Artificial Intelligence

AI-2002

National University of Computer & Emerging Sciences - NUCES - Karachi

Project Proposal

AI-Powered Maze Escape Game

Group Members:

22k-4319 Uzain Ahmed

22k-4492 Syed Muhammad Bilal

22k-4143 Aadil Raja

1. Introduction

Game Concept

The AI-Powered Maze Escape is a puzzle-based game where the player must navigate through a dynamically evolving maze to reach the exit. The game integrates AI techniques to adjust obstacles, generate optimal paths, and provide hints using search algorithms. Players must strategize their movements while avoiding AI-controlled obstacles that change over time. Additionally, the game introduces a time constraint, requiring players to complete the level within a given time frame to succeed.

Heuristics and AI Decision-Making

The game employs heuristic and AI-driven mechanics to enhance the challenge and ensure dynamic gameplay:

- ***Shortest Path Heuristic (A)**** – AI determines the optimal route to the exit.
- **Dead-End Detection (BFS)** – Identifies situations where no valid paths exist.
- **Dynamic Obstacle Placement** – AI adjusts the maze layout based on player movement patterns.
- **Time-Based Pressure Mechanic** – Players must reach the goal within a set time limit, adding an additional layer of difficulty.

Rules and Constraints

- The player can move in four directions: up, down, left, and right.
- The objective is to reach the exit before getting trapped or running out of time.
- AI-controlled obstacles will change positions at regular intervals.
- Some paths will be blocked dynamically, requiring strategic movement.
- Players receive AI-generated hints if they struggle to find a valid path.
- The level must be completed within a specified time limit, or the player fails.

---

2. Implementation Strategy

Uninformed Search (Blind Search Methods)

- **Breadth-First Search (BFS):** Ensures the shortest path is found in an unweighted maze.
- **Depth-First Search (DFS):** Explores deeper paths but may lead to dead ends.

Informed Search (Heuristic-Based Methods)

- *A Search (A-Star):** Utilizes heuristics to determine the most efficient route to the exit.
- **Greedy Best-First Search:** Prioritizes moving toward the exit but may take suboptimal paths.

Maze Dynamics (AI-Based Adjustments)

- AI randomly modifies the maze at set intervals by adding or removing walls based on BFS calculations.
- AI monitors player movement and strategically places obstacles to increase difficulty.
- If a player is unable to find a path, AI dynamically removes obstructions to ensure a solvable maze.
- A time-based challenge is incorporated, requiring players to complete levels before the timer runs out.

---

3. Deliverables

Goal State

The game is won when the player successfully reaches the exit before the time expires.

Failure Conditions

The game is lost if the player:

- Becomes trapped by AI-generated obstacles with no valid escape route.
- Fails to reach the exit before the timer runs out.

Game Mechanics and AI Integration

- Fully implemented maze generation and modification system controlled by AI.
- Implementation of *search algorithms (BFS, DFS, A, Greedy Best-First Search)** for pathfinding and decision-making.
- Dynamic AI adjustments based on player movements and maze conditions.
- Time-based challenge mechanism to introduce an additional level of difficulty.