Simple and Cheap Video Games and Artificial Intelligence

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Abstract—The evolution of video games has been significantly influenced by advancements in Artificial Intelligence (AI) in recent years. This paper explores the interplay between simple and cheap video games and AI, examining how games have been utilized to enhance AI methodologies and, conversely, how AI innovations have contributed to the development of video games. Starting from the ancient origins of games, through the introduction of the first video game in 1958, to the present-day gaming industry's technological summits, this paper highlights the historical milestones and modern trends in the video games. Specific case studies, such as the Puzzle-8, Akinator, and Find the Differences games, demonstrate the practical applications of AI in gaming. Additionally, the paper discusses the challenges faced in developing simple cost-effective games and how AI can assist in overcoming those challenges, particularly in the areas of game idea generation, scene creation, level design, and character development. By integrating AI with game development, we can create more engaging, innovative, and accessible gaming experiences, specifically for simple and cheap games.

Keywords—video games, artificial intelligence, cheap games, simple games, game stages

I. INTRODUCTION

Games are as old as human civilization. Playing games play an integral role in human life and culture. By playing games, you can communicate with others. Games can enhance people's imagination and creativity when doing physical or mental activities. The oldest game in the world was invented about 5000 years ago by Assyrians and found in the Persian Gulf. It was a board game called "The Royal Game of Ur" [1].

Archaeologists have also found evidence, such as paintings and frescoes of puzzle games in Egypt and the Babylonian civilization. Many games were invented during the ancient Greek period, but no trace of games with coins was found. On the other hand, later Roman games came to the surface and may have been identical to Greek games.

In Europe during the middle ages, there were mainly games of skill and outdoor games. However, the relevant sources are not verified. In 1280, the king of Castile and Leon, "Alfonso X the Wise," wrote "The Book of Games," a collection of many games like chess [1].

In Europe during the Industrial Revolution, around 1850, the game known today as checkers went viral. Today, games like checkers are popular, and there are dozens of more diverse games worldwide.

William Higinbotham introduced the first video game, Tennis for Two, in 1958. It involved two separate controllers connected via an analog computer, and an oscilloscope was used as the screen [2].

The Magnavox Odyssey, see Fig. 1, is the first commercial

home video game console. The Odyssey consists of a white, black, and brown box that connects to a television set and two rectangular controllers attached by wires. It can display three square dots and one line of varying height on the screen in a monochrome (black and white) theme, with differing behavior for the dots depending on the game played. The console cannot generate audio or track scores [3].

Modern video games are summits of IT technology, programming, art, and marketing. They have captured different parts of the daily lives of younger people. According to industry reports, this is a growing element of the industry that will earn almost \$2 billion by 2024 [4].



Fig. 1. The first Magnavox Odyssey console in the series released in 1972 [3].

II. THE CURRENT STATE OF THE INDUSTRY

A. Realism and Soaring Revenues

Over the last decade, the gaming industry has seen unprecedented growth. Games have become more complex, detailed, and expensive to produce. Studios now invest hundreds of millions into games like "Grand Theft Auto V" and "Destiny", with successful titles generating billions of dollars in revenue.

Games like Uncharted or God of War have incredibly elaborate stories. Their scripts are longer than those of many movies, and these games often last between 15 and 20 hours [5].

Games are now more significant than ever. "Grand Theft Auto V", for instance, has reportedly earned over \$6 billion, making it the most valuable entertainment title in history [5].

The next few years are set to bring even bigger releases. Titles like "Grand Theft Auto VI" are anticipated to surpass their predecessors, while new entries in the "Halo" and "Call of Duty" franchises will continue to drive substantial revenue.

B. Future Trends

The next major innovations in the gaming industry appear to be Virtual Reality (VR) gaming and AI. Although attempted before, such as with Nintendo's Virtual Boy in 1995, which was largely considered a failure, VR is gaining renewed interest and investment. AI, on the other hand, has always been a partner in the game. See Fig. 2 for more details.

Modern gaming consoles have evolved far beyond simple

game-playing devices. They now serve as comprehensive entertainment hubs, allowing users to watch live TV, stream movies, and access social media.

