

Application of Artificial Intelligence Technology in Game NPC

Lili Zhang

{iopop2023@163.com}

College of Digital art and Media, Shandong University of Art & Design, Jinan, China

Abstract: The application of artificial intelligence technology in game NPC enables NPC to show more realistic behavior and reaction ability. Through the research and development of artificial intelligence technology, NPC has become a thinking and intelligent game object in the game, adding realism to the game environment. This paper studies the artificial intelligence technology of game NPC, and discusses the application method of artificial intelligence technology in game NPC. In the game industry, this technology has made remarkable progress and has been successfully applied to the development of games. Through artificial intelligence technology, the behavior of game NPC is more real and credible, providing players with a richer and more interactive game experience. The application of artificial intelligence technology in game NPC brings new possibilities and improvements to the game experience, which enables NPC to show more realistic behavior and response ability. Through this study, we hope that the game NPC will have more innovations and breakthroughs, and present a more wonderful game world for players.

Keywords: Artificial Intelligence Technology, NPC, Games, Mechanism of NPC Action

1. Introduction

In the past few years, artificial intelligence technology has made some important achievements in robotics, pattern recognition and knowledge engineering [1]. However, in recent years, with the rise of the game industry, the intelligence of NPC in the game has become more and more important. The behavior of NPC plays a vital role in the interest of players in the game, which can be said to be one of the core technologies in game development [2]. This paper will discuss the application of artificial intelligence technology in game NPC in order to provide useful information for game developers in this field.

2. The Application Purpose of Artificial Intelligence in Game NPC

2.1 Interpretation of Game NPC

NPC in the game is the abbreviation of Non-Player Character (Figure 1), which refers to the non-player character in the game. These NPCs exist to provide players with a better game experience or meet the needs of the game plot [3]. Compared with the past, NPCs in today's games have higher IQ, more realistic images and are better at interacting with players [4]. However, these NPCs are still limited by solidified images, because they are actually controlled by program codes and instructions. These NPCs are designed as players' play tools. Although they can respond according to the players' behaviors, their behaviors are still preset and will run according to the instructions of the program [5].

When game developers create NPCs, they are usually given some specific roles and tasks. The image and personality of these NPCs will be designed according to the settings and needs of the game. Some NPCs may be mentors or instructors in the game, and they will provide guidance and suggestions to players. There are also some NPCs who may be businessmen or task publishers, and players can trade with them or accept tasks [6]. In addition, some NPCs may be enemies or challengers in the game, and they will fight with players or provide certain challenges (Fig. 1).

Although NPCs in modern games have become more intelligent and real, they are still limited by the behavior patterns and code logic set by game developers [7]. This means that although NPCs can react according to players' behaviors, their behaviors are based on preset instructions and programs. Therefore, although NPC plays an important role in the game, they still can't completely break away from the limitation of behavior modeling and solidified image [8].



Fig.1 Game NPC(Non-Player Character)

2.2 The Application Purpose of Artificial Intelligence in Game NPC

The application of artificial intelligence in games has the following main purposes:(1) Create a challenge experience: Through artificial intelligence technology, the game can provide players with challenges suitable for them, so that they can feel excited and excited in the game. This challenge can arouse players' enthusiasm and sense of identity and make them more involved in the game [9].(2) Unpredictable operation reaction: Through artificial intelligence technology, the game can present an unpredictable state, which makes players feel full of curiosity. This makes the operation and reaction in the game diversified and interesting, and increases the player's desire and curiosity to explore [10].(3) Auxiliary storyline: Artificial intelligence can help game production

and improve storyline. Through the design and behavior of intelligent NPC, the game can present a more vivid and fascinating story, and increase the player's sense of participation and immersion.(4) Create a colorful game world: Artificial intelligence can help games create a vivid and challenging world. Through the perfect story system and game rules, artificial intelligence can inject more diversified and rich elements into the game world and provide more opportunities for interaction and exploration [11].

