Project Proposal: The Moving Maze

Project Title: The Moving Maze

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Course: AI

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1. Project Overview

Project Topic:

The Moving Maze is a dynamic board game where the maze layout changes after every few turns, challenging players to adapt their strategies continuously. AI will assist in generating maze transformations.

Objective:

- Develop an interactive board game with a shifting maze to create an engaging and unpredictable gameplay experience.
- Implement AI to either control an opponent navigating the maze or dynamically generate maze changes to increase difficulty.
- Use strategic decision-making algorithms like Minimax to make AI-controlled opponents challenging.

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2. Game Description

Original Game Background:

Inspired by classic maze-solving puzzles, this game introduces an innovative twist the paths change periodically, forcing players to reassess their approach constantly.

Innovations Introduced:

- A dynamic board layout where sections of the maze move, disappear, or rearrange after a set number of turns.

- AI-controlled characters that adapt to the shifting maze.
- Different difficulty levels, where AI can predict maze transformations and optimize paths accordingly.

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3. AI Approach and Methodology

AI Techniques to be Used:

- Pathfinding Algorithms: A* or Dijkstra's Algorithm for efficient maze navigation.
- Minimax Algorithm: For AI-controlled players competing against human players.
- Randomized Maze Generation: AI dynamically modifies the board using procedural generation techniques.

Heuristic Design:

- AI evaluates game states based on proximity to the goal, number of available paths, and opponent positions.
- Weighting system to prioritize safe paths and avoid dead ends.

Complexity Analysis:

- The complexity of AI decision-making increases with larger mazes and more frequent transformations.
- Balancing difficulty so that AI remains competitive but fair.

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4. Game Rules and Mechanics

Modified Rules:

- Players must navigate the maze to reach an objective before their opponents.
- The maze shifts every X turns, altering pathways and creating new obstacles.
- AI-controlled players can predict maze shifts and adjust their paths accordingly.

Winning Conditions:

- A player wins by reaching the goal first or collecting a required number of objectives within the maze.

Turn Sequence:

- Players take turns moving a set number of spaces within the maze.
- After a certain number of turns, the maze shifts, altering paths and barriers.
- AI players analyse and adapt strategies accordingly.

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5. Implementation Plan

Programming Language: Python

Libraries and Tools:

- Pygame: For graphical interface and board rendering.
- NumPy: For handling maze transformations.
- Pathfinding Libraries: Implementation of A* or Dijkstra for AI movement.

Milestones and Timeline:

- Week 1-2: Finalize game design and rules.
- Week 3-4: Develop AI pathfinding and movement.
- Week 5-6: Implement maze transformation logic.
- Week 7: AI adaptation and performance optimization.
- Week 8: Final testing, debugging and report preparation.

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6. References

1. Dynamic Maze & AI in Board Games:

- Silver, D., et al. (2016). "Mastering the Game of Go with Deep Neural Networks and Tree Search." *Nature*.

2. Pathfinding Algorithms:

- A* Algorithm: Hart, P. E., Nilsson, N. J., & Raphael, B. (1968). "A Formal Basis for the Heuristic Determination of Minimum Cost Paths." *IEEE Transactions on Systems Science and Cybernetics*.
- Dijkstra's Algorithm: Dijkstra, E. W. (1959). "A Note on Two Problems in Connexion with Graphs." *Numerische Mathematik*.