AI Beyond Computer Games

Andrew Stern

PF. Magic / Mindscape
88 Rowland Way
Novato, CA 94945
+1 415 895 2714
andrews@pfmagic.com, http://www.pfmagic.com
apstern@ix.netcom.com, http://www.netcom.com/~apstern

Abstract

This paper discusses and critiques the current state of digital interactive entertainment, with references to recent projects from both industry and academia. Suggestions are given for new directions to pursue, particularly those that involve the application of artificial intelligence and artificial life technologies for making virtual characters and interactive story systems.

Artificial Progress

Read the back of the box of any hot new computer game today and you'll be bombarded with exciting descriptions of state-of-the-art game technologies. In a frenzied attempt to keep up with the latest hardware, new games woo consumers with eye-catching realtime 3D graphics, ultra-high polygon counts, moving cameras, motion capture, and of course artificial intelligence. AI is generally considered these days to be one of the most important components of a computer game. Traditionally AI is used to control the behavior of game opponents, whether they be tanks and armies in a realtime strategy game, or heavily armed monsters in a first-person shooter, or faceless adversaries in a virtual chess tournament. Gamers feel that the better the AI is, the better the game is. One of the latest technologies being applied to computer games, Artificial Life, was described as "one of gaming's hottest new frontiers" by *Next Generation*, a popular computer and videogaming magazine.[1]

It can't be denied that over the past several years the production quality of games have been steadily increasing, as well as their production budgets. And the speed and power of computer hardware continues to grow at a phenomenal rate, spurring developers to constantly improve their games' graphics and animation. But have the designs of new games been improving as well? Or are we just seeing souped-up versions of the same old games from the past? What role does AI play in this situation?

Chris Crawford, an outspoken veteran of the game industry who wrote dozens of essays about design and the state of the industry in his journal *Interactive Entertainment Design*, laments about computer games "reaching a state of moribund stasis". Crawford describes how the current state of computer games is stagnating – becoming ever more market-driven, expensive to develop, and very often derivative clones of one another. Take a look at the vast majority of games coming out today and you'll notice they are fundamentally the same as they were in the eighties – "flight simulators, sports games, graphic adventures, role-playing games, strategy wargames, running-jumping-climbing games, 'shooters', puzzle games... The only changes that we have seen in these ten years have been embellishments. The graphics, animations and sound are better. The games have more internal detail, larger worlds, more complexity. But the basic designs have not changed."[2,3]

As a designer and programmer who has been working the game industry for the past seven years, I wholeheartedly agree with Crawford's observations. I am noticing that by and large, computer game design is not moving forward, even though PC's are now being purchased in droves by mainstream consumers who are not "gamers". This paper will discuss new directions that computer games can go in, and how artificial intelligence will be instrumental in that change.

What Do People Want? It's No Puzzle

In the aforementioned *Next Generation* article about Artificial Life, a co-worker and I were quoted as saying, "When people talk about wanting great A-Life (or great AI, for that matter), what they really want is the experience of interacting with something truly alive." In developing Virtual Petz, a series of interactive lifelike computer characters from PF Magic, our goal was to create the best and most interactive "illusion of life" available on a personal computer. By combining a direct interaction interface with highly expressive and personality-rich characters, users are easily able to suspend their disbelief and form emotional relationships with their adopted Dogz

and Catz.[4] We feel that the worldwide popularity and critical acclaim of Virtual Petz is reasonable evidence that users are looking for new types of experiences beyond traditional computer games.

But when you think about it, you realize it's more than a great interactive illusion of life that people want from their entertainment. Look at the most popular forms of entertainment today – movies, television, and books. They're mostly about *people*, their stories, their dramas, their lives. As the computer becomes ubiquitous in people's homes, it becomes a viable new mass-market medium for entertainment. There's every reason to believe that users will want computer-based entertainment to be about similar topics and themes that they enjoy in other media: people. I'll even go so far to say that people will expect entertainment in the computer medium to rise to the artistic level of the best cinema, theater and literature.

What kinds of entertainment are we talking about here? Interactive stories? Virtual reality? Perhaps the most popular visualization of futuristic computer entertainment is the Holodeck from *Star Trek*. The Holodeck is a "universal fantasy machine"[5] where users can immerse themselves in rich storyworlds with characters they can talk to, form relationships with, touch and be touched by, and together alter the course of events – literally creating a new story in realtime. In such a vision of interactive entertainment, artificial intelligence would be an essential ingredient. But even if the Holodeck eventually gets created, clearly it is a long way off from where we are today. What is feasible in the short term? What can we do now, with existing technologies?

First we need to realize that the majority of people out there won't be interested in today's computer games. *Quake, Myst, Tomb Raider, Mario* – these are goal-oriented games that require users to master complex joystick skills and solve endless numbers of frustrating puzzles. Personally, I count myself as one of these people. I don't play games. I'm not a gamer. I don't like puzzles. When talking about new directions to innovate in, let's get rid of the term "games"! For lack of a better term for what the majority of people want, let's call it *character-centric interactive entertainment*.

