The Integration of Generative Artificial Intelligence into Video Games

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Abstract:
Generative artificial intelligence (GenAI) has exploded in recent months, with OpenAI releasing newer and newer versions of their GPT model. With this explosion, there are questions about how it will seep into major industries such as entertainment and retail, and our paper discusses how it will affect video games. Very few examples exist of current games that use GenAI, but the doors are open and the future is bright for the implementation of this revolutionary technology in video games. In this paper, we will explore the history of artificial intelligence in video games, understand how GenAI can be implemented into video games, and take a look into the future of GenAI in game development.

Keywords: Generative artificial intelligence, generative pre-trained transformers, application programming interface, learning language models, developers, video games

Introduction

In "Ready Player One," the Oasis is a big place where the digital and real come together to make new experiences. Wade Watts says it's the only place that makes him feel important. This movie is about a future where people and machines mix. Generative AI (GenAI) is a big step towards making this world a reality. It can learn from lots of data and make new and changeable content, like people do. In games, this means a big change. GenAI is not just for coding but shapes everything in games. With Fortnite, Unreal Engine, The Finals, and RecRoom, GenAI makes games better and changes them as you play. This study looks at how GenAI is used in games, what this means for play, and how it might change the way we tell stories in games.

Regular, non-generative artificial intelligence has been around in gaming since arcade machines. The ghosts in Pacman for example can respond to where the player is going and move to intercept their path, and grow more aggressive as the game goes on. In Halo: Combat Evolved, released in 2001 by Bungie, there are various enemy types each with their own set of algorithms for deciding how to engage and attack the player. The Elite enemy type will jump out of the way of grenades, find cover when they are low on health, and the more cannon-fodder enemy type, the Grunt, will flee and panic when their Elite commander dies. These kinds of interactions allow gameplay to feel dynamic, and more importantly, increasingly harder as the player progresses through the game. How was something this seemingly complex process possible with the technology of the 90s? An article from Columbia Engineering suggests that AI is just a series of algorithms that allow for non-player-characters (NPCs) to respond to player actions (Columbia Engineering, n.d.). While at times this may seem predictable, they argue that predictability is exactly how games are mastered in the first place.

Programming Artificial Intelligence in video games before the creation of Generative AI (GenAI) was usually a very meticulous and tedious task. Developers were required to explicitly code each potential action and reaction within a game’s environment. This necessitated a thorough understanding of both the mechanics of the game as well as the desired outcomes of the AI’s behavior. This approach, while effective at the time, was inherently limited by a developer’s ability to anticipate and program every single possible scenario that a player might encounter. The code had to be complex and needed to consist of multiple conditional statements and decision trees, with each line written to trigger specific responses under certain conditions. Developers had considerable time commitments to their projects and the development cycle

would extend significantly as teams would work to create the outward appearance of intelligence and adaptability within the game's non-player characters (NPCs) and systems. Despite these efforts, the end result would often be a quite rigid and predictable AI, constrained by the boundaries of its predefined logic.

Needless to say, there are flaws in traditional AI systems and this stems from their approach to programming. The need to code each unique decision makes the development process harder, more time consuming, and also caps the potential for in-game AI to change. This blatant predictability meant that NPCs would react in the same manner to the same prompts, thus lowering the realism and immersion of the game. With Generative AI, this is no longer the case. Instead of a set of hard coded options the possibilities are limitless. NPCs can actually respond to your questions with authenticity and realism and you as the player are also able to interact with the game in ways that were never possible before.

There are some very notable examples of these AI limitations in modern video games, examples well known by the video-gaming community. The first of these is Mojang's Minecraft world generation; on the surface, Minecraft offers infinite worlds, generating a completely new world with a random seed every time the player starts up a new game. It is unfathomable to comprehend just how many seeds have been generated already, and the possibility of endless to come, and each seed is unique and never repeated. Despite this, world generation works off certain parameters that are always pre-set and pre-coded. This means, although the world is technically different, many of them look and feel the same, with biomes being generated in the same way every time, resulting in each Minecraft world being familiar. Another example is Ubisoft's Assassin's Creed franchise, which is notorious for its clueless NPCs. Countless examples exist of enemies in these games forgetting about danger even when they see it with their own eyes, or being unable to see the player in their peripheral vision. Bethesda's Elder Scrolls: Skyrim shares these drawbacks in their NPCs as well, with them being ridiculously easy to outmaneuver, where simply running behind a table can confuse them. GenAI will be able to remedy these drawbacks.

