Project Report: Adaptive Maze Battle Game

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1. Project Title

Adaptive Maze Battle Game: A Dynamic AI-Powered Strategy Game with Real-Time Maze Alteration

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2. Introduction

The "Adaptive Maze Battle Game" is an interactive 2D battle game developed using Python that explores the intersection of artificial intelligence and game development. The key feature of this game is a dynamically changing maze, altered in real-time using a rule-based AI system. This environment enhances player strategy and engagement, requiring adaptive decision-making. Players must navigate this shifting terrain using efficient pathfinding algorithms while engaging in gameplay modes such as player vs. AI and survival mode.

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3. Objectives

- Develop an interactive maze-based battle game with dynamic obstacle generation.
- Integrate a rule-based AI engine to modify the maze structure in real-time.
- Implement A* pathfinding for intelligent navigation through the maze.
- Support multiple gameplay modes, including AI battles and survival challenges.
- Encourage strategic gameplay by continuously evolving the game environment.

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4. Technologies Used

- **Programming Language:** Python

- **Game Engine/Rendering:** Pygame or a custom rendering system
- **AI System:** Rule-based dynamic maze generator (ai_engine.py)
- **Pathfinding:** A* algorithm (pathfinding.py)
- **Architecture:** Modular Python scripts

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5. Key Modules

Module	Description
`main.py`	Initializes and controls the main game loop
`maze.py`	Handles maze creation and transformation logic
`pathfinding.py`	Contains the A* algorithm for efficient movement
`ai_engine.py`	Applies rule-based AI to alter maze structure dynamically
`player.py`	Represents the player's attributes, state, and movement
`game_modes.py`	Provides different gameplay modes like survival and PvE
`config.py`	Stores configuration variables and global constants

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6. Methodology

1. **Static Maze Design:** Create a basic maze structure with defined entry and exit points.
2. **Player Controls & Movement:** Enable player movement and basic interactions.
3. **Pathfinding Algorithm:** Implement the A* algorithm for intelligent path navigation.
4. **Rule-Based AI:** Develop an AI that adapts the maze in real-time based on player behavior.
5. **Integration & Testing:** Combine all modules and test for gameplay smoothness, AI behavior, and user interaction.

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7. Expected Outcomes

- A fully playable 2D maze battle game with dynamic maze changes.
- A demonstration of how rule-based AI can be used for real-time environment adaptation.
- Enhanced understanding of AI, pathfinding, and game loop synchronization.
- A scalable codebase ready for future academic and development enhancements.

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8. Potential Extensions

- **Reinforcement Learning:** Replace or complement rule-based AI with learning-based AI for improved adaptation.
- **Online Multiplayer:** Enable network-based gameplay between multiple players.
- **Advanced Graphics:** Use more sophisticated libraries for improved visual experience.
- **Player Progression:** Implement difficulty scaling, level-ups, and player achievements.

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9. Conclusion

The Adaptive Maze Battle Game represents a novel application of artificial intelligence in real-time game design. By integrating rule-based AI with classic pathfinding and modular programming, the project offers both educational value and gameplay challenge. It sets the foundation for future innovations, including learning-based AI and online competition, making it a valuable academic endeavor.