3. NPC Path Planning and Searching

In large-scale game scenes, the path planning of NPC involves obstacles or no obstacles, mountains or lakes. The complexity of large 3D game maps is higher than that of 2D games. In order to realize the path planning of NPC, the fixed-point method can be adopted. This method designs the path that NPC can walk in advance in the game design stage. For example, you can use the Y-shaped path to record some key coordinate points on the path. For each bifurcation point, its adjacent coordinate points are stored in different linked lists. This is repeated until all the forks are recorded in different linked lists [12].

When NPC makes path planning, it will look for the nearest coordinate point record. After finding it, NPC will walk in the order of linked list. When NPC meets bifurcation point, it can use random algorithm to randomly choose a path to walk. In this way, as long as there are multiple bifurcation points, the path that NPC walks every time will be basically different [13]. This makes players feel that NPC has the thinking ability, which makes the game more intelligent and improves the running efficiency.

4. Action Mechanism of Game NPC

4.1. Game NPC Mechanism in the Scene of Game Object Chasing and Dodging

In games, chasing and dodging are common elements. Not only players chase NPCs, but NPCs may also chase players. During the game, it can be judged whether to continue searching according to the distance between the player and NPC. When the distance between the two sides exceeds a certain value, the chasing state is released [14]. In addition, there are usually some hidden hiding places in 3D games, and the coordinates of these places are collected and stored in the array. When the player escapes and dodges at these coordinates, it can be judged whether the coordinates are in the stored coordinate array. As shown in Figure 2, rectangular objects are obstacles, circular objects are identification objects, triangles are enemies, dotted lines indicate that the current area is invisible to the enemy, and solid lines indicate that it is visible [15].

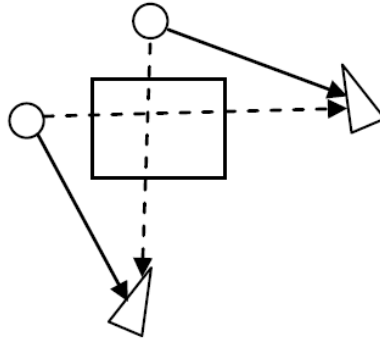


Fig.2 The visual field of the game object and the dodging scene of obstacles.

In the game, we hope that NPC can avoid static obstacles and cope with the emergence of dynamic obstacles. First, we need to define the size and position of the detector, usually within a certain distance in front of NPC. Then, we check whether the detector intersects with the obstacle, and if it does, it means that the detector has detected the obstacle [16]. Next, we need to calculate a force away from obstacles. This can be achieved by transforming the distance between NPC and obstacle into a force vector. The closer the distance, the greater the force exerted. Finally, we apply the calculated force to NPC to keep it away from obstacles. This method can effectively help NPC avoid static obstacles, and it is also adaptable to dynamic obstacles (Figure 3). When other NPCs or temporary obstacles triggered by players appear in the game scene, NPCs will detect their existence through detectors and take corresponding actions to avoid collisions [17].

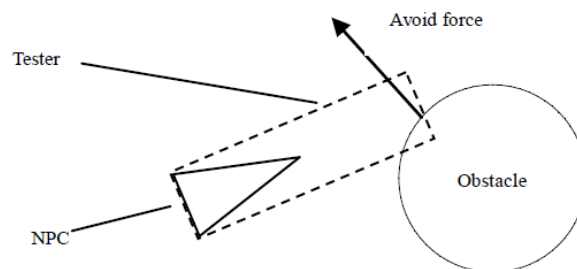


Fig.3 Schematic diagram of NPC obstacle avoidance

4.2. Game Object Clustering Scheme

In strategy games, it is often necessary to deal with the clustering of game objects. Especially in some classic games, such as The Ember Storm (Figure 4) and Diablo: Immortality (Figure 5), the movement of game objects involves the clustering function. Usually, the same type of game objects are organized into a group. In the design of clustering algorithm, we can define a leading object whose decision will affect the movement of the whole group. The position and behavior of the leading object will be

concerned and imitated by other objects. By imitating the position and behavior of the leading object, other objects can keep a certain distance and relative position with the leading object, thus forming the form of the whole group [18].

