

Emotional Simulation in Game AI and Its Impact on Player Experience

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Abstract: In modern video games, the role of artificial intelligence (AI) cannot be overlooked. Game AI is not only responsible for the internal logic and character behavior within games but also serves as a crucial tool meticulously crafted by game designers to enhance the gaming experience. The objective of AI extends beyond simply achieving the highest efficiency or optimal decision-making; it aims to provide players with an engaging and challenging experience. To this end, emotional simulation has emerged as a popular research direction in the field of game AI. Emotional simulation enables virtual characters in games to have more realistic and rich emotional responses, thereby enhancing the immersion of players. When players interact with these virtual characters and perceive their genuine emotions, such as happiness, anger, sadness, and joy, they become more invested in the game and gain a deeper emotional experience. Hence, emotional simulation represents not only a technical challenge but also a crucial area of research for improving the overall quality of video games. With ongoing technological advancements, future video games will offer even richer and more realistic emotional experiences.

Keywords: Game AI; Emotional Simulation; Player Experience.

1. The Importance of Emotional Simulation

Emotional simulation plays a vital role in modern video games, with its significance manifesting in several aspects, as shown in Figure 1. Firstly, through emotional simulation, machines can communicate with humans more naturally, understanding and responding to human needs and emotional states. This form of interaction, closer to natural human interaction, makes human-computer interaction more intimate and vivid, enhancing people's trust and reliance on machines. Secondly, in video games, emotional simulation allows virtual characters to have more realistic and rich emotional responses, thereby increasing the game's

immersion and appeal. Interacting with emotionally responsive virtual characters enables players to have a more in-depth and personalized gaming experience[1-2]. Thirdly, emotional simulation can assist in the field of psychological aid, helping people better understand and deal with their emotional issues and providing personalized psychological support. In emotional marketing, simulating consumers' emotional responses allows companies to grasp market demands more accurately and develop effective marketing strategies. Fourthly, emotional simulation is an important research direction in the field of artificial intelligence. The research outcomes not only enhance the practicality and popularity of AI but also promote the development of AI technology in more fields.