The gaming industry has come a long way from its early days with simple titles like "Mario" and "Dig Dug" [5]. Its ever-expanding reach continues to attract new fans and converts, promising a vibrant future for gaming enthusiasts. However, there are some challenges in front of the video game industry. We will focus on game development challenges (Again, see Fig. 2).



Fig. 2. Historical overview of gaming revenue share from 1970 to 2020, highlighting key developments and shifts in the gaming industry. The early years were dominated by arcade games, which accounted for a significant portion of the industry's revenue. The rise of home consoles, such as the Nintendo Entertainment System (NES) and Sega Genesis, began to shift revenue shares towards console gaming. By 2000s with the advent of more advanced consoles like the PlayStation and Xbox, and the proliferation of Personal Computer (PC) gaming, the revenue share of console and PC games increased. The following decade, the mobile gaming market emerged and grew rapidly, driven by the widespread adoption of smartphones and tablets. This decade also saw the rise of digital distribution platforms and the continued dominance of console gaming. The current landscape is marked by a diversified revenue distribution across mobile, console, and PC gaming, with mobile gaming taking a substantial share due to its accessibility and broad audience [6].

To name but a few, typical challenges that we met during the video game development are

- Implementation complexities;
- Software quality;
- Audio/video quality;
- Speed;
- Hardware constraints;
- Interface versatility;
- Terms and regulations;
- Copyright.

However, designing and developing levels, scenarios, and characters are the most decisive challenges for Simple and Cheap (SC) video games developers.

III. SIMPLE AND CHEAP GAMES

As the term "Simple and Cheap Games" suggests, these games are cheap because they are free, or use in-app payment, extra-level payment, or monthly payment. SC games are also simple, as they can be easily installed on mobile phones and PCs or played through web browsers. SC games do not need to be produced by large companies or professional developers; sometimes, they are just developed by small businesses like start-ups or one-man teams. Unity, Unreal Engine, GameMaker Studio and Gadot are examples of free game engines and tools employed by SC developers.

In the SC game business, developing ideas, levels, scenes, and characters is a major challenge. Software quality and copyright are also considerable challenges. A question to ask is how AI and SC games can help each other.

IV. WHAT CAN GAMES DO FOR AI?

Puzzle-8 and Puzzle-15, Akinator, Fig. 3, and Find Differences are examples of using game ideas in artificial intelligence. For instance, based on how people solve Puzzle-8, we can analyze heuristics and attempt to come across new heuristics.

Akinator [7], meanwhile, is a great model that uses fuzzy logic, entropy, and decision trees. It relies on online servers and cloud services. Akinator's main goal is to guess a real or fictional character, object, or movie by asking a series of questions, and the player can answer with 'Yes', 'Don't know', 'No', 'Probably' and 'Probably not'. Based on each answer, Akinator decides on the next question to ask, then finally makes a guess. If the first guess is incorrect, Akinator continues to ask new questions, up to three guesses. After the third try, if the guess is still wrong, the player is asked to add the character to a game database [8].

Akinator was developed by a French company named Elokence. The algorithm used for question selection is a secret; however, it is relatively easy to find out how it was built. Some articles claim that Akinator uses decision trees, as well as Probabilistic Methods (ID3 and ID4) as well as Reinforcement Learning. High performance non-LLM (Large Language Model) chatbots and Intelligent Q&A systems can be inspired by how Akinator and its algorithms work [8]. This could be carried out by conversion of 'Guess Who' approach of Akinator to a 'Guess What' approach in a chatbot or intelligent Q&A engine, where a priori knowledge plus Q&As facilitate a plausible series of answers for the users.

In "Find the differences" games, players must find visual differences that can be implemented in deep learning models. Some phenomena like attention can be inspired by analyzing the players behavior. Those games are also applicable in cognitive science and visualization task studies.

