thing that really counts is a strong body of work—every article on how to get a job in games will tell you that a strong demo reel is the magic ticket to success. But when you’re a veteran looking for an appropriately senior job, everybody you’re competing with has a strong reel; competition has already weeded out the 3DS Max fan-boys and overly optimistic web designers. Add to the mix a potential employer who’s worried about your salary, commitment, and technical skills, and the picture is pretty bleak.

DON’T FEAR THE REAPER

AGAINST THIS BACKDROP, the best thing you can do for your career is to understand how you look to potential employers. In effect, your career is a product, and every time you go looking for a job—within your current

company or without—you’re marketing. We tend to snicker (or throw up) when the word marketing comes up, but it’s a fact of life for anybody who wants to sell anything. You won’t sell much if you don’t know what people want to buy or if they don’t know what you have to sell.

Emotionally, this is often a difficult leap for artists to make—we put so much of ourselves into our work that we’re offended when people take our creative skills as a given and want to talk about how we “contribute to the team” or “drive the product.” Unfortunately, only a small fraction of us will be hired for our artistic genius or personal creative vision. Far more of us are there to contribute to the team and drive the product. To manage our careers effectively, we need to understand how we fit into the complex machine of game production. In short, we need to market ourselves effectively.

One thing most headhunters will tell you is that their clients—our potential employers—want solutions to specific problem. It’s not enough to go to a studio and say, “I’ve got this artist who is a really great person and very talented.” What most companies want to hear instead is, “You need somebody who can manage the pipeline on your upcoming

PS3 title, and I've got just the person." Very few companies have the luxury of hiring an applicant solely for his or her talent or potential; which 40- or 50-person studio can support a Xerox PARC or Advanced Technology Group for distracted geniuses?

The problem for us, of course, is that it's very difficult to predict the specific needs of individual companies in advance. The range of knowledge you need to be a good marketer for yourself is pretty intimidating: in order to manage your career, you need to be up to date on current and future trends in technology as well as fads in pop culture that get recycled into game art and the rise and fall of different studios.

Once you've mastered all that, you need to build—I hate to have to be this crude about it—a brand for yourself. When you're 25, you can sell yourself on drive and potential. By 35, you have, intentionally or not, shut off some possibilities and embraced others. Most studios are already subdivided to the point that modelers, animators, texture artists, and level designers are seen as mutually exclusive. Within those specialties, new sub-specialties are emerging: for example, scripters, character riggers, and shader writers. As each new discipline matures, people who picked it up out of necessity or curiosity will become "experts," which is a powerful selling point as long as those specialties are in demand. At mid-career, you have a complex mix of skills that represents most of your value in the eyes of a potential employer. You need to know which ones are in demand and which aren't. At 25, you're a commodity product, one of the many warm bodies the industry needs to function. At 35, you need to be a specialty item with a narrower market but much higher potential value.

Whether it's a technical or an artistic niche you're looking for, remember that you don't have control over the environment in which you'll be trying to peddle yourself and your skills. If you were a history buff with a fantastic reel of *Shermans and Tigers*, you'd have had a hard time pitching yourself in 1999, when everyone wanted to build the next *HALF-LIFE* or *UNREAL*. But after *Saving Private Ryan*, *MEDAL OF HONOR*, and *BATTLEFIELD 1942*, you'd suddenly find yourself a hot commodity. If, starting today, you take six months off to master the details of the PanzerKampfwagen IV tank, it's probably too late. Something else will have already become the specialite du jour. The same problem bedevils technical skills too. If you have a lot of production experience in, say, PlayStation2 environments,

you've got a leg up relative to somebody who's only done Dreamcast games. Yet becoming tagged as a PlayStation2-monkey can one day become a drag on your career, if it ghettoizes you into B-list, end-of-lifecycle titles and keeps you away from cutting edge PlayStation3 or Xbox2 games. Specialization is a double-edged sword, and you need to have an eye on the future as you indulge in your passions. You also need to look for assignments that will keep you current with upcoming tech and topics.

