**Project Title:** AI-Based Stealth Spy Game

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**1. Project Overview**

**Project Topic:**

Our project is an AI-driven stealth-based spy game where players must sneak past AI-controlled guards that learn and adapt to different tactics. The AI guards will employ adaptive learning, improving their patrol strategies based on the player's previous actions.

**Objective:**

* Develop an AI system for stealth-based gameplay using adaptive learning mechanisms.
* Implement AI guards that dynamically adjust their patrol routes based on the player’s past movements.
* Enhance the challenge by introducing multiple difficulty levels where AI becomes more intelligent over time.

**2. Game Description**

**Original Game Background:**

Stealth-based games typically involve players avoiding detection while completing objectives. Examples include games like *Metal Gear Solid* and *Splinter Cell*, where AI guards follow pre-defined patrol paths and respond to player presence.

**Innovations Introduced:**

* **AI Guards with Learning Ability:** Guards adapt to the player’s behavior, dynamically changing patrol patterns and reaction times.
* **Unpredictable Patrol Routes:** Instead of fixed paths, AI guards will generate new movement patterns based on reinforcement learning.
* **Noise and Distraction Mechanics:** Players can create distractions to manipulate AI behavior.
* **Detection Level System:** Guards will have varying levels of suspicion, increasing the challenge as they adapt.

**Impact on Gameplay Complexity:**

* The game will be more challenging, as players cannot rely on memorized guard paths.
* The AI will provide a more realistic stealth experience by dynamically adjusting to different strategies.
* Encourages creative problem-solving and strategic planning by the player.

**3. AI Approach and Methodology**

**AI Techniques to be Used:**

* **Minimax Algorithm:** To optimize AI guard patrol paths and decision-making based on player movement.
* **Alpha-Beta Pruning:** To enhance efficiency in AI decision-making.
* **Reinforcement Learning:** AI guards will learn from previous player movements to predict future behavior.
* **Monte Carlo Tree Search (MCTS):** Used for strategic decision-making in dynamic game states.

**Heuristic Design:**

* **Path Prediction Heuristic:** AI predicts player movement based on past actions.
* **Noise and Visibility Heuristics:** AI guards will prioritize areas where sound was detected or where the player was last seen.

**Complexity Analysis:**

* Time Complexity: **O(b^d)** for minimax search, where **b** is the branching factor and **d** is the search depth.
* Challenge: Implementing real-time AI learning while maintaining fast response times for guards.

**4. Game Rules and Mechanics**

**Modified Rules:**

* The player must navigate through AI-guarded areas without being detected.
* AI guards will dynamically alter their patrol routes based on the player’s previous actions.
* Players can create distractions (e.g., throwing objects) to lure guards away from their intended path.

**Winning Conditions:**

* The player successfully reaches the objective without being caught.
* Some levels may require collecting intelligence or escaping the facility.

**Turn Sequence:**

* The game runs in real-time with AI guards continuously adapting to the player's actions.
* Guards have a reaction time that decreases as they become more familiar with the player’s tactics.

**5. Implementation Plan**

**Programming Language:**

* Python (for AI implementation and logic)
* Pygame (for game mechanics and visualization)

**Libraries and Tools:**

* **Pygame:** For game rendering
* **NumPy:** For data handling and AI computation
* **TensorFlow/PyTorch:** For reinforcement learning (if applicable)
* **OpenAI Gym:** For AI training simulations

**Milestones and Timeline:**

* **Week 1-2:** Define game mechanics and finalize AI approach.
* **Week 3-4:** Implement AI movement and initial guard behavior.
* **Week 5-6:** Develop reinforcement learning for AI adaptation.
* **Week 7:** AI testing and integration with the game.
* **Week 8:** Final debugging, balancing, and report writing.

**6. References**

* Research papers on **Reinforcement Learning for Stealth AI.**
* *Artificial Intelligence: A Modern Approach* by Stuart Russell & Peter Norvig.
* Online resources and game development forums.