Generative AI in Video Games

Generative AI is revolutionizing the way that game developers go about creating and integrating AI into their games by using models such as Generative Pre-trained Transformers (GPTs) and specific Application Programming Interfaces (APIs). A GPT is a type of AI that really excels at understanding and generating human-like text based on the input that it receives. An API acts as a bridge to allow different software applications to communicate with each other seamlessly. In the context of GenAI, APIs allow game developers to integrate the output from GPTs into their games by using preexisting structures of code already suited for the tasks needed. By doing this, developers are able to produce more content than ever before, decreasing the time spent on their projects.

When it comes to writing code or actually programming, Generative AI generates code in a completely different way than traditional methods. GenAI uses specific learning language models (LLMs) that have been trained extensively on data sets including existing code, game design documentation, as well as playerbase feedback. All of this training allows GenAI to

understand different coding languages, player expectation, and game mechanics. When faced with a prompt or a set of given parameters, GenAI is able to produce code, game design elements and even narrative content. As it does so, GenAI models continuously learn from user input and become more and more refined to game development processes and content. This constant evolution opens doors to creativity and experience that has never existed before.

The impact of Generative AI in game development grows everyday, even every second as more data is used to train the models. This is providing decreased development time and cost saving all while increasing the industry's production rate. Using GenAI developers are beginning to automate testing as well as content creation, allowing for the dedication of resources in a more efficient and cost-friendly manner. Developers can accomplish more with smaller teams and with shorter development life-cycles. To continue, the adaptive nature of GenAI means that as games are released, any future updates and fixes can be met with swift action and intuitive knowledge with little to no human interaction. According to Consultancy.eu, "Over 50% of videogame development will happen with the assistance of Generative AI in the next 5 to 10 years" (Consultancy.eu, 2023).

There are a few game mechanics that will be heavily impacted by GenAI and require a brief introduction. One of the biggest features of any game is quests or missions. These are specific accomplishable objectives that reward the player with items, experience points, or currency. They often force the player to try something new or explore a part of the world they have not been to. When multiple quests build off each other to create a longer story, it is called a questline, and finishing an entire questline usually reaps more rewards. Quests are often given by NPCs, or non-player-characters, which is any character in the game that the player can interact with, whether it be enemies, allies, or just someone to talk to. Most NPCs come with their own set of dialogue that can be triggered by talking to them or is triggered by in-game events. They have pre-recorded and pre-coded interactions with the player, and often the player's methods of interaction are pre-coded as well, with some modern games such as Rockstar's Red Dead Redemption 2 offering some of the most layered interactions in modern gaming. Another mechanic is world generation, which as mentioned earlier, follows specific parameters to allow for new worlds upon each generation, if the game's world is not pre-designed already. Character creation works similarly, where if the player is allowed to create their own character, they are usually offered a selection of faces and must work from those.

Now that there is some understanding of these mechanics, how will GenAI affect them, and why are these mechanics specifically going to be the most heavily impacted? GenAI, being generative by nature, allows for on demand reactions and responses to player input. Rather than displaying what is pre-coded, it can be uniquely generated and respond to any kind of player input, not just pre-coded interactions. This will allow objectives such as quests to be uniquely generated based on where the player is, who they have interacted with in the past, and it's even possible that players can request specific types of quests, and the objectives and rewards will be generated for them. GenAI will even be able to generate brand new quest storylines, allowing players to venture on an infinitely unique amount of story missions. NPC dialogue in these quests and in general will be revolutionized as well. Using a combination of text-to-speech and a language learning model, NPCs will be able to adopt specific personalities and generate responses based on that, enabling a player to have full conversations or relationships with NPCs.