The real key to being rewarded for your experience is honesty: the ability to take a good, hard look in the mirror. Without a realistic sense of your own strengths and weaknesses, you won't be able to sell yourself. I don't mean the kind of feigned weakness people use in interviews, as in, "my biggest weakness is I don't know when to stop devoting myself to the company." I mean a sober look at your real skills and personality. If you know what you can do well, you can either find companies that need you, or become good at something they need, which can be derived from your existing skills. If you don't know what you're not good at, you'll always be competing at a disadvantage without knowing why. One artist I know, with a track record dating back to the VGA era, found his career slowing down because the combination of family life and production pressure made it almost impossible for him to keep up with cutting-edge technology. After a lot of soul searching, he accepted the fact that he wasn't going to stay on the edge any more. He found a job doing interface design rather than production art; as an "interaction designer," he can still use lessons he learned on a 286 about clear design, user expectations, and the relationship between interface constraints and gameplay. His deep knowledge of how gamers think makes him very good at his new job. Moreover, in 10 years he'll still be learning and growing, instead of swimming upstream against a continuing flood of technological change.

GOING CORPORATE

OF COURSE, the classic way to capitalize on experience is to move from line production to management. This is harder for artists than for many other folks; most of us become artists precisely because we enjoy making things, and the thought of spending our lives monkeying with schedules and meetings terrifies a lot of us. It might be easier to seduce us into management if there were management niches to fill, but in most studios the career ladder is extremely short. You can become an art lead, then an art director, and then you're done and can retire. Without a lot of intermediate

positions, it's tough to know if you have the aptitude or the desire to lead a team.

Unfortunately, the role of art director is often a dubious reward for success as a production artist. The key skills of an art director—communication, personnel management, transmitting a shared vision and getting people to collaborate on realizing it—are only tangentially related to the technical skills that make a great production artist. The notion that art direction is a "level up" in the great career RPG is a source of unhappiness and frustration for many. If you do have people skills, though, you may find that not only art direction but becoming a producer or studio head is the best place to spend your second decade in games. Your artistic judgment will still be necessary, but you'll be free of all-nighters and carpal tunnel syndrome and all the years you've spent watching games and games people will be a big asset to your work.

Many of us, though, just want to keep on doing what we love to do. It's always possible to keep beavering away, perfecting our craft and (hopefully) being rewarded for our skills and vision. Hopefully, the tactics and observations we've sketched out here will at least help dedicated artists to remain well paid and well respected in their work even if there is no corporate ladder for them to climb. In the golden age of Hollywood, craft specialists like cinematographers, set designers, and effects people hardly ever made the jump to management either as directors or producers. However, they did have their own parallel status hierarchy in the form of professional societies and particularly the Oscars, which gave meaning and shape to careers that topped out, in terms of money and job titles, when you were 35 or 40. Our industry would certainly benefit if we could have a similar level of professional respect and community in which we could recognize and applaud each other's work. How many game artists' works do you actually know? Can you put an artist's name on a particular character or environment? If you read Jason Rubin's manifesto ["The Anti-Communist Manifesto," May 2004], you know how much studios and developers need to work to promote their professional profiles. We need to do the same thing—to form a network that recognizes and rewards talent and expertise in our medium. That would be a benefit for all of us, old fogies or not. ❖

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PITCH—NOT DESIGN

BEING A GOOD GAME DESIGNER

requires intense, creative thoughts to devise intricate schemes that squeeze the most fun out of code and art. Writing pitches is the exact opposite. Pitches, especially the good ones, are huckster bamboozling that would have impressed even Tom Sawyer. The goal of a pitch is to get a project—nothing more. While the idealistic folks out there might think intricate gameplay can get you a project, industry veterans know better.

People hate thinking. If years in the public school system haven't taught you this, you really weren't paying attention. The bullies who used to beat you up by the bike racks are now holding the purse strings for that dream project you've always wanted to work on. You need to talk to them on their level.

Forget the AI diagram. Forget nonlinear emergent gameplay (unless it's the buzzword of the week). They don't care. If you can't describe the concept in two to three sentences, it won't sell. Your first goal in writing any pitch is to come up with those simple main points that make your idea stand out in the mind of any stupid person. The pitch for *LEISURE SUIT LARRY: MAGNA CUM LAUDE* I wrote was all about being funny and sexy. Every sentence went through the funny-and-sexy filter, even when talking about sales numbers or UI layout, which led to section headings like "Forget

Raymond, Everyone Loves Sex" or "Big Piles of Money."

People hate reading. Don't think about how people will read your precious document; think about how they'll skim it. What's the first thing people are likely to notice on each page? You need to sell your idea on that alone. Bullet points are your friends.

- The dots call attention to themselves.
- Short sentences are easy to digest.
- They're great for skimmers.

And then there are people who find even bullet points too complex. In that case, a picture is worth a thousand words—not because it has more information, but because people might actually bother to look at it. Vaguely reminiscent images pulled off the web are much better than a page of little squiggly icons that require thinking.

