

PLAYING WITH INTELLIGENCE: AI AND GAMING

Elena CHIZIL

Group TI-221, Faculty of Computers, Informatics and Microelectronics
Technical University of Moldova, Chişinău, Republic of Moldova

* Author correspondent elena.chizil@isa.utm.md

Coordinator: Corina TINTIUC, university assistant, Department of Foreign Languages, TUM

Abstract. *Artificial Intelligence is becoming more common in our daily lives, from virtual assistants like Siri and Alexa to innovative technology in medical treatment, self-driving cars, and drones. AI has already transformed multiple fields, and the gaming industry is no exception. Its history dates back to the 1950s and 1960s when researchers began to explore the concept of intelligent machines. Since then, AI has become an integral part of almost every game. It is used to enhance gameplay, improve user experience, and even create more visually appealing game environments.*

Keywords: *algorithms, game development, limitations, player experience.*

Introduction

When we think of AI, the first thing that comes to mind is an intelligent machine, a robot, or a system capable of performing various tasks that typically require human intelligence. But are real-world AI and game AI the same thing? Although both use similar principles, they serve different purposes. In day-to-day life, AI helps to solve complex real-life problems in healthcare, finance, transportation, etc., while gaming AI aims to make the game more realistic and challenging for the player. By utilizing AI, game developers can create a more natural setting with believable storylines and characters.

What is Artificial Intelligence in Video Games?

Before we go into the specifics of AI and how it works, we need to understand what it is exactly. In simple words, AI in video games is a set of detailed conditions, but it also goes beyond that. It involves the use of complex algorithms and programming to simulate the behavior of intelligent agents. These agents mostly focus on deciding which action to take based on the current game state.

Implementations of Game Artificial Intelligence

Non-player characters or *NPCs* are where game AI is used the most. NPCs are characters that are not controlled by a player. They represent a crucial part of world-building in games as they provide useful information, a sense of history, and context to players. They can act as allies who assist the player in combat, as enemies who track the player's movements and coordinate attacks, or as simple citizens who give tasks or quests to complete.

About 20 years ago, NPCs were generally less complex in comparison to modern games. They had limited abilities, and their moves were simple and predictable, which resulted in a lack of challenge for the user. Nowadays, NPCs can adapt to different environments, learn about the player's behavior and tactics, and react to them accordingly. For instance, in "Red Dead Redemption 2", a game with one of the most well-developed NPCs, enemies will try to cover all the exits from the building or try to flank the player if they take cover too often [1]. Therefore, introducing these various innovations makes the gaming experience more immersive and unique to every player.

The integration of *decision-making systems* in game development plays an important role in creating more realistic non-player characters. One common approach to implementing decision-making AI in video games is through the use of behavior trees. Behavior trees are hierarchical

structures where each node represents a possible outcome or a certain decision an agent can execute. Let's take the Police NPCs in "Grand Theft Auto" for example, who may decide to pursue the player character if they commit a crime, or call for backup if they are outnumbered. In "Detroit: Become Human", while gathering evidence of a crime, the player's choices can affect the course of the investigation, adding a layer of depth to the gaming experience. An example of a decision tree is shown in Fig. 1.

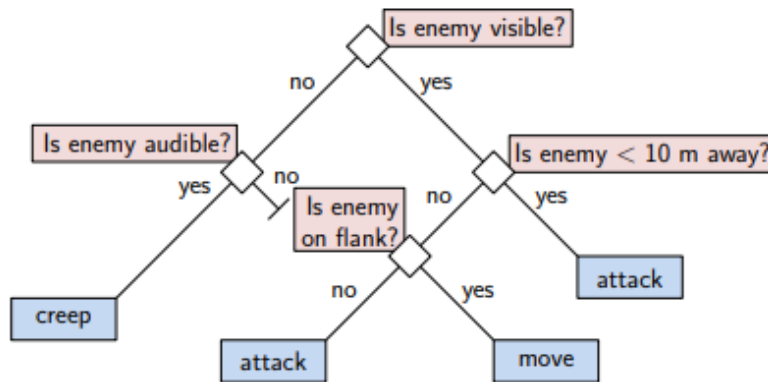


Figure 1. A decision tree in a video game [2]

Pathfinding is another application of AI that can be utilized in video games. It is a plotting node to find the shortest or minimum path between two points, which is from source to destination by a computer application [3]. Where to stand or take cover is one of the most fundamental decisions AIs need to make, and it is also one of the hardest. Pathfinding uses up a lot of CPU power and memory, thus, researchers have to come up with different techniques to optimize the existing algorithms (Dijkstra, A* shown in Fig. 2, genetic algorithms, ant colony), and improve the efficiency of the hardware. Hence, the games run smoother, allowing the characters to navigate game environments in real time.

