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Innovative Practice of Game Level Design and Scene Narrative Driven by AI Technology

Zhiqi Zhu

Wimbledon College of Art, London college of Art, Shenzhen 518000, China

Abstract: As Artificial Intelligence Technology has advanced rapidly, a great deal of change has happened on the stage of Game Development concerning Level Design and Scene Narration. This paper systemically examines the new application scenarios of AI-powered technologies, including Procedural Content Generation (PCG), Generative Adversarial Networks (GANs), large language models (LLM), and dynamic difficulty adjustment (DDA) in game level Design and Narrative creation. Referring to verifiable market Data, peer-Reviewed Researches and documented Industry applicationss To identify The essential Technical Pathways Through Which A I Enhances Content Diverse City Playengement And Narrative Immersion. The global artificial intelligence (AI) in games' market is worth about \$5.85 billion in 2024, expected to reach US\$37.89 billion by 2034, showing its enormous Scale of Transformation. The limitations of current artificial intelligence techniques have been discussed; therefore, the Future Direction of Game Design Will Be Human-AI Collaboration That Preserves Authoritative Intent While Enhancing Scalability and Adaptation Abilities of The System.

Keywords: Procedural Content Generation, Game Level Design, Scene Narrative, Large Language Models, Dynamic Difficulty Adjustment, Generative AI, Human-AI Collaboration.

1. Introduction

The convergence between artificial intelligence and game Design is a very Dynamic Front of interactive Media at present. In the past, game level Design and Narrative Construction Are Labour-intensive Involving Only Human Designer Iterative play test and manual coding Is Extensive. With the expansion and diversification of games, in order to provide more interesting content quickly within limited time, it is now necessary to invest a relatively large amount of human resources continuously over a long period during game development.

AI-powered tools have brought about a transformation of the model for producing content that is shared among players. Procedural Content Generation (PCG) is generally understood to be the generation of game content automatically through algorithms; it dates back at least two decades both academically and in practice. Deep Learning and, more recently, Large Language Models have changed the development path of PCG to produce richer, more contextually coherent content that surpasses what was previously possible with rule-based systems. In addition to level Generation, beyond this point in terms of Scene Narrative - including story Events, NPC Dialogue and Player-Driven Narration. LLM-empowered NPs can now have a more flexible and context-aware dialogue with the player at any time to fundamentally change interactive story-telling.

The State-of-the-Art research on AI-based Game Level Design and Scene Narratives is examined in this paper. Section 2 introduces the market environment and size of AI application in the game industry. Analyse AI Techniques Used in Level Design, Section 3. Section 4 investigates LLMs and generative AI in scene narratives and NPC behaviour. Section 5 presents dynamic difficulty adjustment as the link between level Design and Personalised narratives. Sections 6 Identify the present constraints and prospective orientations; Section 7 Concludes: Practical Implications for Research and Practice.

2. AI in the Gaming Industry: Market Context and Adoption Trends

First of all, the examination should start from an industry perspective on how technology affects AI in-game Design; In 2024, the global AI in Gaming Market reached US\$5.85 billion, with its value expected to exceed US\$37.89 billion by 2034; The compounded annual growth rate from now until then will reach 20.54%. [16] Currently, North America leads the market share; In coming years, the development of the Asia-Pacifc region will be very fast, mainly due to mobile games in China and India [16].

The adoption of studios has increased significantly recently. Regarding The Application Situation in Industrial Statistics: By 2021, about 45% of game development studios had adopted AI technology; More than three-fourths of AA-A standard games were already equipped with this technology [17]. Regarding players' reaction, through a survey among game fans in 2023 about introducing intelligent agents (enrollees) for better entertainment and enhance players' sense of immersion when gaming [17]. From these figures above, we can infer that artificial intelligence has been involved at various stages of game creation for some time now [16, 17].

The speed of this is also problematic. Artificial Intelligence technology integrating with narrative-sensitive domains such as role-playing Games and Storytelling causes disputes about intellectual property rights, product uniformity problems, and the lack of players' belief in some Designers [1, 9]. Research indicates that, among existing cases of effective application in combination with AI-generated contents and human supervision is more successful than being fully autonomous [1, 13].

3. AI-Driven Game Level Design

3.1. Procedural Content Generation: Foundations and Evolution

Procedural Content Generation is defined as generating automatic game materials such as maps, Levels, Items, Environment and Quests using algorithms instead of manual design [2]. PCG techniques cover various forms: Search-based Methods; Constructive Methods; Machine Learning-Based Approaches; And Recently, some Researches Based on Large Language Models [1-2]. In a 2024 study, although deep learning broadened the application scope of PCG Systems; However, lately LLM has changed the research direction to enable semantic control and natural language-driven generation [1].