Games can help AI not only by providing heuristics but also by providing a vast amount of feedback and users' interactions. A popular SC game has got many active diverse users who spend hours playing, so will easily generate necessary interactive information for AI developers. This could be accomplished indirectly by analyzing the log files, or directly by asking them to provide some feedback. This way, AI will have more actionable data. Also, AI traditionally has not been that rich that it is now. For a while, game industry was a sponsor for AI studies. Again, simplified and virtual environment and constraints of a game, provides a testbed for AI algorithms. So, games have been assisting AI notably.



Fig. 3. Akinator game interface [7]. Akinator uses AI techniques such as fuzzy logic, entropy, and decision trees to guess characters based on player responses. Developed by Elokence, this game demonstrates the integration of AI in entertainment [8].

V. WHAT CAN AI DO FOR GAMES?

In the previous section, the impacts of games on AI are mentioned. Now, we determine how AI affects the world of video games. According to a survey conducted in 2021, 34.6% of American gamers claim that fast performance is the most

important feature in games. In Fig. 4, you can see the most important features of the popular video games among Americans in 2021 [9].



Fig. 4. Survey results show the most important features of video games among American gamers in 2021. Fast performance was highlighted as the top feature by 34.6% of respondents [9].

While there are plenty of indefinable aspects that make individual games masterpieces, there are eight key points that each video game needs to contain in order to become successful [10]:

1. A solid story: whether the game's story is well written or not, the game needs to be solid, meaning it should pursue a specific goal. A successful video game involves gamers' emotions and lets them think they are part of a game's world.

2. Attractive visuals: today, almost all successful games use graphics, such as scene rendering speed and artistic visuals, to hold gamers' attention.

3. Intuitive controls: the most successful games are the ones that provide a satisfying and enjoyable experience to the player. The gameplay should flow naturally, requiring quick decisions that come instinctively. However, camera controls often cause games to fail. The automatic adjusting of the camera angle to achieve the desired character movement is crucial.

4. Worthwhile long-term goal: open-world games are the most popular type of games among players, where they can build, farm, manage, and so on, but these are all just shortterm goals and after a while, they may result in losing interest. Highly successful games motivate gamers to accomplish some missions, leading to a greater one.

5. A killer soundtrack: soundtracks and sound effects are definitely as important as visual elements. A game's audio plays an integral role in involving players' emotions and affects their mood depending on what happens in the game. Nowadays, game companies collaborate with great musicians to produce memorable soundtracks.

6. Replay-ability: the best video games persuade gamers to play the game repeatedly and do not make them bored. Every time they repeat a game, it shows them a different ending with a unique memory. Rewarding also encourages players to continue or even replay the game several times.

7. Balancing originality and consistency: providing unique and novel ideas while maintaining originality is one of the key factors in creating a successful game. For example, over the years, Super Mario games have evolved but still preserve the familiar Super Mario feel.

8. Interesting and relatable characters: it is important for

players to have a bond with the characters in a game. Successful games are able to evoke emotions from players towards characters.

When it comes to downloading games from platforms there are numerous options for only one type of game (e.g. bubble shooters, crosswords). In these situations, gamers should consider rate and feedback as well as price and appearance to choose one among many options. Also, a recommended AI system could help them to choose the best game according to the following factors. Although all requirements mentioned in [10] are very important, there are some extra constraints involved in the case of SC games. For instance, the limited budget and manpower which limit the game to have many stages, scenarios, or characters. This is where AI may help SC game business impressively.

A. Idea

The first, and perhaps the most challenging, stage of game design is coming up with the game idea. It's essential to have a clear concept in mind before proceeding with game development. AI, particularly generative AI, can assist developers in generating new and innovative ideas for games. AI-powered ideation is a new field of study. Typically, an idea would be described as a text. So, a general purpose LLM can assist the game developers to come across and refine an idea. However, a special purpose customized ideation LLM could be of greater assistance. Next step could be development of AI-powered storyboarder.

B. Scenes

Other than ideas, AI can also be used in order to create several scenes, which is a demanding stage in producing games. Scenes must be attractive and relative to the scenario.

