2026 Volume: 02 Issue: 11 www.ijrpa.com ISSN 2456-9995 Review Article

International Journal Research Publication Analysis

Page: 01-04

AI IN GAMING IN HEALTHCARE: APPLICATIONS, BENEFITS AND CHALLENGES

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Article Received: 24 September 2026
Article Revised: 14 October 2026
Published on: 03 November 2026

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DOI: https://doi-doi.org/101555/ijrpa.3143

ABSTRACT

Artificial Intelligence (AI) has transformed the gaming industry from simple rule-based systems to complex, intelligent, and adaptive experiences. This research paper explores the role of AI in modern video games. Initially, AI in games was limited to predefined patterns, like the ghosts in Pac-Man (1980). Today, it powers Non-Player Characters (NPCs), procedural content generation, dynamic difficulty adjustment, and realistic graphics. The paper discusses key AI techniques such as A_ Pathfinding, Finite State Machines (FSM), Behavior Trees, Machine Learning (ML), and Reinforcement Learning (RL). Case studies of games like The Last of Us Part II, Minecraft, and AlphaGo are analyzed. The paper also highlights challenges such as high computational cost, development complexity, and balancing difficulty. Finally, it discusses the future scope of Generative AI, where AI can create entire games, stories, and characters. The study concludes that AI is not just a tool but the core of next-generation gaming.

KEYWORDS: Non-Player Characters (NPCs), Reinforcement Learning (RL), Finite State Machines (FSM), Machine Learning (ML), Artificial Intelligence (AI)

INTRODUCTION

Gaming and Artificial Intelligence have grown together. In the early days, games needed AI to make opponents move. That was very simple. In Pac-Man, ghosts only followed 4 fixed rules - chase, scatter, frightened.

But today, gaming is a $200 Billion industry. Players want realism. They want enemies who hide, who call friends, who learn from player's style. This is only possible with AI.

AI in Gaming means making the game think like a human. There are two main goals:

1. To make game more challenging (Enemy AI)
2. To make game more realistic and infinite (World Generation AI)

This paper will cover how AI changed from simple if-else logic to advanced Generative AI.

LITERATURE REVIEW

1. Yannakakis et al. (2018) in his paper "Artificial Intelligence and Games" said that game AI has two parts - playing to win (like Chess AI) and playing to create experience (like GTA NPCs).
2. Justesen et al. (2019) researched Procedural Content Generation (PCG) and proved that AI can create infinite levels in Minecraft and No Man's Sky, reducing human effort by 70%.
3. DeepMind's AlphaGo (2016) showed that Reinforcement Learning can defeat world champions. This same learning is now used in Dota 2's OpenAI Five.

TYPES OF AI USED IN GAMING

Non-Player Character (NPC) AI

This is the most common. NPCs are characters not controlled by player.

- Finite State Machine (FSM): NPC has states - Patrol, Chase, Attack. Example: Enemy in GTA.
- Behavior Tree: More advanced than FSM. Used in The Last of Us Part II. Enemy first listens sound, then searches, then calls backup.

Pathfinding AI - A_ Algorithm

When an enemy has to go from Point A to Point B with walls in between, it needs to find shortest path. A* Algorithm is used for this. Every modern game from PUBG to Free Fire uses it.

Procedural Content Generation (PCG)

AI automatically creates game levels.

Example: In Minecraft, the world is never same. AI uses Seed value to create infinite new mountains, villages, caves. In No Man's Sky, AI created 18 Quintillion planets.

Dynamic Difficulty Adjustment (DDA)

AI watches how you play. If you are dying too much, game becomes easy. If you are winning too much, game becomes hard. Resident Evil 4 uses this perfectly.

Generative AI (Newest - 2023-2026)

Now AI creates Dialogues, Voice, and Story.

- AI Dialogue: NPCs in games like Inworld AI talk with you like ChatGPT.
- AI Graphics: NVIDIA DLSS uses AI to increase FPS.

CORE TECHNOLOGIES AND ALGORITHMS*

Technology	Kaam Kya Karta Hai	Example
Machine Learning	Data se seekhna	Forza me Car AI player ki tarah drive seekhti hai
Reinforcement Learning	Galti se seekhna (Reward/Punishment)	AlphaGo
Behaviour Trees	Decision lena	Far Cry ke enemies
Neural Networks	Human Brain jaisa sochna	FIFA ke Player movements

CASE STUDIES

- Case Study 1: The Last of Us Part II (2020)

Is game ke enemies me best NPC AI hai. Agar aap ek enemy ko maroge, to dusra enemy uska naam lekar chillayega. Wo chhup jayenge, tumhe gherenge. Isme Behavior Tree + Sound Detection AI ka use hua hai.

- Case Study 2: Minecraft

Isme Procedural Generation hai. Sirf ek formula se puri duniya ban jati hai. Isme Perlin Noise Algorithm ka use hota hai.

- Case Study 3: PUBG / Free Fire Bot AI

Shuruaat me jo Bot aate hain, wo simple FSM AI hote hain - Seedha chalenge, loot karenge. Isse naye players ko easy lagta hai.

ADVANTAGES AND DISADVANTAGES

- Advantages:

1. Realistic Gaming Experience
2. Infinite Content - Kabhi game khatam nahi hota
3. Better Storytelling with Generative AI
4. Auto Game Testing - AI khud game test kar deta hai

- Disadvantages:

1. High Development Cost - AI Expert chahiye
2. High Hardware Requirement - AI ko chalane ke liye GPU chahiye
3. Unpredictable Behavior - Kabhi kabhi AI bahut hard ho jata hai

4. Job Loss - Level Designers ki jarurat kam ho rahi hai

CHALLENGES IN AI GAMING

1. Balancing: AI ko itna intelligent banao ki player ko maza aaye, itna hard nahi ki player game delete kar de.
2. Computational Power: Mobile games me heavy AI nahi chala sakte. Isliye PUBG Mobile me AI low rakha jata hai.
3. Data Privacy: Agar AI player ka data seekh raha hai, to data leak ka dar.

FUTURE SCOPE (2026-2030)

- Future me AI Game Developer ban jayega.

1. Text-to-Game: Tum likhoge "Ek Horror Jungle Game Banao" aur AI 5 minute me puri game bana dega. Roblox aur Ludo AI is par kaam kar rahe hain.
2. Fully Interactive NPCs: Har NPC ka apna brain hoga. Tum kisi se bhi baat kar paoge.
3. AI as Player: Tumhare dost online nahi hain to AI tumhare dost ki tarah khelega.
4. Metaverse + AI: AI se pura virtual world chalega.

CONCLUSION

AI in Gaming started with 4 lines of code for Pac-Man ghosts and now it has reached a stage where AI can create a full game. AI made games more than just games - it made them worlds. From A_ Pathfinding to Generative AI, every technology made gaming more real. While there are challenges of cost and hardware, the future of gaming is 100% dependent on AI. In the next 5 years, we will not just play games, we will play with AI.

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