

Artificial Intelligence for Dynamic Game Environments

by Patrick O' Halloran & Jeff Farnan



TROODON
GAME STUDIOS

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Introduction

This is a concept project to understand what it would take to create a computer game company from scratch. The company will specialize in developing A.I (Artificial Intelligence) in computer games. This is a new and developing field and involves a high level of computer programming and engineering. This document is a proposal showing what would be involved in setting up a company to develop A.I for games. In order for the reader to get a feel for this company, we have included a statement of purpose, and a section explaining the utilisations of Game A.I. Finally we will run over what marketing will be needed. We will wrap it up with a conclusion and a few ideas for our future.

Company Purpose & Image

Statement of Purpose

Troodon Games Studios was founded by Patrick O' Halloran & Jeff Farnan. Our initial goal is to become the industry leader in AI Programming for games. This paper lays out how we plan to achieve this goal.

Our clientele will be computer games development teams, from companies such as Electronics Arts and Ubisoft, who will contract us to program the AI system in their games. This was once done by their own teams, but as AI is becoming such more advanced, they will need to use specialised developers like Troodon to gain the highest standard of AI in their games and stay ahead of their competitors in this field.

Game artificial intelligence refers to the techniques used in video games to produce the illusion of intelligence in non-player (computer) characters (NPCs). The techniques used typically based on existing methods from the scientific fields of artificial intelligence and computer science. We at Troodon are passionate at not only making dynamic AI systems to enhance game play mechanics, but also to create artificial characters that the player can relate to in a very real way. We want to be at the forefront of a revolution in gaming, where realistic AI makes games much more immersive. And perhaps at a later stage we can lend our research and knowledge to other fields such as software design and robotics.

We are a single, closely-knit team. Our employees are highly skilled programmers, at the forefront of their field. We all share a vision to become a household name for a new era of interactive technologies.

Name & Logo

Our name comes from a species of dinosaur, the Troodon, which is believed to have been highly intelligent. The logo was designed to be simple and memorable.



History of AI in Games

The first video games developed in the 1960s and early 1970s, like *Spacewar!*, *Pong* and *Gotcha* (1973) were games implemented on discreet logic and strictly based on the competition of two players, without AI. Games that featured a single player mode with enemies started appearing in the 1970s. The first notable ones for the arcade included the 1974 Atari games *Qwak* (duck hunting) and *Pursuit* (fighter aircraft dogfighting simulator). Enemy movement was based on stored patterns. The incorporation of microprocessors would allow more computation and random elements overlaid into movement patterns.

The idea was used by *Space Invaders* (1978), sporting an increasing difficulty level, distinct movement patterns, and in-game events dependent on hash functions based on the player's input.

Galaxian (1979) added more complex and varied enemy movements. *Pac-Man* (1980) applied these patterns to maze games, with the added quirk of different personalities for each enemy version.



The emergence of new game genres in the 1990s prompted the use of formal AI tools like finite state machines. Real-Time Strategy games taxed the AI with many objects, incomplete information, pathfinding problems, real-time decisions and economic planning, among other things. Later games have used bottom-up AI methods, ranging from the first use of neural networks in a videogame in *Battlecruiser 3000AD* (1996), to the emergent behaviour and evaluation of player actions in games like *Creatures* or *Black & White*.

GoldenEye 007 (1997) was one of the first games to use AI that would react to players' movements and actions as well as taking cover, performing rolls to avoid being shot and throwing grenades at the appropriate time.

Halo (2001) featured AI could recognize threats such as grenades and incoming vehicles and move out of danger accordingly. *Far Cry* (2004) exhibited very advanced AI for its time; the enemies would react to the player's playing style and try to surround him when possible. They would also use real life military tactics to try and beat the player.

F.E.A.R (2005) introduced advanced character AI that used real time cover, tactics and team coordination against the player. AI characters worked as a team, knowing where other AI team mates are and made tactical decisions off of that. The AI would be able to recognize when out gunned and even hide from the player, to later attack from behind.

Left 4 Dead (2008) uses a new artificial intelligence technology dubbed **The Director**. The Director is used to procedurally generate a different experience for the players each time the game is played. The games developers calls the way the Director is working "Procedural narrative" because instead of having a difficulty level which just ramps up to a constant level, the A.I. analyze how the players fared in the game so far, and try to add subsequent events that would give them a sense of narrative.

Game A.I

Game A.I in videogames is used to mimic intelligent behaviour to challenge or entertain the player, and to make the game world more realistic. Most A.I programming is for non-player characters or entities, such as a squad of enemies in a war game, or a computer opponent in a puzzle or sports game.

The decision cycle of those NPCs consistently executes three steps:

- Perceive (*accept information about the environment – sensor information*)
- Think (*evaluate perceived information & plan according actions*)
- Act (*execute the planned actions*)

This approach may appear over-simplified, but it is perfectly suitable for governing NPC behaviour in videogames. If enemy NPCs were overly sophisticated the game may be too difficult to play. Also, game A.I, at least for the moment, is used to create an illusion of intelligence, and not true artificial intelligence.