In order to realize the clustering function, we can consider the following steps. First, you need to select a leading object, which can usually be determined according to some rules or attributes. For example, in a flying game, the fastest object can be selected as the leading object. Next, other objects will be adjusted according to the position and motion direction of the leading object. Some algorithms can be used to calculate the position where other objects need to move to keep the distance and relative position from the leading object. In the clustering algorithm, some other factors can be considered. For example, we can introduce some obstacle avoidance mechanisms to ensure that groups will not collide with obstacles. This can be achieved by detecting the obstacles around the group and incorporating them into the clustering algorithm. In addition, we can also consider some group behaviors, such as coordinated attacks or collective defense. These behaviors can adjust the actions of the whole group according to the decision of the leading object. By designing a reasonable clustering algorithm, we can realize the group movement of game objects in strategy games. This will not only increase the realism of the game, but also provide more strategic choices and challenges for players.



Fig.4 Cluster phenomenon of game NPC and game object in the game "The Storm of Embers"



Fig.5 Movement of game NPC and game object in Diablo: Immortality.

4.3. NPC state mechanism

In the game, the player's state is determined by the player himself, and may change with the change of the game situation. In order to achieve similar intelligence, NPC needs to design a state mechanism, which will put NPC in one of different preset states. Because of the adoption of random mechanism, the behavior of NPC will be different every time, which shows the characteristics of NPC being more intelligent. In order to better realize the intelligence of NPC, we can further expand the state mechanism. For example, you can consider adding a dodge state for NPC, and you can choose to dodge the enemy's attack when attacked. In addition, more states can be designed, such as pursuit state, defense state, etc., so that NPC can respond appropriately in different situations. The design of NPC state machine needs to consider the overall logic of the game and the behavior of the players. Through reasonable state switching and behavior design, NPC can show more intelligent characteristics. The introduction of random mechanism can increase the diversity and randomness of NPC's behavior, so that every interaction with NPC can bring new challenges and experiences. This design can not only improve the playability of the game, but also make players feel the real interaction with the intelligent NPC.

5. Application Practice Of Artificial Intelligence Technology In Game NPC

5.1. Application of Artificial Intelligence Technology in Monster NPC

In the process of applying artificial intelligence technology in monster NPC, it is necessary to design an AI system to determine the monster's reaction in active and passive states. First of all, when the monster is in the active state, you can set a warning range. When a target enters the alert range, the monster will switch to the combat state and prepare to attack the target. This design can make monsters have the ability to actively find targets and actively launch attacks. For example, when a monster is attacked, a certain counterattack mechanism can be set up, so that the monster has the ability to counterattack the attacker. In addition, when the monster is hurt, it can be considered that the monster should take evasive, escape or seek treatment. This design can make the monster more flexible to deal with all kinds of situations in a passive state, and improve its viability and combat strategy. Other factors can be considered when designing the monster's AI system. For example, you can add some special skills or tactics to monsters to make them more challenging in combat. At the same time, you can also design the behavior patterns of monsters. For example, some monsters prefer to act alone, while others prefer to fight in groups. This design can make monsters show different personalities and fighting styles in the game, and increase the diversity and interest of the game. In a word, the AI system design of monster NPC should comprehensively consider the monster's active and passive behavior, and make reasonable settings and adjustments according to the game needs and player experience. Through scientific AI design, the monster NPC can show more intelligent and interesting behavior in the game, and improve the playability and challenge of the game.

5.2. Application Scenarios of Artificial Intelligence Technology in Game NPC

The application of artificial intelligence technology in game NPC has become an important part of modern game development. First of all, artificial intelligence technology can provide more realistic behavior patterns for NPC. Traditional game NPCs usually only perform fixed actions and dialogues according to pre-set scripts, and cannot make corresponding adjustments according to players' behaviors. With the support of artificial intelligence technology, NPC can respond autonomously by learning and adapting to the behavior of players. For example, NPC can adjust its own combat strategy according to the player's decision, or change the content and tone of the dialogue according to the player's behavior. Secondly, artificial intelligence technology can make NPC more emotional and individual. Through the combination of emotional model and artificial intelligence algorithm, NPC can express more real emotions and emotions. For example, NPC can show emotions such as emotions, likes and dislikes according to the development of the game plot. This design can make the game more attractive and increase the player's sense of substitution and emotional resonance. In addition, artificial intelligence technology can also make NPC more intelligent and make independent decisions. By using machine learning and deep learning algorithms, NPC can make corresponding decisions according to the changes of environment and tasks. For example, in a battle scene, NPC can choose the best tactics and skill use order according to its own ability and enemy state. Such intelligent design can increase the challenge and strategy of the game and enhance the player's game experience. Generally speaking, the application of artificial intelligence technology in game NPC provides game developers with more creativity and freedom. By giving NPC more intelligent behavior and reaction ability.