Monajemi *et al.* gathered a dataset of 1st pages of 163 university websites worldwide and asked people to score them based on the quality and attraction of these photos [11]. Afterward, Gabor filtering and H-S color features were used to extract texture features. Finally, they train a Multi-Layer Perceptron (MLP) to classify the extracted features. The results show that the linear combination of the output of two Artificial Neural Networks (ANN), Gabor-based and H-S-based) leads to the best performance with 88.88% using $0.6y_{color} + 0.4y_{gabor}$. Similarly, AI could be employed to score the aesthetic attributes of the game scenes.

Aesthetic evaluation of games' characters can be carried out similarly; meanwhile, in both cases, Deep-Convolutional Neural Networks (DCNNs) are supposed to perform better. Writers repeated their research again in 2017 with a deep learning model as well as a larger dataset. With over 1000 test samples and three classes, the accuracy was 93%.

Therefore, it can be summed up that generative AI can assist the game industry in scene generation, either by employing simpler Generative Adversarial Network (GAN) models, or the more advanced LLM-driven multimedia synthesizers. Moreover, scene evaluation may be automated using AI evaluators.

C. Levels and Stages

Moreover, level design is challenging, costly and timeconsuming. Again, these levels should be arranged so that the game's coherence is maintained and players are entertained. Heuristics can help arrange the levels according to their difficulties. Heuristics can sort levels automatically and then organize them by their solution cost.

Generative Adversarial Networks (GANs) have shown remarkable results in image generation tasks [12]. However, GANs face challenges in generating content with certain limitations, such as game levels. Creating game levels that have aesthetic appeal and playability proves challenging. Additionally, because training data is usually limited, generating unique levels with current GANs is challenging. Torrado *et al.* proposed a new GAN architecture named Conditional Embedding Self-Attention Generative Adversarial Network (CESAGAN) and a new bootstrapping training procedure [12].

The CESAGAN is a transformed version of the selfattention GAN that includes an embedding feature vector input to condition the training of the discriminator and generator. It allows the network to model non-local dependency between game objects and count them. A bootstrapping mechanism was proposed to reduce the number of levels needed to train the GAN. This mechanism involves adding playable generated levels to the training set. The results reveal that the novel approach generates a larger number of playable levels with fewer duplicate levels compared to a standard GAN [12].

D. Characters

Without professional skills, the automatic AI-driven design and generation of anime characters offers an opportunity to create a custom character. This technology can also be useful for professionals looking for inspiration in designing animation and game characters.

However, existing models for generating anime images often produce blurred and distorted results, making it difficult to generate industry-standard facial images for anime characters.

Zhu *et al.* proposed a model that can produce high-quality anime faces with a promising rate of success, using a clean dataset from Getchu, a DRAGAN-based SRResNet-like (Super-Resolution Residual Network) GAN model, and a general approach to training conditional models from images with estimated tags as conditions [13]. So, a small team of SC game developers can rely on AI-Aided character design methods and tools. The quality and accessibility of those methods and tools for SC games sector should be subtly evaluated and compared.

VI. CONCLUSION

In conclusion, the relationship between video games and AI is symbiotic, with each field driving advancements in the other. Simple and cheap video games offer a fertile ground for experimenting with AI techniques, providing valuable data and scenarios for AI research. Conversely, AI enhances the gaming experience by enabling the creation of more sophisticated, engaging, and personalized games. The continuous evolution of AI technologies promises to bring even more innovative solutions to the gaming industry, pushing the boundaries of what games can achieve. Future research should focus on leveraging AI to address the challenges in game development, ensuring that the benefits of AI are accessible to small developers and independent creators, thereby democratizing the gaming landscape, specifically in developing new stages, characters, and scenarios for simple and cheap games based on generative AI models and tools. Consequently, two propositions can be made based to the findings of this study.

- 1. The AI sector can rely on the game industry, SC games specifically, as a resource for data and new ideas.
- 2. The game industry should be more AI-driven and ask for customized LLMs and GANs that be able to address the game developers challenges and requirements.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Amirhassan Monajemi has proposed the idea, supervised the study, and drafted the first version of the paper. Farzaneh Alsharif and Fatemeh Alsharif have done the literature review and the comparative study. They have also developed the final paper. All authors had approved the final version.

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