Right now you may be asking, why not stick with proven mediums for this kind of entertainment? Maybe computers are best suited for games as we know it, and we should leave character-centric entertainment to film, TV and books? I don't think this is true. Interactivity allows for an entertainment experience that actively pays attention to you, that listens to you, adapts to you, becomes custom for you – making the experience much more personal, and

therefore more powerful and affecting. It should be made clear that I'm talking about an experience that could only be constructed in this new medium, not simply a port of a story from a traditional medium.

A-Star is Born

To begin moving towards character-centric interactive entertainment, it makes sense that one should begin by developing virtual character technology. It's true that computer games have always had characters, but in general these have been no more than shallow cardboard-cutouts. Characters in computer games typically consist of mindless avatar-like puppets controlled by the user, or one-dimensional enemies with limited and often predictable behavior.

However there have been a few software products that have broken out of this mold. In the mid-eighties a lighthearted computer program called *Little Computer People* allowed users to watch and poke at a tiny animated person living in an simple computer house. Ten years later, once the power of computer hardware had advanced by several orders of magnitude, the world's first virtual pets, *Dogz* and *Catz*, were released. Subsequent versions of Virtual Petz offered increasingly sophisticated animation and AI, allowing them to grow into a popular and successful product line that has sold over two million copies worldwide. Around this time a simple handheld keychain toy from Japan called *Tamagotchi* became a hugely successful fad, truly making "virtual pets" a household word. This was soon followed by *Creatures*, the first full-blown commercial entertainment application of Artificial Life and genetic algorithms. In Creatures users are able to train and breed fantasy-like mammals whose behavior is controlled by the integration of a neural network, a model of biochemistry and an artificial genome with crossover and mutation.[6] Not so well known was an unusual adventure game called *The Last Express* where the user participates in a immersive story set on a moving train inhabited by a large cast of computer-controlled virtual characters.

In parallel with (but disconnected to) these developments in industry, several academic media and AI labs began focusing on interactive virtual characters. Several years ago Joseph Bates of Carnegie Mellon University formed the Oz Project to study believable agents and interactive drama. Bates and his team of graduate students developed software architectures for virtual characters using models of behavior, emotion and story structure, and applied them to make the well-known Woggles demonstration.[7] Other research projects involving virtual characters include Bruce

Blumberg's virtual reality dog Silas at the MIT Media Lab; Ken Perlin and Athomas Goldberg's Improv system at New York University; Barbara Hayes-Roth's Virtual Theater Project at Stanford; Karl Sims' virtual creatures from Thinking Machines; and Demetri Terzopoulos' Artificial Fish at the University of Toronto.[8]

These academic papers and pieces of software can hopefully serve as examples of new directions for developers to move in. Many of these projects apply some kind of AI or A-Life technique in the creation of their virtual characters. If you study and play with them you'll find a variety of different approaches and design principles in use. To progress beyond the status quo in computer game design, perhaps a good question to ask at this point would be: what AI or A-Life methods and techniques are best suited for creating character-centric interactive entertainment with mass appeal?

Author, author

Although the line is somewhat blurred in each case, these aforementioned systems tend to approach the problem of creating virtual characters from two different starting points: a more top-down, behavior-based approach (Oz, Petz, Improv) versus a more bottom-up, emergent behavior approach (Creatures, Silas, Sims' creatures, Artificial Fish). At their most extreme, the top-down approach requires each behavior to be explicitly defined by the programmer, whereas the bottom-up approach depends on low-level mechanisms (such as neural networks) to cause high-level behaviors to emerge.[9] The argument for the bottom-up approach is that as the size and complexity of virtual characters grow, it will become impossible to create all the necessary behaviors by hand. The top-down approach to creating virtual characters will eventually become too unwieldy to use, whereas the bottom-up approach is much more scaleable.

What needs to be considered here is the role of the author in the creation of characters. As we know the best entertainment in traditional media is hand-crafted by talented writers, actors and directors. At the risk of sounding old-fashioned, I see no reason why this won't also be required for interactive entertainment, no matter how sophisticated it gets. Again, entertainment is very often about people and contemporary issues in their lives. I would argue that even the characters in a system like the Holodeck would need to be authored by real people, or at least real people would want to author them.

Because purely bottom-up approaches do not give authors direct control over the behavior of their characters, I

challenge the idea that biologically-inspired A-Life alone will be the answer here. Real life, while endlessly rich and complex, is often marked by long stretches of dullness. Users that want to be entertained are not going to be willing to wait very long for something funny or exciting to happen. For example, a recent article about AI in *Game Developer* magazine mentions that the A-Life techniques used to control non-player characters in the *Ultima Online* virtual world had to "be compromised in the interests of game play".[10]

Perhaps a successful method would be a *hybrid* between the two approaches: a system that allows a high-degree of direct authorial control, as well as offering some degree of adaptiveness and unpredictable emergent behavior, but without ever getting out of control and "breaking character". With careful attention to design, could one author top-down behaviors to work alongside or together with a finite set of simple bottom-up rules? Could neural networks and genetic algorithms be applied to a dramatic or theatrical model of behavior, not a biological one?[11] Integrate such a system with expressive realtime animation, a natural language interface, and a database of common-sense knowledge, and you can go a long way towards creating intelligent, lifelike dramatic characters for interactive entertainment.