When you do have to use words, use them carefully. If people are only going to read a few words, make every one count. George Orwell recommends the following rules in his essay "Politics and the English Language":

1. Never use a metaphor, simile, or other figure of speech which you are used to seeing in print.
2. Never use a long word where a short one will do.
3. If it is possible to cut a word out, always cut it out.
4. Never use the passive where you can use the active.
5. Never use a foreign phrase, a scientific word, or a jargon word if you can think of an everyday English equivalent.
6. Break any of these rules sooner than say anything outright barbarous.

Executives hate hearing about gameplay. Gameplay alone doesn't sell games—look all the good games that have bombed (remember *ICO*?). Executives want to hear about how this game will sell—not how it will impress your friends. If you can introduce some great gameplay, great. But make sure it

sells first; your co-workers need to eat. Avoid talking about gameplay too much in your game pitch; focus instead on things that people can easily wrap their brains around. Tell gripping stories from the character's perspective. Emphasize the "wow" factors that people will tell their friends about. When I was writing the *LARRY* pitch, I was thinking about how to merge *INCREDIBLE CRISIS* gameplay with old-school adventure games. But I didn't talk about that. I ended up talking about boobies and trampolines and wet t-shirts. That seemed to go over better.

If there's a recent blockbuster game similar to your concept, talk about how well it sold. If not, then find a connection to a latest blockbuster. When we pitched our version of *THE HULK*, we talked a lot about *SPIDER-MAN*, because it had done well. Right now, if I can find any comparison to *PRINCE OF PERSIA*, I'd include it in the pitch, even if mine is a game about stockbrokers, because the goal is to be the next blockbuster. And it'll take all your devious sales techniques to convince the buyer it's your game.

It may sound like I'm too cynical and dark about the industry. Honestly, I'm not. This system works. The reason it works is that a good designer not only comes up with great ideas but knows how to convince others that those ideas are great. A good visionary can get even the most jaded industry veterans excited about their new movie port. If you can't sell the idea to a publisher, you'll never be able to convince a consumer with just the back of a box. So don't look at pitch trickery as a rejection of good designer skills. Look at it as advocacy. ❖

TOM SMITH is design director at High Voltage Software.

As such, he gets to surf porn all day and call it "LARRY research." Bask in his good fortune at tsmith@gdmag.com.



ALEXANDER BRANDON

» AURAL FIXATION

THE PROPER WAY TO EDUCATE

OFTEN IN THE WORLD OF GAME AUDIO,

one who is an audio professional encounters a colleague who doesn't speak the same language. The colleague could be an artist, a producer, or a programmer, but the difference in terminology and syntax is so drastic each feel as if the other is speaking a foreign language. Let's take a look at ways you can get non-audio folks to see—and hear—things from your perspective.

There are many instances where someone on the audio team, either freelance or in-house, finds a request or comment about the sound, voice, or music completely meaningless. The examples we'll use here are probably familiar to many of you.

EXAMPLE 1: DEMO IT!

Design lead: The ceiling-fan loop you made sounds like a UFO to me.

Audio engineer: Er...that loop was taken directly from a ceiling fan.

Design lead: Well, please change it—it's pretty odd in that space.

Audio engineer: Okay.

One week later.

Design lead: Did you change that sound? I'm still hearing it.

Audio engineer: Yeah, it's even more like a ceiling fan now; it has more 'whoosh' to it and less tone of any kind.

Design lead: Let's listen to it in my office.

The two then demo the game and listen to it together. (What a concept!)

Design lead: Hear that?

Audio engineer: Oh man, that's a computer hum that's bleeding from an

adjoining room! The world geometry isn't occluding properly!

Design lead: Oooh! That makes sense.

Audio engineer: I'll get that fixed—first, I'll kill the audio programmer. [Laughter]

As you can imagine, the issue was solved because the audio engineer was in the same location as the design lead. This sort of thing is much more difficult to track down with out-of-house staff, but it can still be done. The next example will show you how.

EXAMPLE 2: DESCRIBE IT!

WHEN HEARING a befuddling problem or request from someone, tactfully and calmly solicit more detail. If dealing with in-house staff, make sure you tell QA, in addition to anyone responsible for entering bugs, the proper way to describe sound issues. For outsourced folks, good phone and e-mail communication is a really important skill to have.

The Wrong Way

QA tester: This gun sound sucks.

Audio lead: No, you suck.

The Right Way

QA tester: This gun sound sucks.

Audio lead: That doesn't tell me how to fix it. Does it sound wimpy? Does it lack bass?

