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THE RISE OF ARTIFICIAL INTELLIGENCE IN VIDEO GAMES

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ABSTRACT

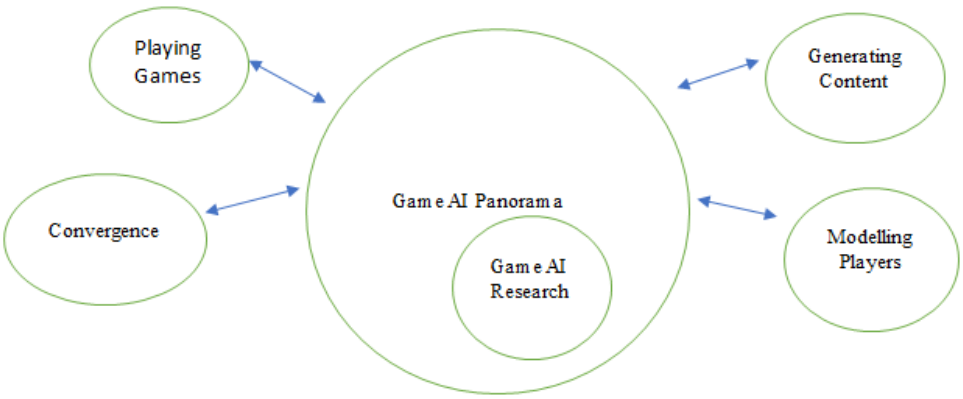
Video games, initially considered for entertainment purpose only, have grown in popularity and significance. One simply cannot overlook the phenomenal role of artificial intelligence in making video games more immersive and impactful as a medium. This paper discusses the growth of artificial intelligence in video games throughout the history, mentioning the types and roles of artificial intelligence and in what manner they have crucially contributed to the video games. Providing ample examples, this analysis points out the relevance of Artificial intelligence in video games and the level of interaction between human and machine. The article also poses a question for the future aspects of advancement in gaming taking into consideration the emerging technologies and new media.

Keywords: Artificial Intelligence, Video Games, New Media, Extended Reality, Convergence.

I. INTRODUCTION

The first working digital computers were developed in the late 1940s or early 1950s, depending on your exact definition of computer, and they were immediately used to play game. The eager inventor (and player) was none other than Alan Turing, one of the founding fathers of computer science and artificial intelligence (Togelius, 2019). Artificial Intelligence is one of the fundamental concepts in video games. Its role is as important as narrative, art, graphics, audio, and any other element. AI not only accounts for the scalable difficulty or interaction with other characters/environment within game, but also for immersion, adaptivity and response. A bad implementation of AI will break the immersion, whereas a game with good AI mechanics will further enhance the whole gameplay experience. Ever since the birth of the idea of artificial intelligence, games have been helping AI research progress. Games not only pose interesting and complex problems for AI to solve - e.g., playing a game well; they also offer a canvas for creativity and expression which is experienced by users (people or even machines!). Thus, arguably, games are a rare domain where science (problem solving) meets art and interaction: these ingredients have made games a unique and favourite domain for the study of AI. But it is not only AI that is advanced through games; games have also been advanced through AI research (Yannakakis & Togelius, 2018). The artificial intelligence in video games can be either deterministic or indeterministic. Deterministic AI is widely used in gaming industry, where the uncertainty is bare minimum. Indeterministic AI has levels of uncertainty and is more adaptive and responsive as it learns from user interaction.

Various roles of Artificial Intelligence in Video games



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- Decision making - AI will let the choices that you simply make have a greater effect on the gameplay. For example, in Rockstar's "Red Dead Redemption 2" and CD Projekt's "The Witcher" series, the behaviour of non-playable characters (NPCs) and their interaction with the player's in-game character (and the player eventually) depend on multiple factors like the demeanour, the attire and the past interactions. Since there's a colossal lattice of conceivable outcomes, the entire in-game scenarios might be controlled by choices player makes with subtle repercussions. There may be greatly detailed and intricate cause-and-effect relationships. In major Role-playing games (RPGs), a decision tree is present where the player provides attributes to the in-game character and actively determines the manner in which they want to represent the character in that virtual world. Additionally, dialogue tree for interacting with NPCs is provided which consists of multiple options with different consequences respectively.
- Non- Playable Characters – NPCs is the concept where a video game's AI is utilized sovereignly. These are characters in a video game with whom the player interacts. The level of interaction with NPCs is highly dependent on the game engine used for the development of the game and the programmed artificial intelligence present in the database. Random encounters with NPCs make a game-world more immersive. In most of the modern vide-games, the NPCs are well-characterized and are actively preoccupied with their own chores and activities adding a sense of realism in the virtual world. Moreover, each NPC is designed to be different from the other, which justifies the real-world persona and accounts for individuality and diversity making a product less machine-like which is eventually created with help of AI.
- Game level generation – Procedural Content Generation (PCG) is a game designing technique which makes use of AI algorithms to generate various gaming assets, game levels, and huge open-world environments. The open-world games have been trending where lots of options and a big deal of flexibility to approach a virtual world is available. Most of the modern games in 21st century have this in-game mechanics as their selling point, proving the player(s) multiple options to play the same game enhancing the vivid experience. New and improved game engines with advance AI are capable of generating such levels providing unique gameplay and unprecedented experience to the user.
- Graphical Enhancement – Using deep learning and machine learning, AI experts in the game development team 3d models into ultra-realistic visuals. "Marvel's Spiderman" and "Grand Theft Auto 5" are prime examples of this technology as their game world representation is very-detailed and totally map-accurate. Marvel's Spiderman and Grand Theft Auto 5 accurately portray the cities of New York and Los Angeles respectively. Many other open-world games with freedom of exploration make use of artificial intelligence to enhance the visual data being generated to the player.
- Pathfinding - Pathfinding in video games stands for traversing from one point to another. Artificial Intelligence is used to generate the landscape as player's character roams in the virtual world. According to in-game decisions, movement, playstyle and other similar parameters, the artificial intelligence modifies the landscape.
- UX-based modelling – Artificial Intelligence in case of video games has developed to such an extent that based on the player's input and gauging the interaction with the environment during the gameplay, it can adjust the scalable experience. Dynamic difficulty in video games is an apt example of this concept. The AI, based on the player's interaction and the perceived mood, can escalate, or de-escalate the virtual scenario, making the gameplay fluid and more immersive.
- Data Mining – To gain insights on player behaviour and to explore monetization opportunities, data mining is performed by game developers. It is also used to enhance gameplay, fix bugs with future updates, and to recognize patterns like - why players are enjoying a certain level in game and skipping skipping the perceptible dull ones.