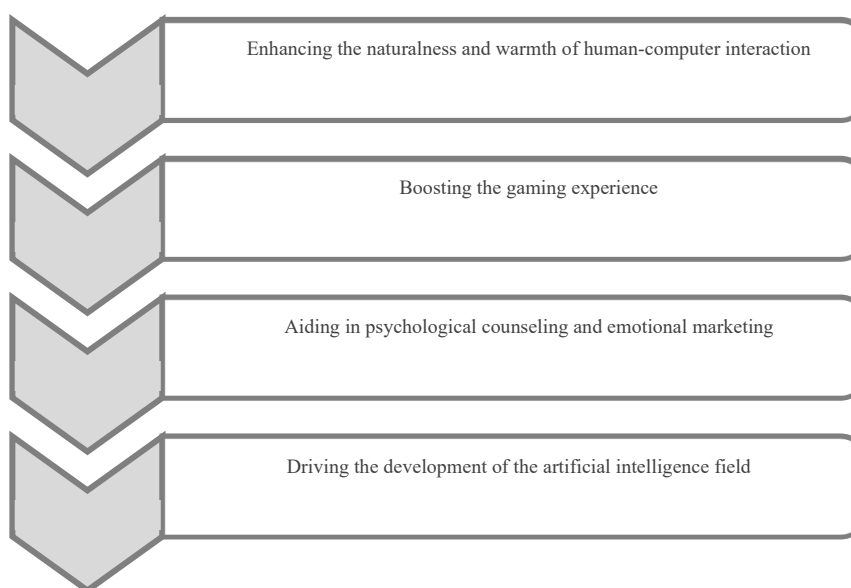


Figure 1. The Importance of Emotional Simulation

2. Main Approaches to Achieving Emotional Simulation

2.1. Rule-Based Methods

Rule-based methods are a common and intuitive approach in emotional simulation, where a series of explicit rules are predefined for NPCs to determine their emotional responses in different gaming contexts[3]. These rules are usually based on conditional judgments, triggering specific emotional states when certain conditions are met. For example, a simple rule might be: if a player's action causes an NPC's health to decrease, the NPC's emotional state becomes "angry", with the intensity of anger proportional to the percentage decrease in health. Represented by data formula, assuming the NPC's initial health is 100 and current health is (L), then the anger value (A) can be calculated as: $(A = 100 - L)$. Similarly, when a player helps an NPC complete a task, a comparable rule can be applied. Assuming the task completion rate is (C), the NPC's "gratitude" emotional value (G) can be proportional to the task completion rate, with the formula: $(G = C)$. The advantage of rule-based methods lies in their simplicity and ease of implementation, allowing game developers to clearly define and control NPCs' emotional responses, ensuring consistency in game behavior.

2.2. Machine Learning-Based Methods

Machine learning-based methods exhibit significant advantages in NPC emotional simulation, allowing NPCs to autonomously and realistically respond to player actions and environmental changes. This approach utilizes large-scale human emotional data and machine learning algorithms, such as neural networks, to build a complex emotional response model. During the training process, the algorithm iteratively optimizes model parameters to minimize the difference between predicted and actual emotions. Each iteration processes a vast amount of data, calculating the loss function and its gradient. The computational resource consumption is proportional to the dataset size, model complexity, and number of iterations. Assuming the dataset contains N samples, the model has M parameters, and iterates T times,

the computational complexity can be roughly represented as $O(NMT)$. This means that as the data volume and model complexity increase, the required computational resources also surge significantly. Although this method offers higher authenticity and flexibility, allowing NPCs to make natural emotional responses in various contexts, the demand for data and computational resources poses a significant challenge. In practical applications, balancing model performance and computational cost is essential to achieving the optimal gaming experience.

3. The Connection Between Emotion Simulation and Player Experience

3.1. Enhancing Immersion

The application of emotion simulation in games brings an unprecedented level of immersion to players, as shown in Table 1. When players interact with NPCs in the game, the real and nuanced emotional responses displayed by these characters undoubtedly add more vividness and realism to the game. Emotion expressions similar to those of humans make players feel as if they are in a real and vibrant game world, establishing deep emotional bonds with the characters. With the continuous progress of game technology, emotion simulation has become an important means to enhance the gaming experience. It not only allows players to participate in the game more deeply but also deepens their cognition and feelings towards the game world. When players see NPCs showing emotions such as joy, sadness, and anger in response to their actions, they pay more attention to the fates and stories of these characters, thus exploring the game world more deeply. Moreover, emotion simulation can bring richer plot and story developments to the game. Through emotional interactions with NPCs, players can influence the direction and outcome of the game world, and this sense of participation and decision-making power is also one of the important factors in enhancing the gaming experience. Therefore, emotion simulation not only makes the game more realistic and vivid but also brings a deeper and more memorable gaming experience to players.

Table 1. How Emotion Simulation Enhances Game Immersion

Aspects	Explanation
Authenticity of Emotional Responses	NPCs displaying human-like emotional responses make it easier for players to empathize.
	2. Authentic emotional responses strengthen the emotional connection between players and NPCs.
Vividness of the Game World	1. Emotional simulation makes the game world more vivid and real, as if it were a living world.
	2. Players are more easily drawn into the game world, forgetting that they are outside of reality.
Player Engagement	Emotional simulation increases player engagement, making them more focused and immersed in the game.
	2. Players become more concerned with the fate and stories of NPCs, willing to delve deeper into the game world.
Richness of Plot and Storylines	1. Emotional simulation brings richer plot and story developments to the game.
	Players can influence the direction and outcome of the game world through emotional interactions with NPCs.
Enhancement of Game Experience	1. Emotional simulation significantly enhances the overall gaming experience, providing players with deeper and more memorable gaming memories.
	2. The sense of immersion players gain in the game helps to increase their satisfaction and loyalty.