This is not to say that there won't be entertaining experiences offered by A-Life. Playing with characters authored in a more top-down behavior-based approach versus a more bottom-up A-Life approach is crudely analogous to going to Disneyland versus going to the zoo. In one entertainment experience you interact with exaggerated, theatrical, personality-rich characters; in the other you interact with realistic, natural, adaptable animals. Both Disneyland and the zoo are fun experiences for people, but for different reasons. (And I hasten to add, Disneyland is a lot more popular.)

Plotting the Future of Interactive Entertainment

Besides virtual characters, artificial intelligence can and will need to be applied to other aspects of character-centric interactive entertainment. For example, an interactive story experience would need some way of controlling the plot of the story. Although typical plots follow the classic structure of a "dramatic arc" – where an inciting incident leads to rising action which builds to crisis, climax and finally denouement – the exact events that make up that plot would need to vary depending on the user's interaction. It seems reasonable that AI techniques could be applied towards making this kind of realtime decision.

Much like the shallow virtual characters described earlier, there exist a slew of computer games, text adventures and interactive movies that call themselves interactive fiction but aren't much more than a collection of turn-based puzzles placed at the nodes of a fixed branching narrative tree. These games are reminiscent of the "choose-your-own-adventure" series of books, where a user cannot cause the plot to go in any directions that weren't pre-defined and pre-scripted by the writer. Users quickly bump up against the limits of the fixed plot structure and feel they have no real choices.

There have been fragmented efforts by a handful of independent groups to create plot *generation* systems, which in theory could create new plots in realtime based on interaction with a user. While there have been some interesting papers and even a few promising demos, there has yet to be a working system that demonstrably makes clear headway towards solving this problem. This area needs much more attention from both academia and industry.

Looking ahead, there are some promising projects currently in development that are applying AI or A-Life in new directions. For example, the Oz group from CMU has formed a startup company called Zoesis, presumably to apply their research to make a commercial product. Chris Crawford is working on an interactive fiction authoring tool called the Erasmatron. PF Magic continues to develop the Virtual Petz product line, with more sophisticated and intelligent characters to be released in upcoming titles. And Cyberlife, the company that made *Creatures*, is continuing to develop their A-Life technology and hopes that by the year 2020 (a "2020 vision") to have developed "all the necessary structures and systems for the creation of truly intelligent, sentient, synthetic life forms." But ultimately it will be up to the gaming community at large to realize that the market for interactive entertainment has grown tremendously in the last several years, to the point where there are more non-gamers than gamers out there. Hopefully with some creative applications of artificial intelligence and attention to what other kinds of interactive experiences are possible to achieve in this medium, we will move more towards what mainstream audiences want to play with.

Acknowledgments

References

1. N. West, "The way games ought to be…" column, *Next Generation* magazine, Imagine Media Inc., Brisbane, CA, March 1998, pp.104-5.

2. C. Crawford, "Computer Games Are Dead", *Interactive Entertainment Design*, Volume 9, http://www.erasmatrazz.com/library.html, 1996.

3. C. Crawford, "Revolution and Apocalypse", *Interactive Entertainment Design*, Volume 7, http://www.erasmatrazz.com/library.html, 1994.

4. A. Stern, A. Frank, and B. Resner, "Virtual Petz: A Hybrid Approach to Creating Autonomous, Lifelike Dogz and Catz", Proceedings of the Second Intl. Conference on Autonomous Agents, Minneapolis, ACM Press, May 1998, pp. 334-5.

5. J. H. Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*, The Free Press, New York, 1997, p. 15.

6. S. Grand, D. Cliff, and A. Malhotra, "Creatures: Artificial Life Autonomous Software Agents for Home Entertainment", Proceedings of the First Intl. Conference on Autonomous Agents, Minneapolis, ACM Press, 1997, pp. 22-9.

7. J. Bates, "The Nature of Characters in Interactive Worlds and The Oz Project", Tech Report CMU-CS-92-200, Carnegie Mellon University, October 1992.

8. "Virtual Characters and Interactive Story" comprehensive reference list, http://www.netcom.com/~apstern.

9. M. Mateas, "An Oz-Centric Review of Interactive Drama and Believable Agents", Tech Report CMU-CS-97-156, Carnegie Mellon University, 1997.

10. S. Woodcock, "Game AI: The State of the Industry", *Game Developer* magazine, October 1998, p. 34.

11. A. Stern, "Interactive Fiction: The Story is Just Beginning", *IEEE Intelligent Systems*, Los Alamitos, CA, Volume 13, No. 5, November 1998, p. 16.