In the case of world generation and player creation, GenAI will be able to change the parameters upon which each of these mechanics has been based, allowing for worlds and characters to feel and look completely unique while still offering an infinite amount of possibilities.

An example of all these innovations of GenAI in video games comes from streamer and content creator CodeMiko. Miko is a former motion capture developer who uses her skills to create virtual avatars that replace her actual self as a creative way of interacting with her audience. She is also knowledgeable in code, frequently creating her own interactive environments for her avatar to play in, and recently has gone as far to create her own game. While there are no objectives, quests, or storylines in her game, as that would be too much for one developer, Miko was able to implement the latest GPTs and LLMs into her game. She has created 4 unique NPCs each with their own personalities, who much like Chat GPT, can generate a unique response based on what she says. In one example, she asked two of her NPCs to recite the alphabet. The first, being obviously narcissistic, said he was above all of that, and decided not to do what she asked. The second responded to his narcissism by saying there's more to life than big biceps, and proceeded to respond to Miko when asked again for the ABCs, correctly reciting the whole thing although verbally pronouncing some letters wrong. Not only was Miko's NPC responsive to his environment and the other NPCs, but he also created a unique response based on Miko's question, in a way that fit his hero-like personality. Miko's small and solo venture into GenAI NPCs is a demonstration of how capable current technology is at accomplishing the next step of video game evolution. Soon, larger publishers will do what Miko did but on a much larger scale with more strategically trained LLMs and more NPC systems.

The potential for GenAI in modern games, more specifically in large and expansive games such as "No Man's Sky" is quite transformative. "No Man's Sky" has made great strides to implement procedurally generated content, creating a virtually infinite universe with over a trillion unique planets and ecosystems. The implementation of GenAI would further this concept tremendously by enabling more intricate NPC experiences, reactive questlines, and even change the storyline of the game depending on the player's choices and actions in the game. (Biz4group 2023) Games like "Minecraft" and "No Man's Sky" are great examples of games that could potentially explode with innovation due to the use and integration of GenAI into their development. This is largely due to GenAI's unique ability to handle procedurally generated content allowing game experiences to be significantly more immersive and realistic.

Another example of a current video game using GenAI is Embark Studio's The Finals. In this competitive objective-based first-person shooter, players run around a map attempting to obtain and deposit as much cash as possible. The environment is reminiscent of a stadium, with the arena in the center surrounded by a skybox of what looks like hundreds of thousands of audience members. Much like actual competitive events, The Finals has announcers who provide commentary about the game and players, and these announcers are powered by GenAI. Embark Studio hired voice actors to provide a slew of voice samples, and with their permission, used these voice samples to generate new voice lines on a whim. According to an article by PC Gamer, the process of getting a voice actor to voice new lines usually takes weeks, sometimes months (Randall, 2023). This longer process slows the implementation of ideas and the rolling out of new updates for the player. Using GenAI, the developers can come up with an idea for a new voice line and combine it with their GPT to put it into the game within minutes rather than

months. The announcers in the Finals also run off a GPT, allowing them to reactively respond to the game, commenting unique lines depending on how many players on a team die, or how many players are dead at a given time, or how much cash a player is holding. Embark Studio's innovation is the beginning of a trend that will reduce development and update time, and limit the number of variables involved in idea implementation.

The Future of Generative AI in Video Games

Unreal Engine 5 and future versions such as Unreal Engine 6 are right at the forefront of game development that is currently using GenAI. Features such as Lumen for dynamic global illumination and reflections, Nanite for virtualized micropolygon geometry allowing for highly detailed scenes without compromising performance, and advanced AI and machine learning capabilities for creating more believable AI agents and enhancing player interactions, are exemplary of how Unreal Engine is using GenAI (Unreal Engine, 2023) Furthermore, Unreal Engine has partners with MetaSounds to create procedurally generated audio that can enhance a players immersion into a truly transformative experience. It is because of this strong development that Unreal Engine will continue to break ground and innovate in the field of GenAI. In the notion of Fortnite and other similar games such as VR Chat, RecRoom, and Roblox, where the worlds played in are largely impacted by the choices of the user, the innovation of Unreal Engine and all of the tools available to players is allowing the games to be more detailed, dynamic and interactive. This hints at a future where the lines between creator and player are blurred.