It's like with movie fiction, which we know is not real, but with good direction, editing and acting the viewer can get enraptured in the storyline and characters, in what is called "suspension of disbelief". This is just as important with games. If the characters or entities are so predictable that you're able to figure out what they're going to do before they actually do it, then the suspension of disbelief required to put yourself in the game is high, and the game becomes less immersive, and therefore less enjoyable.

However, trends seem to suggest that game AI will be used to develop highly intelligent NPCs that you can interact with, with speech and even touch, as seen with the Milo (pictured below). This project by Lionhead Studios aims to create an intelligent boy using Microsoft's Natal technology which will be released later this year for Xbox 360.



At Troodon we aim to make a name for ourselves by programming memorable interactive characters as well as more traditional forms of game A.I. As games become bigger and more immersive the need for AI increases exponentially, making it a perfect time to enter the marketplace as the demand is higher than ever.

Commercial & Custom Game Software

Autodesk Maya

Autodesk Maya, or simply Maya is a high-end 3D computer graphics and 3D modeling software package originally developed by Alias Systems Corporation, but now owned by Autodesk as part of the Media and Entertainment division. Autodesk acquired the software in October 2005 upon purchasing Alias. Maya is used in the film and TV industry, as well as for computer and video games, architectural visualisation and design. The core of Maya itself is written in C++.

Project files, including all geometry and animation data, are stored as sequences of MEL operations which can be optionally saved as a human-readable file editable in any text editor outside of the Maya environment, thus allowing for a high level of flexibility when working with external tools.

3ds Max

3ds Max is the third most widely-used off the shelf 3D animation program by content creation professionals according to the Roncarelli report. It has strong modeling capabilities, a flexible plug-in architecture and a long heritage on the Microsoft Windows platform. It is mostly used by video game developers, TV commercial studios and architectural visualization studios. It is also used for movie effects and movie pre-visualization.

In addition to its modeling and animation tools, the latest version of 3ds Max also features advanced shaders (such as ambient occlusion and subsurface scattering), dynamic simulation, particle systems, radiosity, normal map creation and rendering, global illumination, an intuitive and fully-customizable user interface, and its own scripting language A plethora of specialized third-party renderer plugins, such as V-Ray, Brazil r/s , Maxwell Render, and finalRender, may be purchased separately .

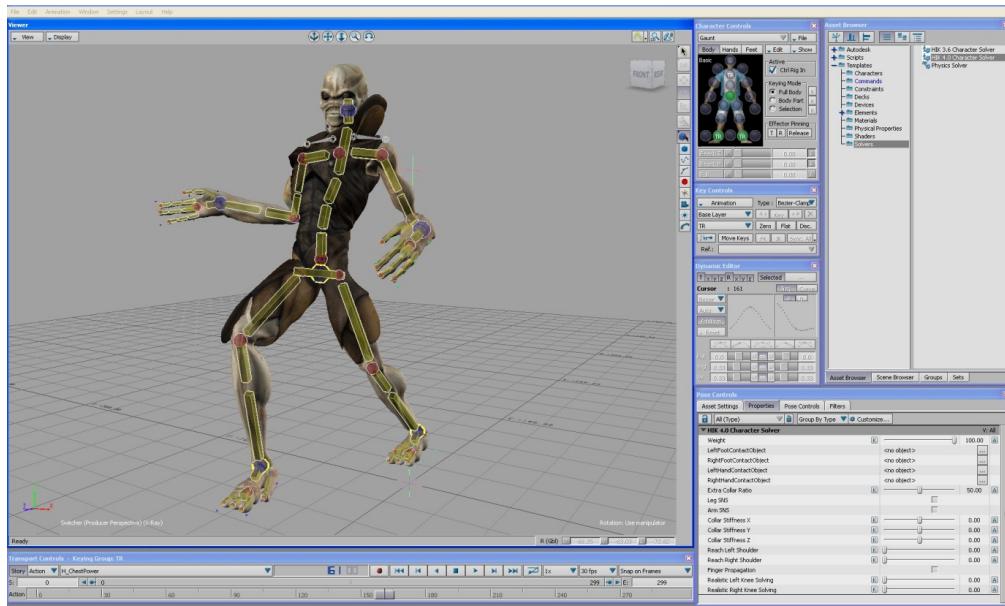
To begin with, Troodon will be using a suite of software from Autodesk. These programs are the best currently available for 3D modeling, character design and AI development. As mentioned before we do plan to create our software, as our needs develop, but for the time being we will use the Autodesk software listed below will be used.

Autodesk 3ds Max 2010

Autodesk 3ds Max software is a tool for game developers looking for out-of-the-box productivity. It is a powerful, full-featured 3D modeling, animation, rendering, and visual effects package. 3ds offers a template-based character rigging system, a modeling and texturing toolset, and a range of third-party plug-ins.

