

DECONSTRUCTION OF THE LAST OF US - USE OF AI IN MAKING IMMERSIVE EXPERIENCES

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Abstract— A thrilling pass time in many lives, video games have been a source of entertainment since it was first released in the 1950s at a science fair. Video games are a place where creativity and art meet science and mathematics, which is clearly depicted through the usage of Artificial Intelligence. Its role is as important as narrative, art, graphics, audio, and any other element. One can not overlook the role of AI in making Non-Playable Characters (NPCs) more human-like, and how they make a game more immersive. This paper reviews the franchise of The Last of Us by Naughty Dog and discusses the usage of AI for decision-making by Non-Playable Characters in the game as well as in other fields.

Keywords— Artificial Intelligence, Video Games, Non-Playable Characters, Path Finding, FSM.

0. INTRODUCTION

The inception of AI in video games- Artificial Intelligence plays an important role in video games ever since its inception in ‘The Nimatron’, an ancient mathematical game. The game was commercially released at the Westinghouse pavilion at the New York world fair in 1939. ‘Nim’ is a game played by two players where each player takes a turn to remove some coins from a single heap. There are two versions of ‘Nim’, one where the winner is the one to take the last coin and another where the player must avoid being the former. “A sturdy chrome-edged cabinet topped with rows of light bulbs representing the game tokens”, was built and named ‘The Nimatron’. The 8-foot tall entertainment device stood as an attraction to anyone who wanted to defeat the machine. Almost as if it had a mind of its own, ‘Nim’ made its decisions promptly and confidently, of which the players were quite taken aback. Although ‘Nim’ might not have a lot to contribute to the Gaming Industry directly, its development did bring the idea of humans going against mechanical components into the limelight.

NPCs or Non-Playable Characters- NPCs have been a part of video games since the era of ‘Pong’. They are computer-controlled bots or characters that interact with the player and give the illusion of playing against or with other human players. These characters allow the game to provide an open-ended experience to its players in addition to making the game more interactive. It removes the restriction of having human players fill in additional roles in a story.

The Last of Us franchise is set in post-apocalyptic America, where about 60% of the population was either infected by the deadly fungal infection Cordyceps or killed surviving from the infected following an explosion that spread the fungus around the country around mid-September in 2013.

AI can be implemented in various ways in the game through NPCs. Starting with character dialogues and the buddy trailing system to the behavioural integrity of the human enemies as well as the infected. This paper will discuss these aspects in detail.

I. FINITE STATE MACHINES

This section explains the repetitive AI models in depth for the sections followed later. The Last of Us is a stealth-based game, and to ensure a smooth transition between the different states of NPC awareness, the game uses Finite State Models or FSMs.

An FSM is a mathematical model used to describe the behaviour of a system by distributing the system into a number of 'states' and the transitions between them. Each state in the FSM represents a specific behaviour that the buddy AI or the enemy AI follows, such as following the player, searching for them or engaging in combat. The transitions are triggered by certain events or conditions in the game. However, they can become repetitive if too simple and struggle with unforeseen situations. To address this, developers can use advanced FSM techniques like hierarchies for complex behaviors or even explore alternatives like Behavior Trees for more nuanced decision-making.

In The Last of Us, an FSM could control the buddy AI's behavior. It might have states for following the player, being on alert, and assisting in combat, with transitions triggered by the player's actions and the environment.

II. DIALOGUE AND AUDIO

In The Last of Us, immersive and environmental audio plays a huge role in creating a world that is realistic and supports the gameplay and the story. This section talks about how Aural Immersion plays a role in bringing the story to life, and how the player can find themselves fitting into the character they are playing.

For this franchise, the sound design team wanted to implement an AI system that allowed NPCs to converse with each other in a realistic way, which includes giving every human enemy their name. In Last of Us 2, the Fireflies engage in conversation while searching for the player and react to the death of their friends with anguish and rage when the bodies are discovered.



Fig 3.1: A WLF soldier (enemy NPC) cries in anguish as he discovers his friend's body.

Dialogue in video games can be categorised as *Narrative* or *Environmental*. Narrative Dialogue carries forward the story through conversational dialogues or audio logs and gives an inside look into the game's world, whereas environmental dialogue fulfils the purpose of updating the player on the NPC alert status and helps the player to make better decisions during combat or Quick Time Events.



Fig 3.2: The player being alerted of a hostile by a Buddy NPC

Adam Ritchie, a senior Voice Designer says, “A bark is a voice line, designed to rationalise and telegraph the actions and reactions of an NPC.” Barks are what make NPCs appear intelligent and emotive, as they communicate with other NPCs to give contextual clues to the player. Barks can be either *Literal* or *Nonliteral*. Literal barks often convey the actions of an NPC contextually. They contain important situational information, which allows them to anticipate a situation and react to it appropriately.