Artificial Intelligence and its role in different genre of video games

The research paper – "Research Directions for AI in Computer Games" (Fairclough, Fagan, Namee, & Cunningham, 2001) has outlined the role of AI in video games according to genre.

- Interactive Story - The field of interactive stories has its roots in the arts of oral storytelling and theatre, and ideas from these fields have been integrated into new forms of of narratives utilizing the computer as a medium.

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- Strategy Games – Commonly marked by the usage of "bird's-eye view", a strategy game allows the player to control various military units based on real world and fantasy, and to formalize suitable strategy to be enacted. Managing time and resources is another aspect of playing these games. Strategy games can either be – "real-time" or "turn-based". In real time strategy (RTS) games, the AI controls all the units simultaneously akin to the real-world battles, where the events are instantaneous. In a turn-based strategy game, the AI interacts with the human player by taking turns like the game of chess.
- Action Games – A typical action game of early 2000s takes place in a fully rendered 3d environment and is viewed from a first-person perspective. Squad-based tactics and realistic models providing a great deal of simulation tend to be some core gameplay mechanics of these games. The real-environment physics is well-emulated making these games more engaging. Also, the Perspective is another factor.
- Role Playing Games – The games range from older text-based interactions to modern fully rendered, vast open-worlds. The branching story with active decision making and the behaviour of NPCs serve as the main aspects in RPGs which are driven by AI.
- Adventure Games – A cross between interactive story and role-playing, an adventure games makes use of advance AI to make the world and interaction more realistic.

Past, Present and Future

Artificial Intelligence have been used in computer-based games since 1950s. Nim (1951) was a turn-based games in which the AI has been stated to win frequently against human-players. Early versions of chess and checkers in 1950s and 1960s also utilized AI as game mechanics. In 1970s, "Space invaders" made use of dynamic difficulty level, and in 1980s "Pac-man" gained mainstream success for its gameplay where the player guides the entity through mazes. Dragon Quest 4 in 1990s allowed players to set the AI battle interaction of supporting characters to generate optimal strategies for success and experimentation regarding battle strategies. The popularity of sports games in 1980s and 1990s cab be accounted to the better implementation of AI in those games, ultimately leading to enhanced immersion and recreation.

The video games in early 21st century like – Half Life 2, S.T.A.L.K.E.R, Halo, StarCraft 2and Gears of War, introduced new mechanics in games like cover-based shooting, co-ordinated attacks by enemy AI and better response to situation by allied NPCs controlled by AI. Modern video games like "Shadow of War" make use of "Nemesis System" governed by AI, where the NPCs remember the earlier actions done by the player and react accordingly. Other modern games like – Red Dead Redemption 2, Bioshock Infinite, Alien: Isolation are renowned for brilliantly implemented AI within their game world.

The future of gaming is inclined towards convergence and extended reality. Recent augmented reality game "Yaatra" which was led by partnership of "Reliance Jio" and "Google maps" makes use of custom 3d avatars. This action-adventure game makes use of user's camera to integrate the virtual and the real world. Several other games have been released in recent times which fall under the category – Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). These Extended Reality (XR) games are being developed and purchased more frequently than ever, due to advancement in various aspects of AI regarding the game worlds and gameplay. The future is indicative of the accelerated growth of convergence media and more-immersive games with the advancement in artificial intelligence.

II. CONCLUSION

One can undoubtedly discern the growth of artificial intelligence in video games taking into account the examples of various AI elements throughout the history of video games and ultimately realize the development, changes made and the potential taking into consideration the multitude of video games as examples of the advancement in artificial intelligence. With emerging technologies, the video game industry has become the largest revenue-generating media industry. Extended Reality has made video games more immersive than ever, but the limitations do exist. Artificial Intelligence plays a significant role in game-development; however, it has not yet reached a level of self-sufficiency to generate media-content on its own. Just like films (using bot-generated script s and sequences) and books made by AI, video games' production solely based on artificial intelligence without human intervention is not possible as most of the AI-only generated media content are

sloppy, unstructured, and incoherent. Although experimentation and research in this domain is going on, we can only hope see visibly remarkable results with the further advent of new technologies in 21st century.

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