QA tester: Yeah, I don't feel powerful when I fire it. I feel like I'm shooting a pellet gun.

Audio lead: You're not supposed to feel powerful when you fire it. It's a pistol. It's the first weapon you have in the game. If you feel powerful when you fire this weapon, you'll be blowing your load early and the only way to make the biggest weapon make the player feel truly powerful is to send someone to their house and add a subwoofer punch each time they switch to it. The gun sounding

like a pellet gun is *not* good, however. Let's check it out together and we can figure out how to improve it at least a little.

QA tester: Yeah, cool.

EXAMPLE 3: DON'T DUMB IT DOWN! DEEPEN IT!

SOUND IN GAMES is the most easily misinterpreted thing there is. It causes many sound designers and composers to dumb down their production because they aren't sure how to respond to requests that won't help the audio in the game as a whole. It doesn't have to be this way. Think of alternatives that are cool sounding to a layman, not just what you think would be more clever sounding to the audio pals you're trying to impress at EA or LucasArts (unless you're already in those companies).

Producer: I'd like to have Spike Rammers do a song for this game; I think it'd fit well in the castle level. They're pretty cool! Check out this CD.

Audio lead: [Listening] Okay, did you think one of these songs would be licensed and we'd include it as the background music for the level?

Producer: Yeah, it'd rock!

Audio lead: Give me a few hours. I think I might have an idea.

Producer: Sure.

A few hours later.

Audio lead: Okay, what do you think of this track without the vocals and this main guitar riff coming in when the player encounters this pack of monsters, then the softer bridge section playing when they walk through the portcullis, to give them a sense of tension before they make their first combat encounter?

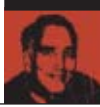
Producer: [Listening to custom track] Wow, this is even cooler!

Audio lead: The vocal track is a distraction, since its lyrics have nothing to do with the game's story, but the heavy guitar work will sound good as an action track. The synthesized bits will work well as a prelude to the action. Think you can get Spike Rammers to send us the separated tracks?

Producer: Absolutely. Thanks!

These techniques are invaluable when working with people who don't share your knowledge base. Consider your options and alternatives. ❖

ALEXANDER BRANDON has been involved with game audio since 1994 and is currently the audio manager at Midway in San Diego. You can e-mail him at abrandon@gdmag.com.



NOAH FALSTEIN

» GAME SHUI

LIGHTS, CAMERA, ACTION!

I'VE HAD THE PRIVILEGE TO WORK WITH several excellent movie directors, producers, and writers in the course of my career. I particularly enjoy teaming up with people from other fields because there is often a great cross-fertilization of ideas and approaches when both collaborators keep an open mind about what they can learn from each other. Often, I've found that the nuts-and-bolts practical aspects of a technique that may apply to writing a novel or making a film may not work as well with designing a game, but the underlying concepts behind the techniques are eye-opening and can often be adapted into basic game design rules, if I consider the special circumstances that apply to interactivity.

One such technique came up during a discussion with Hal Barwood of Finite Arts about the design of *INDIANA JONES AND THE FATE OF ATLANTIS*. We needed to visually frame our two main characters as they walked along, talking to each other. I

assumed we would view the action from the side and above the heads of Indy and Sophia as they walked, using side-scrolling and multi-plane animation to simulate motion as was standard for games from the 1990s. But Hal said no—instead, he suggested we put the camera (virtually speaking) squarely in their path at eye level and have them walk toward it, moving the camera point of view backward as they approached. “Why go through the trouble?” I asked. “Because it’s emotionally much hotter that way,” Hal replied.

That was an alien thought to me, but as I mentally reviewed similar situations in movies and TV shows I’d seen, I realized he was exactly right. Games that put the virtual camera point of view at eye level or close to it are emotionally “hot,” evoking greater involvement and tension. Games that give a lofty top-down perspective from the equivalent of hundreds of feet up in the air like most RTS games are cooler, giving the player a sense of personal detachment from the action. With today’s technology and 3D capabilities, it’s even more important to understand this rule:

THE RULE: *Use the position of the camera to elicit emotional involvement.*

THE RULE'S DOMAIN: This rule applies to all games that depict realistic surroundings and utilize a point of view within those surroundings.

RULE THAT IT TRUMPS: *Maintain suspension of disbelief.* This rule is not so much trumped by the new rule, but rather transformed. Changing the point of view to create an emotional effect can actually increase a player’s involvement in the game whether or not it makes logical sense. Filmmakers discovered that instant cuts or impossible points of view could be quickly accepted by viewers and could actually improve their sense of being part of the action, much in the way game makers have used automatic restarts after failure to improve the player’s enjoyment of the game.