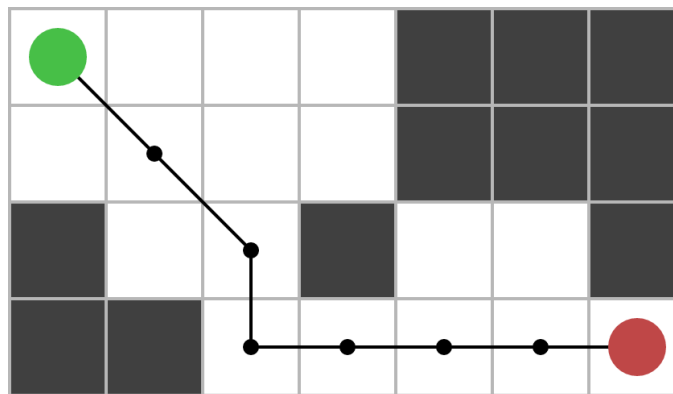


Figure 2. A* pathfinding algorithm [4]

Artificial intelligence in gaming can create new content, interactive stories, environmental conditions, levels, and even music automatically [5]. This method is called *procedural generation* (proc-gen) and it allows creating data algorithmically rather than manually. Moreover, with the help of this tool, game developers can focus on other aspects of the game like graphics or game mechanics, saving time and effort. To give you an idea of how incredible this AI can be, look no further than "No Man's Sky". This game features an open universe with over 18 quintillion planets, each with its unique climate, wildlife, and flora. The game's engine employs several algorithms that can mimic a wide range of geometry and structure found in nature [6]. As a result, every time a player starts a new game, they encounter a completely new and captivating environment.

Limitations and Challenges of Artificial Intelligence in the Gaming Industry

Despite its potential, game AI has limitations, which, unfortunately, affects the gameplay. The most prominent challenges are [7]:

1. **Cost and complexity** – developing AI technology is a complicated operation that requires a lot of resources and qualified developers with special knowledge and skills in this area.
2. **Lack of creativity** – while procedural generation AI creates diverse worlds, it's still not as creative as human designs. The reason for this is the fact that AI heavily relies on pre-programmed algorithms to generate content.
3. **Impact on player immersion** – AI in video games should be predictable because otherwise something unexpected might happen and it could break the game. It also should be believable as it mimics real human behavior, and humans are not perfect: they have flaws. Imagine a character always making the right moves and perfect decisions. That would feel out of place in the gaming world. For this reason, developers must carefully research human psychology and design a convincing AI.
4. **Limited ability to adapt** – while AI can learn and adapt to players' tactics, it can only do so within a certain range. It cannot adapt beyond the parameters that have been already programmed into it. That is why games tend to become repetitive over time.

The Future of Artificial Intelligence in Video Games

It's hard to say with precision what the future of game AI will look like, as there are still many problems with its implementation that require solutions. Currently, the big studios are taking it slow, choosing to prioritize the improvement of existing systems and having control over the creation process. Even so, they have been investing heavily in research and development to create more advanced AI algorithms that can power the next generation of games.

AI has already demonstrated the ability to create music, art, and even write novels. As these systems become more advanced, it's not difficult to imagine that they will be able to create games that are not only functional but also engaging and fun to play.

Conclusions

To summarize, Artificial Intelligence in video games is a very sophisticated and interesting field of technology and its trajectory is looking bright. With constant experiments and developments of technology (new consoles, more powerful hardware) the role of AI in game development is expected to grow even further. AI will keep on empowering the creation of video games, offering more interactivity, original content, and high-level graphics and visuals [8]. So, whether you are a hardcore gamer or just love to casually play from time to time, the customized experience created with the help of AI will make you feel like the game was made just for you.

References

1. VELARDO, V. The Reality of Red Dead Redemption 2's AI (Part 1) [online], 2019. [Accessed 27.02.2023]. Available: <https://medium.com/the-sound-of-ai/the-reality-of-red-dead-redemption-2s-ai-part-1-c276e9da2763>
2. MOUNT, D., EASTMAN, R. Artificial Intelligence for Games: Decision Making [online], niversity of Maryland Department of Computer Science, 2018. [Accessed 27.02.2023]. Available: <https://www.cs.umd.edu/class/spring2018/cmsc425/Lects/lect21-ai-dec-making.pdf>
3. RAFIQ, A., ASMAWATY T., ABDUL KADIR, S. NORMAZIAH IHSAN. *Pathfinding Algorithms in Game Development*, IOP Conference Series: Materials Science and Engineering, Volume 769, The 6th International Conference on Software Engineering & Computer Systems 25-27 September 2019, Pahang, Malaysia. <https://iopscience.iop.org/article/10.1088/1757-899X/769/1/012021>
4. A* pathfinding algorithm [online], 2012. [Accessed 27.02.2023]. Available: <https://www.growingwiththeweb.com/2012/06/a-pathfinding-algorithm.html>

5. DSOUZA, J. AI in Gaming: 5 Innovations Changing The Future of Gaming [online]. [Accessed 27.02.2023]. Available: <https://www.engati.com/blog/ai-in-gaming>
6. Procedural generation [online]. [Accessed 27.02.2023]. Available: https://nomanssky-archive.fandom.com/wiki/Procedural_generation
7. Artificial Intelligence in Gaming Industry [online]. [Accessed 27.02.2023]. Available: <https://www.javatpoint.com/artificial-intelligence-in-gaming-industry#:~:text=This%20means%20that%20AI%20may,AI%20in%20the%20gaming%20industry.>
8. DARBINYAN, R. How Artificial Intelligence Can Empower The Future Of The Gaming Industry [online], 2022. [Accessed 27.02.2023]. Available: <https://www.forbes.com/sites/forbestechcouncil/2022/07/13/how-artificial-intelligence-can-empower-the-future-of-the-gaming-industry/amp/>