Autodesk HumanIK

Autodesk HumanIK animation middleware¹ is for creating believable, interactive character animation for games. HumanIK enhances animation systems by enabling characters to interact and procedurally adapt to game environments. With less gameplay constraints, HumanIK brings games to life with more immersive 3D character animation experiences.



Autodesk Kynapse

Autodesk Kynapse middleware is a leading artificial intelligence (A.I) solution for game development and real-time simulations. This engine supports 3D pathfinding in destructible environments, including large-crowd pathfinding² in complex terrains, dynamic 3D topology analysis, and team coordination. And, with its efficient production tools and architecture designed for easy integration and customization, Kynapse helps to streamline the process of creating top-quality A.I for games.

¹ **Middleware** is software that connects different parts of an application or a series of applications.

² **Pathfinding** generally refers to the plotting, by a computer application, of the best route between two points.

Marketing

There are several avenues for marketing in the games industry. Since we are looking for clients within the industry itself, rather than the gamers, we should concentrate on industry events and publications.

Industry Events



The Tokyo Game Show, commonly known as TGS, is a video game convention held annually in Chiba, Japan. It is used by many international video game developers to show off their upcoming games and game-related hardware, though the main focus is on the Japanese market rather than overseas.

Japan is a huge market for games, and therefore there are many large games companies operating there, such as Nintendo, Sega, Konami and Namco, so it would be wise for us to target that market by sending a representative to TGS.



The Electronic Entertainment Expo, commonly known as E3, is an annual trade show for the computer and video games industry held in Los Angeles. E3 is widely regarded as the world's largest regular convention for video games. Video game companies generally spend more on their presentations for E3 than any other convention.

Major video game critics often have a "best of E3" award session (similar to end-of-year award sessions), but only E3 consistently features such awards (for example, there is rarely a "Best of TGS" award session). Due to the prestige of this event and media interest it generates it would definitely be worthwhile sending a representative to Los Angeles for this convention.

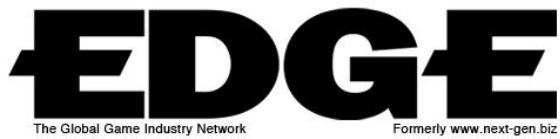


Gamescom is a new European trade fair for interactive games and entertainment held at the Cologne Trade Fair Center. It is the European equivalent of E3 in Los Angeles and Tokyo Game Show in Japan. Gamescom is the world's largest games event with 245,000 visitors, more than 4,000 journalists and 458 exhibitors from 31 countries attending the show in 2009. Since this summit is right our doorstep it would be foolish not to send multiple representatives.



Game Developer magazine gives you access to over 85,000 professional game developers — and their multi-million dollar budgets. Game developers count on *Game Developer* magazine for the most relevant and respected content in the game industry; your message is delivered again and again to the 67% of readers who reference back issues. By game developers, for game developers, *Game Developer* magazine provides the ideal editorial environment to deliver your marketing message.

As you can see, from the above figures, advertising in Game Developer Magazine would give us a lot of publicity in our target market, so our advertising budget would be well spent on this publication.



Edge is the world's most prestigious brand in games journalism. Launched in 1993, it has won numerous awards and continues to be the preferred read for game industry professionals and creative leaders.

Given the popularity and reputation of Edge, advertising in that magazine would be far-reaching and would give our company more widespread press. Since many regular gamers read Edge, it would result in much more brand recognition with the game-playing public.

Conclusion

Short-term plan

Our short term goal is to secure a contract. We will cost approximately 100,000 euro per 2 months of our services. If we are under contract for a full year, we will bring in 600,000 euro, which would easily cover our projected yearly expenses of 250,000 euro. To break even on our investment we need to be under contract at least 5/6 months of the year.

Through promotional work done through the videogame conference circuit and in industry magazines, we will garner the attention of several games companies. Ideally we will become partnered with a big publisher, which would give us much more financial security. Most likely however, is that a new company like Troodon will have to work on shorter term contracts until we make a name for ourselves. Our business plan and structure allows for this riskier strategy.

Should we not be under contract at any stage during our first year, all time and resources will go into developing our own languages, which will increase our productivity for future products, and will also mean that at no point will we be idle.

Long-term plan

In future years we could go a variety of different routes. We may decide to become partnered with a publisher or developer indefinitely. Or we may even decide to sell our business to them. Here is an example of why selling the company could be a tempting proposition; Playfish was founded by four developers in late 2007, with a goal to develop games for social networks, mainly Facebook. They were one of the first companies to concentrate on this niche. In 2009, Electronic Arts paid \$275 million for the company!

Our company shares many traits with Playfish, we are small and specialized, and we are the first to target a niche; ours being advanced character AI for games. Only time will tell if we have the same success, but the possibility is definitely there. However, if we have more ambition for our company, we may expand and start making our own games. Or as mentioned before, we could expand into other industries, such as AI for robotics, or software design or research.

Troodon has many options, both in the short and long term. This will be our main strength as we face new challenges in the future. We will be versatile, and always the best at what we do.

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