RULES IT IS TRUMPED BY: *Gameplay comes first and fight player fatigue.* Don’t sacrifice playability for beauty (or realism or story). Playability trumps all—it’s better to have an inappropriate level of emotional involvement if the alternative is to make the game frustrating or boring. For example, the experiments to make old side-scroller or top-down arcade games into first-person 3D games have often failed because the player lacks vital information that was present in the old perspective. It does little good to increase the emotional heat if you simultaneously increase frustration and failure. Sometimes having the point of view at eye level can make the experience too cinematic and not game-like enough.

Even now, this rule is still trumped by hardware and software limitations. You can’t always put the point of view anywhere you like in an interactive world where the location of the characters can be under control of the player.

Examples and counter-examples: I can just begin to touch on the implementations of this rule in a one-page column, but here are a few basic principles. You can increase the emotional involvement by putting the camera at eye level and having action move in the plane of the player, particularly directly toward the player’s point of view. But the trumping information is important. Purely first-person games provide a great deal of emotional involvement by putting the player’s point of view right into the head of the character in the game. But other games (notably the *TOMB RAIDER* series or many Nintendo games like the *MARIO* or *ZELDA* series) put the camera a little above and behind the character, trading emotional heat for more situational awareness, improving gameplay by letting the player see what’s happening in a wider view.

In conclusion, this is one of several areas where game developers can benefit from some of the groundwork laid by filmmakers. ❖



A wide, over-the-shoulder POV like this one (from *HITMAN II: SILENT ASSASSIN*, Eidos) provides extra information about the action, but it’s not as emotionally involving as a true first-person POV.

NOAH FALSTEIN is a 24-year veteran of the game industry. His web site, www.theinspiracy.com, has a description of *The 400 Project*, the basis for these columns. Also at that site is a list of the game design rules collected so far and tips on how to use them. You can e-mail Noah at nfalstein@gdmag.com.

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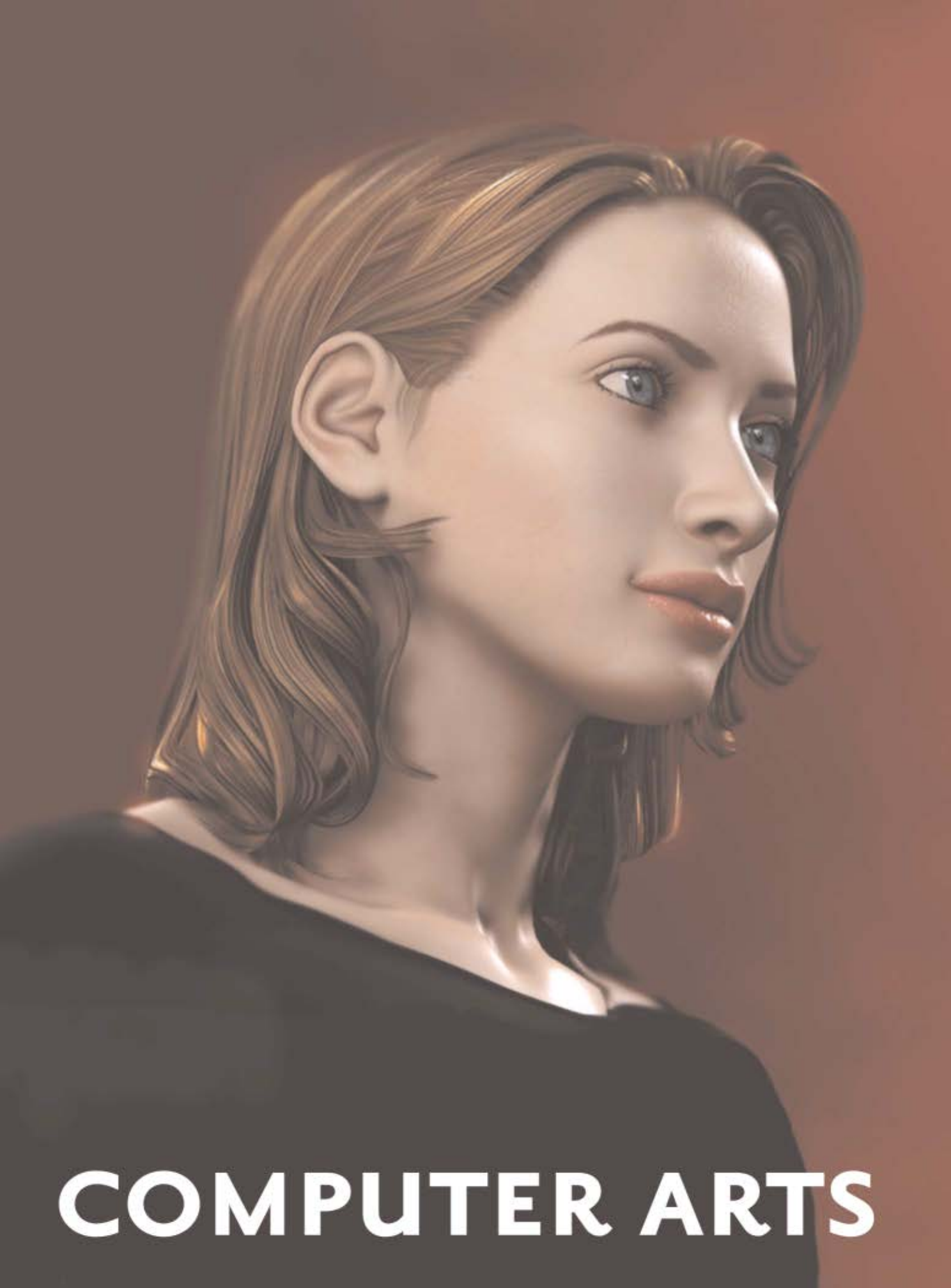