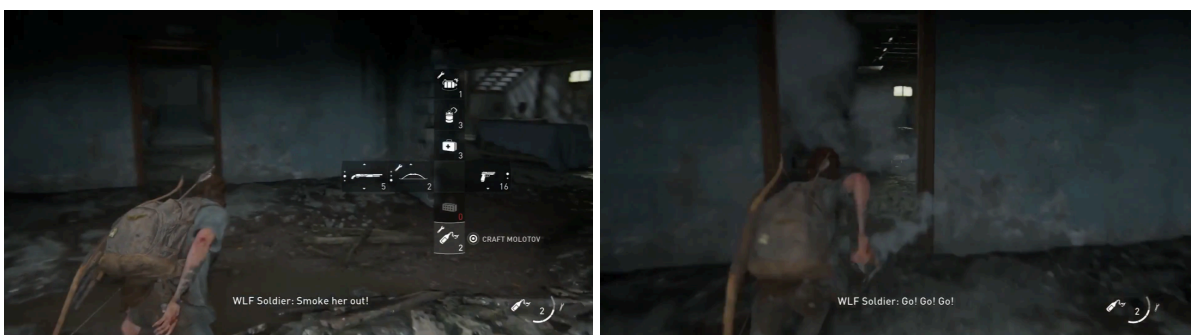


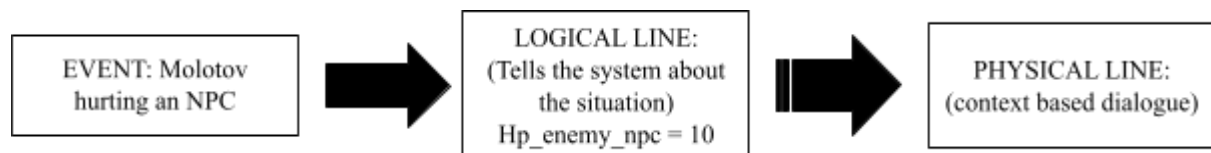
Fig. 3.3: An enemy calls out a smoke grenade followed by an explosion near the player.

Nonliteral barks, on the other hand, help with world-building through conversations and help create an immersive experience for the player. They can create the ambience of a scene and help NPCs to seem

more human, by allowing them to react to situations emotionally based on the context rather than just giving information.

Barks have to fit in the game world smoothly, and there is a certain structure that allows sound designers to categorise which sound is of more importance to the player. Failure to do so can ruin the immersive and the believability of the game and can end up harming the entire experience overall. This is achieved through the process of audio implementation. It is a process of creating a set of rules that determines when and how a specific sound will play to make an NPC's interaction with the game world seem more fluid. The game processes context, the player's actions, and surroundings and then makes a decision based on them, after which it chooses a line from thousands of samples to fit in the situation.

For example, if the player throws a Molotov at an incoming enemy, the series of events that might lead to the NPC warning its group can be simplified as follows:



Just applying the voice line does not increase the immersiveness of the game. The system then looks for various factors such as player position, surroundings, the NPC group size, recently used lines, and priority, after which it picks a line and sends it to the game engine.

To do so, the system first looks at AI behaviour to determine what state the AI is currently in, which is achieved using Finite State Machines. The Multi-State AI is divided into 4 parts: Unaware, Investigate, Combat and Search, which could transition freely between each other. The system determines what state the AI is in to determine what dialogue is to be spoken. This removes the possibility of dialogues being spoken at inappropriate times.

A. Human Partners/Buddy

In *The Last of Us 1*, Creative Director of the game Neil Druckmann explained that in video games, NPCs usually become a hindrance or are incapable of being useful during combat. He wanted Ellie to feel more human and livelier by allowing her to make certain decisions when the player is navigating the world through Joel. The team wanted Joel and Ellie's relationship with each other to be natural and believable throughout the single-player journey. The developers of the game had to take care not to be "overzealous" with their callouts. During the initial stage of their buddy trials, Ellie would call out a threat after spotting them for a fraction of a second. The developers had to take care that the callouts were appropriate and correct, and would act as an aid rather than a hindrance.

In the following instalment, where Ellie acts as the playable character for the majority of the playtime, she has to interact with her partner Dina. One important role that highlights the buddy's role is callouts of seen or invisible threats during or out of combat. Dina effectively warns Ellie and the player about what to expect in the next phase of the game when she's present. This includes the presence of nearby human enemies or the infected.

B. Human Enemy

The Last of Us 2 has revolutionised how a player interacts with an NPC when they are against each other. Being in a post-apocalyptic situation, you will inevitably be against humans too- fighting for resources, against groups of people with their government, and so on. A similar military group called the Fireflies exists in the universe. They are first introduced as the antagonists in the first series of the game, and as a playable factor as Abby in the second instalment.

The game and its developers tried to make the player think twice about the ruthless kills Ellie does in the name of survival. In Last of Us 2, human enemy NPCs now react with fear and restrain Ellie as if they were scared of dying, the combination of which makes them seem more human rather than just bots in the game. The reaction puts a lot of significance on their deaths and puts more weight on the players' actions.

As mentioned before, enemy NPCs now have names and will react differently to the deaths of their friends and their dogs which reminds the player that even they are in the world to survive and are as human as us. Not only us humans but when dogs find out about their fallen owners, they are seen moping and whimpering around their bodies. These interactions make for a unique experience as you are forced between killing and stealth as you navigate through the ruins of America.

III. CONCLUSION

This paper explored the use of Artificial Intelligence (AI) in the video game franchise The Last of Us, developed by Naughty Dog. AI plays a critical role in shaping the player's experience by controlling Non-Playable Characters (NPCs) and their behaviors. The paper discussed Finite State Machines (FSMs) as a core AI technique used in The Last of Us to manage NPC behavior transitions. Additionally, it explored how AI is used for dialogue and audio systems, creating a more immersive and realistic gameplay experience.

The exploration of AI in The Last of Us highlights the increasing sophistication of AI in video games. Buddy NPCs provide support and companionship, while enemy NPCs exhibit more human-like reactions, creating a morally complex environment. These advancements blur the line between player and NPC, fostering a deeper emotional connection with the game world.

Future research on AI in video games could delve into more complex AI techniques like Behavior Trees and their impact on gameplay. Additionally, exploring the ethical considerations of increasingly human-like AI characters in video games could be a valuable area of study. As AI continues to evolve in video games, it will undoubtedly play an even greater role in shaping the future of interactive storytelling.

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