5.3. Specific Methods and Techniques

When artificial intelligence technology is applied to game NPC, the following specific methods and technologies can be adopted:(1) Path planning: NPC needs to be able to navigate autonomously in the game world and find the best path to complete tasks or interact with players. Path planning algorithm can help NPC calculate the shortest path or avoid obstacles, so that it can move more naturally.(2) Behavior tree: Behavior tree is a common tool for NPC behavior modeling. By defining a series of behaviors and conditions, the behavior tree can choose appropriate behaviors according to the current situation and the behavior of players. For example, when a player approaches an NPC, the NPC can choose to talk to the player or perform a specific task.(3) Machine learning: Through machine learning algorithm, NPC can learn and adapt from the behavior of players. For example, NPC can improve its fighting ability by observing the player's fighting strategy, or adjust the conversation content by analyzing the player's preferences.(4) Emotional modeling: In order to make NPC more realistic and personalized, emotional modeling technology can be used. Through the emotional model, NPC can show different emotional states, such as happiness, anger, sadness, etc., and adjust behaviors and dialogues according to the emotional states.(5) Adaptive difficulty: NPC can adjust the game difficulty according to the player's ability and experience through adaptive difficulty technology. For example, when a player shows high game ability, NPC can choose more challenging strategies and behaviors to increase the difficulty of the game.(6) Natural language processing: In order to enable NPC to have a smooth dialogue with players, natural language processing technology can be used. Through speech recognition and natural

language understanding technology, NPC can understand the player's instructions and respond accordingly.

The comprehensive application of these technologies and methods can make the game NPC more intelligent, realistic and have independent decision-making ability, and enhance the player's game experience.

6. Summarize

The application of artificial intelligence technology in game NPC enables NPC to show more realistic behavior and reaction ability. Through path planning, behavior tree, machine learning and emotion modeling, NPC can navigate autonomously, make adjustments according to the player's behavior, and show emotion and personality. In addition, technologies such as adaptive difficulty and natural language processing further enhance the intelligence and interactivity of NPC. Generally speaking, artificial intelligence technology has brought richer game experience to the game NPC, and improved the playability and realism of the game.

Acknowledgments

This work was financially supported by 2020 Shandong Province Undergraduate University Teaching Reform Research Project: Research on the Application of Digital Media Art Integrated Moral Education Teaching Model (No. M2020241);2023 Shandong Institute of Arts and Crafts Curriculum Ideological and Political Education Reform Research Project: Research on the Deep Integration Model of Design Art Education and Ideological and Political Education in China under the Background of Artificial Intelligence (No. 2023SZ13).

References

- [1] Kuwahara Takamichi,Hara Kazuo,Mizuno Nobumasa,Haba Shin,Okuno Nozomi,Fukui Toshitaka,Urata Minako, Yamamoto Yoshitaro. Current status of artificial intelligence analysis for the treatment of pancreaticobiliary diseases using endoscopic ultrasonography and endoscopic retrograde cholangiopancreatography.[J]. DEN open,2023,4(1).
- [2] Afifa Tamanna,Ezzatollah Shamsaei,Robert Urquhart,Hoan D Nguyen,Kwesi Sagoe-Crentsil, Wenhui Duan. Artificial intelligence-based gene expression programming (GEP) model for assessing sprayed seal performance[J]. Road Materials and Pavement Design,2023,24(8).
- [3] Faraji Behnam,Rouhollahi Korosh,Nezhadi Akram, Jamalpoor Zahra. Advanced non-linear control based on artificial intelligence tuner for hand tremor suppression[J]. Transactions of the Institute of Measurement and Control,2023,45(12).
- [4] Rohit Tanwar,Surbhi Bhatia,Varun Sapra,Neelu Jyoti Ahuja. Artificial Intelligence and Machine Learning:An Intelligent Perspective of Emerging Technologies[M].CRC Press:2023-07-05.
- [5] Song Gao,Yingjie Hu,Wenwen Li. Handbook of Geospatial Artificial