In early applications of deep learning to level Design based on GANs. A basic study used generative adversarial networks to generate Levels in DOOM from a training set of more than 1,000 manually designed levels and found that it generated valid Level structures with retained Spatial features similar to the originals [3]. Afterward, studies exploring top-down dungeon generation also concluded that GANs can learn the structural regularity of levels constructed by hand; however, during training instability and invalid outputs persisted issues. The results indicate that although GANs based on generative adversarial networks can recreate styles and structures at a large scale, they cannot explain in depth how certain levels are considered interesting or narratively valid [1, 3].

3.2. Reinforcement Learning for Level Optimization

In addition to the generation of models, beyond reinforcement learning (RL), which optimises level Design based on simulated player Behaviour. Experience-driven methods take the generation of levels as a sequence of decisions and look for content that can trigger certain types of player experience, such as challenges, flows or novel situations [2, 8]. This player-oriented perspective contrasts with that of imitation-based creation; it is based on experience and outcome, not similarity in history [2].

Through simulation of players with different skills, an RL-based system will optimise the difficulty level to ensure a suitable play experience [4, 15]. Therefore, it is possible to build an environment that has a sense of being carefully selected but also flexible enough to accommodate different situations [4, 15]. Procedural pipelines, on the other hand, can also discover broken geometries and impossible paths in advance through agent-based evaluations to reduce iteration cost before starting human playtesting.

3.3. LLMs as Level Design Agents

The latest wave of innovation involves using directly generated by LM models during the level Design process. Recent scholarship on emerging LLM integration in PCG emphasizes that language models can translate high-level design intent into structured representations that downstream systems can operationalize [1]. Substantially reduce the entry threshold for non-technical creators, allowing them to express a desired Space by describing it naturally without constructing each environmental regulation manually [1, 8].

In addition, LLM-accompanying pipelines have been more valuable during the idea formation and prototype creation phases; Designers can quickly generate several levels of ideas by prompting them after refining their preferences iteratively. Meanwhile, LLM-generated specifications also need a constraint system and verification layer to prevent natural language ambiguity from producing inconsistent spatial logic or mechanically unbalanced layouts without these defenses [1, 2].

4. Generative AI and Scene Narrative

4.1. Limitations of Traditional Narrative Systems

In traditional games' narrative Design, the Story delivery mainly depends on pre-written dialogue trees, Cutscenes and scripted Event Trigger. This mode has a stronger authority figure and restricts the flexibility of narration to some extent; that is, NPCs can only read out dialogues pre-written. Due to its rigidity, there is often an inconsistency between players' sense of freedom and the response generated by their own actions in role-playing and open-world games stories systems. When Dialogue and Quest Logic are too rigid, after repeated playthroughs, one can discover the limitations of the authorised system and lose faith in this living World [10, 13].

4.2. LLM-Powered NPCs and Dynamic Dialogue

Large language models have risen to the forefront of technologies for generating NPC dialogues. Unlike rule-based Dialogue Trees, LLMs have the ability to produce context-sensitive answers in response to various user Input scenarios, thus increasing the sense of novelty and adaptability in conversation [9, 10]. A 2025 study presented a cross-platform LLM-driven NPC system that covered both Unity games and Discord simultaneously; It used cloud storage LeanCloud to retain conversation context session-to-session/platforms [11].

Recently, studies have turned to examining multimediated interactions. A 2026 study combined LLMs and computer vision to make NPCs take into account the visual condition of the game environment when responding, thus achieving an earlier form of sense of place for generative NPS systems [12]. Further research on GPT-based dynamic Dialogue indicates that, by embedding model output into character-specific knowledge Graphs and Interaction Histories, it generates more coherent and lore-accurate character behaviour [9]. Supporting a more general Design Principle: generative freedom works best in conjunction with structured Memory and world-awarded control systems [11, 12].

4.3. Procedural Narrative Generation

In addition to establishing an entire storyline that has developed through gradual developments triggered by players' actions, another instance of integration at this time exists as well. A master's thesis by SMU Guildhall presented an implementation of a GPT system-based RPG narrative and NPC personality generation method using the big five personality model in the generation process, thus enabling characters with stable behaviour when interacting over time. The study found that personality-guided generation can alleviate the problem of uncontrolled LLM's narrative divergence from its original tone, purpose and behavior [13].