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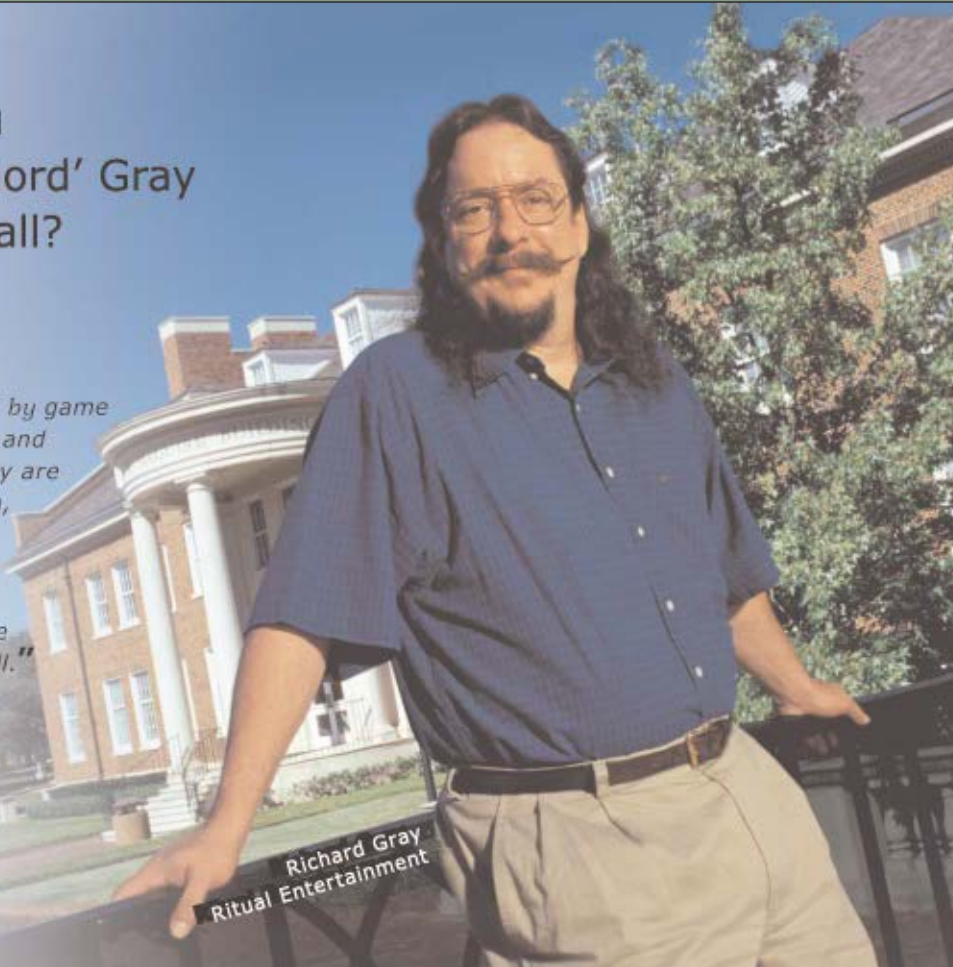
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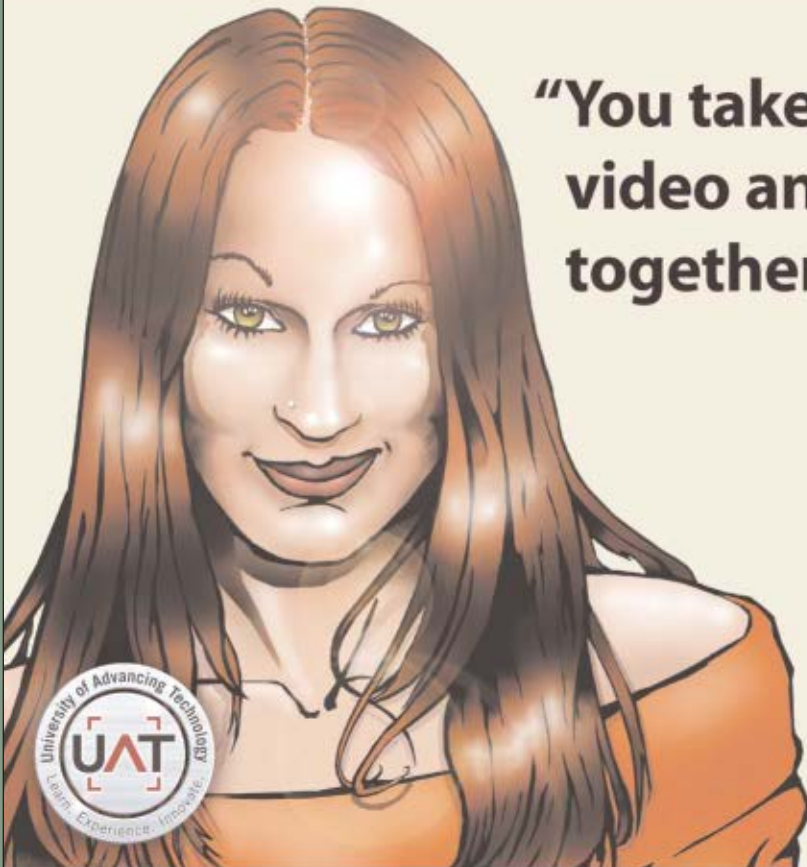
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Programmable Features Highlight OpenGL 2.0