3.2. Emotional Resonance

The use of emotion simulation technology makes NPCs in games more than just cold lines of code; they are flesh-and-blood characters that can display a variety of emotional responses realistically and naturally. When players interact with these NPCs in the game, they resonate emotionally with the NPCs' emotional responses, thereby establishing deep emotional connections with these characters. For example, when a player helps an NPC complete a task and sees the NPC express joy out of gratitude, the player feels that their effort has been rewarded, leading to a sense of satisfaction and achievement[4]. This emotional resonance not only makes players more engaged in the game but also subtly cultivates their compassion and empathy. Through emotional interactions with NPCs, players can learn to think from others' perspectives and understand others' feelings, which is positively significant for players' personal growth and social skills development. Therefore, the application of emotion simulation technology in games effectively enhances the attractiveness and playability of games, bringing deeper and more beneficial gaming experiences to players.

3.3. Enhancing Game Interactivity

Enhancing game interactivity has always been an important goal in game design, and the introduction of emotion simulation technology brings a new dimension to this goal. In traditional games, NPCs could only offer limited and predetermined responses, making the player experience monotonous and dull after repeated interactions. However, with NPCs capable of emotion simulation, their behaviors and responses become more intelligent and diverse, reflecting emotional changes according to different player actions. This change brings higher interactivity to the game, requiring players to adjust their strategies and behaviors based on the emotional state of NPCs. For example, when facing an angry NPC, players might need to choose to soothe or avoid it, rather than simply opting for attack or communication. Such interactions increase the game's challenge, requiring players to have higher adaptability and strategic thinking while also making the game experience more varied. Each interaction with an NPC can lead to different outcomes and feedback, keeping players constantly fresh and eager to explore, enhancing their satisfaction with the game.

3.4. Influencing Player Decisions

The introduction of emotion simulation in games has a profound impact on players' decision-making processes. In traditional games, players' decisions were often based solely on game mechanics, such as objectives, rewards, and punishments. However, when NPCs have realistic emotional responses, the basis for players' decisions becomes more complex and multifaceted. Players start to realize that every action, every choice, may have a profound impact on the emotional state of NPCs. This awareness makes players more cautious and thoughtful in their decision-making, no longer

solely pursuing optimal solutions from a game mechanics perspective but beginning to consider how to build better relationships with NPCs, how to avoid harming them, and even how to help them out of difficult situations[5]. This change in the decision-making process adds depth and complexity to the game, making players more invested and concerned with the game's outcomes. Because each decision can affect the fate and emotional state of NPCs, thereby affecting the overall direction of the game world and the player's ultimate achievement. The introduction of emotion simulation makes the game more realistic, vivid, and engaging.

4. Conclusion

In summary, emotion simulation occupies a pivotal position in game AI. By accurately simulating characters' emotional responses and behavior patterns, game AI not only creates a more engaging environment for players but also greatly enhances their immersion. When players interact with NPCs in the game, the real and natural emotional feedback from these NPCs undoubtedly adds more challenge and interest to the game. However, despite the broad prospects of emotion simulation technology, it still faces some technical challenges and limitations. Data acquisition is a key issue; how to collect and process a large amount of emotional data to train AI models is a primary challenge that researchers need to address. Additionally, the lack of computing resources and the need for algorithm optimization also restrict the development of emotion simulation technology. With continuous innovation and progress in technology, these challenges will be gradually overcome, and game AI will be able to present more realistic, flexible, and intelligent emotion simulation effects, bringing unprecedented gaming experiences to players.

References

- [1] Kaptein, F., and Broekens, J. The affective storyteller: using character emotion to influence narrative[J]. *Generation*. 2015, 15, 352–355.
- [2] Ferré, P., Fraga, I., Comesaña, M., and Sánchez-Casas, R. Memory for emotional words: the role of semantic relatedness, encoding task and affective valence [J]. *Cogn. Emot.* 2015, 29, 15.
- [3] Chang, H. M., and Soo, V. W. Planning-based narrative generation in simulated game universes [J]. *IEEE Trans. Comput. Intellig. AI Games*. 2009, 1, 200–213.
- [4] Chowanda, A., Flintham, M., Blanchfield, P., Valstar, M. Playing with social and emotional game companions. In: *International Conference on Intelligent Virtual Agents*. Springer; 2016, p. 85–95.
- [5] Akbar, M.T., Ilmi, M.N., Rumayar, I.V., Moniaga, J., Chen, T.K., Chowanda, A.. Enhancing game experience with facial expression recognition as dynamic balancing[J]. *Procedia Computer Science*, 2019, 157: 388–395.