Research related to the combination of contextualised stories and GPT-generated NPC personalities, such as enhancing players' engagement through these methods compared with static NPC baseline systems, has been presented [14]. Operational realist is the extent that generated narrative satisfies with the World Rule or Task logic, as an important indicator of players' acceptance on procedurally-generated story [14]. These studies jointly suggest that the matured form of procedural narrative has shifted from experimental novelty to practical Design method, while its core issues are coherently addressing memory, Mechanics, and Player Agency. [9, 13, 14]

5. Dynamic Difficulty Adjustment as Personalized Level Experience

5.1. Theoretical Framework

Dynamic Difficulty Adjustment (DDA) links level Design and personalisation of the Game Pace through real-time adaptation of game Parameters based on a Player's ongoing Performance. Central Design Logic: Maintain a state of equilibrium between the difficulty of game operations for users and the requirements set by games; That is, it should be able to satisfy some degree but not too much. According to a substantial review of DDA research, heuristics, probabilistic models and Machine Learning have been frequently employed in the implementation of Digital Games for different categories. Therefore, DDA is no longer a purely equaliser but has become an essential component in forming individualised games Experience pattern Construction devices that impact mechanical operation and story presentation [4, 5].

5.2. Machine Learning Approaches to DDA

Machine learning performs more accurately than traditional rules in difficulty judgment. In 2024, A personalised DDA study used a two-agents reinforcement learning method for approximation of player behaviour and dynamic challenges; The other model became an adaptive opponent according to the changed skill level [15]. Personalisation can reduce the fragility of a fixed difficulty level and enable the system to react flexibly in real-time instead of switching suddenly.

Complementary industry-oriented research showed that the dynamic difficulty model can increase participation by matching the problem's dynamics with behaviour observations, rather than skills [4]. A 2025 system-wide literature review spanning studies in DDA under ACM, IEEE and Web of Science databases found that currently, artificial intelligence (AI) has occupied around half of the global application volume for DDA; Heuristic and parameter adjustment constitute about three-quarters of these. In summary, based on existing studies [7], it can be confirmed that using AI for adjustment achieves relatively reasonable levels and encounter situations among various types of players' sports [4, 5, 7].

6. Challenges, Ethical Considerations, and Future Directions

6.1. Technical Limitations

There is an incomplete technical difficulty with AI-based level design and narrative creation. GAN-based generation remains vulnerable to training instability, invalid outputs, and limited controllability, especially when training data are sparse or structurally inconsistent [3, 6]. LLM-based systems often produce coherent but in-lore inconsistent or inaccurate answers; especially with prolonged conversations due to difficulty in managing memories [1, 9, 12]. Due to the obvious defects in games, layers of validation, memories, and structure building rules have gradually become basic research areas rather than supplementary functions. [1, 12, 14]

6.2. Ethical and Creative Concerns

The Deployment of generative AI in narrative-sensitive Areas has obvious moral Obligation issues. The AI-generated conversation reproduces bias from the training data and can introduce improper content or actual situation into a fictional context without guidance [10, 13]. Educational and young people's applications have a particularly significant risk of harm to information credibility and social image, and also reduce the entertainment value [14]. The 2024 GPT-based NPC framework added restrictions to avoid off-topic content or real-world information being introduced; thus, it was realised that unmonitored generative systems pose credibility and security hazards.

Generative AI also complicates questions of creative authorship and accountability. When there is considerable content in games such as dialogue, quests, and environment-generated by algorithms, questions about artistic authorship, labour identification, and disclosure standards of players arise urgently [1, 17]. These issues have been gradually appearing in new industries' discourse about AI content regulation for commercial games published by enterprises [1, 17].

6.3. Future Directions

The most feasible research and development paths are to refine the human-AI collaborative Design framework system with a view toward generating candidate contents from an overall perspective [1,13]; It also retains responsibility for content selection, setting constraints on them, and making final narratives. As shown by the NLTLP paradigm proposed in Section 3.3, it expands on the designer's intention without replacing their judgement [1]. LLM Integration with knowledge Graphs, Personality Models and computer vision-based Environmental Grounding Points towards NPCs Systems which are more Expressive and Operationally Coherent [11, 12].

Multimodal AI systems can integrate text, images, sound and behaviour data to achieve level generation and narrative design at a higher level. As these systems continue to improve, the central research issue in the field will change from determining whether AI can produce enough material to managing such an output responsibility-keeping and maintaining its originality while ensuring players' interests [1, 12].

7. Conclusion

AI has become the main reason to alter changes in game Difficulty Levels and scene Descriptions. Procedural generation, reinforcement learning; LLMA-PPC; adaptive difficulty system: Contemporary design tools have altered the way designers conceive, build and customise interaction experiences through LLMs. The global path of the development of the AI in games market: $5.85 billion in 2024; Projected to reach $37.89 billion by 2034 (Source): Global Industry Analysts, Inc.

From the data of this paper, we can say that AI brings people new ideas; However, these Ideas are still its own innovations without being imitations. The optimal combination is still capable of monitoring the situation carefully, using intelligence to reduce Speed diversity and flexibility. The future of innovation in game Design will rely on collaborative Frameworks for combining computational scale-up with authorship to ensure that Generated content remains Engaging, logical and ethical.

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