CONTINUED FROM PG 5

even more hardware-independent than it was before. Along with a new major version of OpenGL, the ARB is now committed to annual point releases, with the next step (2.1) likely being the addition of more general-purpose vector processing support beyond graphics. The Khronos Group expects to synchronize most of these changes with its mobile efforts, with a goal of releasing the OpenGL ES 2.0 specification by next year's Siggraph.

All these developments have interesting implications for the future of the language, particularly considering that Sony PlayStation (along with Fujitsu, Samsung, and a few others) has just joined the Khronos Group, signaling its interest in OpenGL ES and related technologies—not surprising given the parallel computing nature of the Cell chips that Sony is expected to use in its next-generation console.

—Peter Sheerin



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Fork in the Online Road

CONTINUED FROM PG 7

avatar skins, casinos, strip clubs, and other marketable goods and services, and turning a profit for themselves.

THERE, a more casual online world, fought to break boundaries and redefine online game genres by "going after the AOL logins" for its user base, said CTO Ken Duda at an E3 workshop. But a recent press release from Michael Wilson, vice president of community, points to the company abandoning aspects of the game, such as software updates and bug-fixing, to focus on licensing the game engine. The company is creating a virtual world in which the U.S. Army will train its members. Future relationships of this nature might prove more lucrative, and dubious. THERE players worry about the game's demise.

Year-to-date, as of June, Linden Lab CEO Philip Rosedale says SECOND LIFE's user base is "growing at a rate of about 30 percent per month." As of press time, Rosedale reports the number of users "at about 10,000." A basic membership costs \$9.95, which is a one-time fee, and premium memberships cost a bit more on a scheduled-charge (for example: monthly, quarterly) basis. Although Rosedale won't share earnings figures, the majority of revenue comes from virtual land sales, not membership fees.

—Jill Duffy

Alias Brings Maya Unlimited to Mac OS X

CONTINUED FROM PG 5

Unlimited for OS X boasts features specifically adapted for the Mac platform such as Mach-O optimization, AppleScript support, Quartz rendering, and complete QuickTime implementation. Maya Unlimited for Mac OS X is scheduled for release in late summer of this year at the same price as the Windows XP version: \$6,999. Maya Complete on both platforms is \$1,999.