- Intelligence[M].CRC Press:2023-07-05.
- [6] Junjie Xu,Tong Wang,Yu Luo,Lintao Shang,Xiuying Mai,Junjie Ruan,Xiaofen Pan, Feng Chi. Set-up errors of the neck are underestimated using the overall registration frame of head and neck in IMRT for NPC.[J]. Journal of X-ray science and technology,2023.
 - [7] Kited Launches Open Beta Testing for AI-Powered Quest Generation and NPC Interaction Systems[J]. M2 Presswire,2023.
 - [8] Sousa M, Maamari B, Bremova T, Nuoffer J M, Wiest R, Amstutz D, Krack P, Bartholdi D, Tinkhauser G. Late adult-onset Niemann Pick type C (NPC): An "atypical" typical presentation at the age of 62.[J]. Parkinsonism & related disorders,2023.
 - [9] Zhong Qiong, Nie Qihong, Wu Renrui, Huang Yun. Exosomal miR-18a-5p promotes EMT and metastasis of NPC cells via targeting BTG3 and activating the Wnt/ β -catenin signaling pathway.[J]. Cell cycle (Georgetown, Tex.),2023.
 - [10] Zhang Yunfei, Zhang Lei, Zhou Bingqian, Ahmad Mudasir, Zhang Qiuyu, Zhang Baoliang. Microwave absorption and thermal conductivity properties in NPC@MoSe₂/PDMS composites[J]. Carbon,2023,209.
 - [11] Ko Youngjong, Ryu Taerim, Choi Ui Min. Active thermal control for reliability improvement in photovoltaic single-phase T-type NPC inverters[J]. Journal of Power Electronics,2023,23(5).
 - [12] Tsujimoto Mariko, Kakei Yasumasa, Yamano Nozomi, Fujita Takeshi, Ueda Takehiro, Ono Ryusuke, Murakami Sae, Moriwaki Shinichi, Nishigori Chikako. Clinical trial on the efficacy and safety of NPC-15 for patients with xeroderma pigmentosum exaggerated sunburn reaction type: XP-1 study protocol for a multicentre, double-blinded, placebo-controlled, two-group crossover study followed by a long-term open study in Japan.[J]. BMJ open,2023,13(3).
 - [13] Shen Yue, Chen Chun, Zou Zidan, Hu Zhi, Fu Zhen, Li Wenchao, Pan Shenglong, Zhang Yunxia, Zhang Haimin, Yu Zhixin, Zhao Huijun, Wang Guozhong. Geometric and electronic effects of Co@NPC catalyst in chemoselective hydrogenation: Tunable activity and selectivity via N,P co-doping[J]. Journal of Catalysis,2023,421.
 - [14] Wei Cheng, Hui Fei, Khattak Asad J., Zhao Xiangmo, Jin Shaojie. Batch human-like trajectory generation for multi-motion-state NPC-vehicles in autonomous driving virtual simulation testing[J]. Physica A: Statistical Mechanics and its Applications,2023,616.
 - [15] Li Wang. Exploration on English Teaching Reform under the Combination of Big Data and Artificial Intelligence Technology[J]. Frontiers in Educational Research,2023,6(17).
 - [16] Shapiro Jacob, Reichard Adam, Chowdhry Saba, Fellner Angela, Broering Mark, Kuhn Brian, Kulwicki Aaron, Recht Matthew, Muck Patrick, Hayner Christopher. The Use of Artificial Intelligence Technology in the Detection and Treatment of Pulmonary Embolism at a Tertiary Referral Center[J]. Journal of Vascular Surgery,2023,78(3).
 - [17] Zhai Shaoxuan, Liu Zhenpeng. Artificial intelligence technology innovation and firm productivity: Evidence from China[J]. Finance Research Letters,2023,58(PB).
 - [18] Ameye Nicolas, Bughin Jacques, van Zeebroeck Nicolas. How uncertainty shapes herding in the corporate use of artificial intelligence technology[J]. Technovation,2023,127.