***Title: AI-Driven Dynamic Snake and Ladder Game***

***PROJECT REPORT***

1. Introduction  
   The AI-Driven Snake and Ladder game is a modern twist on the traditional board game, leveraging intelligent algorithms to create a dynamic and unpredictable experience. Unlike the static nature of the classic version, this version introduces adaptive gameplay through AI techniques that adjust obstacles and aids based on player performance and probability of movement.
2. Project Objective  
   The main goal of the project is to simulate a Snake and Ladder game where the placement of snakes, ladders, and power-ups is determined dynamically using artificial intelligence. This not only increases the strategic element of the game but also enhances replayability and user engagement.
3. Key Features

* Dynamic Board Generation
* Real-time AI Decision Making
* Three Difficulty Levels: Easy, Medium, Hard
* Power-Ups: Snake Killer, Immune Booster, Time Extender
* Visual and Time-Based Challenge Scaling

1. Difficulty Modes

| **Mode** | **Snakes** | **Ladders** | **Time Limit** |
| --- | --- | --- | --- |
| Easy | Few & Short | Many | Generous |
| Medium | Moderate Size & Count | Moderate | Limited |
| Hard | Large & Numerous | Few | Very Limited |

Each mode adjusts both the number and size of snakes, the number of ladders, and the player’s time to make decisions. This increases the challenge and requires strategic thinking and quick decision-making.

1. AI Algorithms Used
2. 5.1 Monte Carlo Simulation  
   The Monte Carlo Simulation algorithm is used to predict a player’s most probable future positions. Thousands of simulations are run before each move to determine:

* Cells most likely to be landed on: These are considered “danger zones” and are often targeted for snake placement.
* Less probable cells: Chosen for ladder placement to limit rapid upward progress and maintain challenge balance.

5.2 MiniMax Algorithm  
This algorithm minimizes the player's progression toward cell 100. As the player approaches the goal:

* The AI increases difficulty by spawning larger or more snakes.
* The response becomes more aggressive in the Hard mode by limiting power-ups and increasing snake clusters near the end.

This creates a competitive environment where reaching the goal becomes increasingly difficult.

1. Dynamic Game Elements  
   In addition to traditional gameplay elements, the game includes dynamic power-ups:

* Snake Killer: Eliminates a nearby snake.
* Immune Booster: Temporarily grants immunity against snakes.
* Time Extender: Increases decision-making time.

These are also placed intelligently based on game difficulty and player status to offer balance without making the game too easy.

1. Game Flow

* Game starts on a clean board with player(s) at cell 1.
* At each turn, dice roll is simulated.
* AI evaluates board using Monte Carlo and MiniMax to place/remove snakes, ladders, and power-ups.
* Player moves and interacts with dynamic elements.
* Game ends when the player reaches cell 100.

1. Conclusion  
   This AI-enhanced version of Snake and Ladder offers a smarter, adaptive gameplay experience where the traditional simplicity meets modern complexity. The use of Monte Carlo simulations and the MiniMax algorithm ensures every playthrough is unique, challenging, and engaging, encouraging strategic thinking and quick decision-making.

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