One of the most important parts of the video game development process are the software development tools. These are usually created specifically for each video game's needs and allow developers to quickly test and design their code without needing to rely on the graphics designers or other departments. For each game, there is usually an individual software developer or team that creates specialized software to streamline the workflow of the developers and designers. GenAI may mitigate this need, as LLMs trained for software will allow developers to create their own toolsets, not only uniquely customized for their game but also potentially for their specific needs as an individual developer rather than a team of developers. Scenario is an up-and-coming online software which allows anyone to gain access to video games LLMs. These models range from generative textures, models, and assets, to even development tools and algorithms of code. It's probable that companies that don't rely on developing their own LLMs, especially indie developers and smaller studios, will utilize software like Scenario to quickly implement GenAI into their development process. Not only will this rapidly increase the production speed and quality of games for larger teams, but also for anyone looking to make a game.

Software development tools are just one way that GenAI is quickening game development. As mentioned earlier, developers can already rely on GenAI to produce their own voice lines, mitigating the need to rely on the somewhat busy or otherwise occupied voice actors, especially if the game studios wish to hire a larger profile actor. Studios can also use GenAI for playtesting. Typically, games hire play testers who tediously spend hours running down the same hallway checking for bugs and functionality. Instead, a studio could train an LLM on a specific area of their game and have it test the same functionality in a fraction of the time. This is exactly what Zollpa is doing in their upcoming game, RoboSquad Revolution, as they've implemented ChatGPT into their code base so it can constantly be testing newly written code (Wilde, 2023).

Most importantly, while technology is not all the way there to allow a GenAI to code on its own (though it is close), GenAI will rapidly decrease the actual coding time. Developers of the future will instead spend their time fixing and improving AI developed code, rather than sitting down and coding every line themselves, making deadlines easier to meet and bugs easier to identify and solve. Overall, development teams of the same size could produce a game twice as fast, or produce it in the same amount of time with a team half the size.

The integration of Generative AI (GenAI), Large Language Models (LLMs), and Application Programming Interfaces (APIs) are largely impacting the skill sets that are needed by upcoming developers and are overall reworking the playing field of technological innovation. With GenAI being used by multiple different industries and practices, there will be novel skills required for developers to have focus on creativity and ethical usage of GenAI. The fact that GenAI relies so heavily on being trained by large data sets also requires that developers become excellent at data processing, model training and natural language processing in general. With over 80% of enterprises projected to use GenAI APIs or deploy GenAI-enabled applications by 2026, the demand for developers proficient in these technologies is set to rise dramatically (Stamford 2023). This will emphasize skills beyond the traditional developer toolkit, including prompt engineering as well as managing the risk of trust in GenAI. Developers are going to need to adapt to survive in this industry.

Conclusion

The video game industry is preparing for a major shift, as is the rest of the entertainment industry as generative AI continues to evolve. Developers have relied on the same technology and coding languages for games over the last 25 years, with the only major leaps and bounds coming in graphical quality and hardware. The development process has been the same grueling and tedious task of programming for endless hours and meeting impossible deadlines. Five years from now, developers will work closely with GenAI to produce code in a fraction of the time and at a fraction of the cost. Hard-coding skills will be less desirable, and knowledge about LLMs and the logic of code will be vital to the success of future developers. For some, such as voice actors, play testers, software developers, and even old-fashioned developers, this may mean job insecurity. However, for the player and the publishers, this means higher quality games, faster production, and seemingly infinite content; infinite content that leads to alternate realities, second lives, the chance to be something that you can’t be. The digital and the real are closer than they’ve ever been, and perhaps James Halliday’s Oasis will come sooner than we think.

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