This announcement comes on the heels of Alias's recent declaration of independence, at least from SGI, as Alias management, Accel-KKR (a private equity firm), and the Ontario Teachers' Pension Plan acquired Alias for \$57.5 million. "Now that Alias is a well-capitalized independent entity," says global communications director Donna Teggart, "the company is better positioned to further expand its business, extend customer value, and create significant growth with its products and services."

—Jamil Moledina

CORRECTION

Our June/July 2004 review of *Kaydara Motionbuilder 5.5* understated the price of the Professional version. The actual price is \$4,195, including 12 months of support and upgrades.

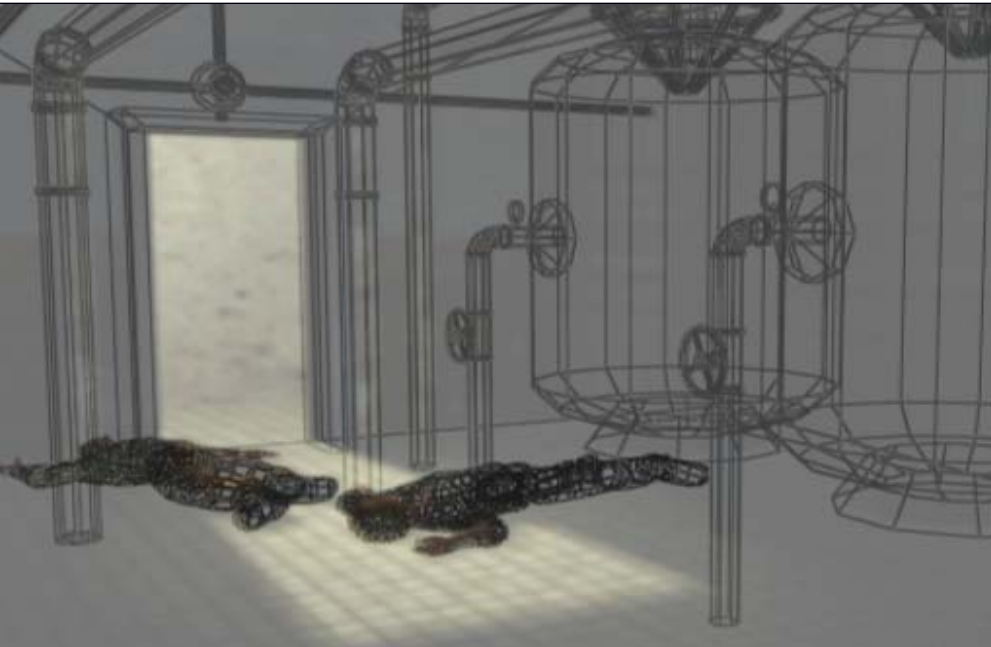
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» A THOUSAND WORDS



TKO SOFTWARE'S SAHARA TRAILER

TKO SOFTWARE HAS BEEN DEVELOPING A videogame of Paramount's film of Clive Cussler's novel *Sahara* for the past few months. It has the rights to the book, the movie, and even star Matthew McConaughey's likeness and voice. What the company doesn't have, as of press time, is a publisher. Like many developers, TKO's pitch strategy includes presenting a video demo of its work, and so, naturally, TKO's SAHARA has a movie trailer video. Development director David Howe put together the overall concept and feel of the trailer. TKO's Dallas team created the models, with its Santa Cruz team producing the animation, using primarily Maya, Photoshop, and TKO's internal Liquid editor. After a week's work, the group had only 30 seconds of footage, and a deadline fast approaching. Art lead Doug Brooks decided to fill out the rest with some bullet points about the sales of Clive Cussler's novels, the stars of the film, some key concept art, and a cinematic score. With the help of After Effects and Premiere Pro, one week later, TKO had a complete two-minute trailer ready to screen. — *Jamil Moledina*

TRAILER
Direction: Doug Brooks
Editing: Merrick Rustia
CG Elements: Tehao Niu

ANIMATION
 Jamaal Bradley
 John Stewart
 Greg Lemon
 Eric "Wardo" Ward
 Kyle Winkleman

MODELING
 Jeremy Palmen
 Jason Maier
 Adam Shuman
 Josh Davis
 Michael Hermes
 Robert Smith

CONCEPT ART
 John Duggan
 Andrew Wallacker

AUDIO
 Alex Howard

Current version of Dirk Pitt model

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Reason #4

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a time
machine.**

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