Wandering in the Woods: Advanced Computer Simulation

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1.0 Introduction

1.1 purpose

The purpose of this document is to describe the software design, use cases and implementation of the Wandering in the Woods computer simulation. The purpose of this project is to develop an interactive, educational simulation that introduces computational thinking, mathematical concepts, and computer science principles to K-8 students through engaging gameplay.

This project is structured to be modified by the user to varying levels of difficulty based on the student that is participating, making it suitable for a wide range of individuals. The simulation itself encourages problem solving, participation, data analysis, and collaboration through an open-ended yet structured game-like environment.

1.2 The Wandering in the Woods Simulation

The Wandering in the Woods Simulation represents a forest as a virtual rectangular grid where students control characters attempting to find each other. The level of control and data complexity increases as students advance through and move up the grade levels. This game and simulation are designed for two students working together on the same screen, promoting teamwork and logical thinking. This simulation includes:

K-2 Level: A very simple visual experience where characters move randomly until they meet, at which point the simulation ends.

3-5 Level: Players set grid size and placement of characters themselves, additional statistics and tracking are introduced into the simulation.

6-8 Level: Students are required to analyze data trends, modify movement protocols, and optimize strategies for faster and more efficient encounters.

2.0 Process Model

The development of this simulation follows an iterative process, incorporating feedback to enhance usability and educational value in the long term. Placing a large emphasis on Agile development principles for ensuing adaptability to allow greater ease of implementation for future improvements. This simulation was designed for maintainability, allowing for expansion of features based on needs.

3.0 Use Cases

3.1 Use Case 1: initialize simulation

Primary actor: Students

Preconditions: Students select a grade level and start the simulation.

Description: The Simulation initializes based on the selected level, setting up the grid size, number of characters and movement rules.

Acceptance Criteria: The Simulation successfully launches with the expected settings for the chosen grade level.

3.2 Use Case 2: Move characters

Primary Actor: Game System (Random movement in K-2) / Students (3-5 and 6-8)

Preconditions: Characters are placed on the grid.

Description: In K-2, characters move randomly. In higher levels, students control placement and observe character movement based on defined rules.

Acceptance Criteria: Characters move according to the defined movement logic without glitches.

3.3 Use Case 3: Detect Encounters

Primary Actor: Game System

Preconditions: Characters have moved on the grid.

Description: when two or more characters land on the same grid cell, an encounter occurs.

Acceptance Criteria: The game recognizes encounters, triggers a visual/auditory response, and updates relevant statistics.

3.4 Use Case 4: Display Statistics

Primary Actor: Game System

Preconditions: The simulation has run long enough to generate meaningful data.

Description: Displays statistics such as the number of moves taken before an encounter, longest/shortest path, and averages.

Acceptance Criteria: The statistics update in real-time and correctly reflect the data from gameplay.

3.5 Use Case 5: Adjust Simulation Parameters (3-5 and 6-8)

Primary Actor: Students

Preconditions: Students select game settings.

Description: Allows modifications to grid size, number of players, and movement strategies.

Acceptance Criteria: The simulation updates settings dynamically without errors.

4.0 Customer Journey

Intended end users are K-8 students with overseers being faculty. The faculty is there to smooth out basic issues and facilitate learning on the system. The goal of the customer (student) is to complete the simulation and learn the required tasks and materials set forth by the faculty. This application is to assist educators at a base level. The journey begins with a selection of grade level, followed by gameplay then analysis of statistics, and finally discussion of findings. Educators can use this as a foundation for classroom assignments and discussions on probability, algorithms, and optimization, as well as general computer science theory.

5.0 Personas

Persona 1: (K-2 Student): 6-9 years old, Enjoys visually engaging tasks, prefers the simple and intuitive over implied.

Persona 2: (3-5 Student): 9-12 years old, comfortable with making basic decisions, interested in comparing results of those decisions and what others are doing.

Persona 3:(6-8 students): 12-15 years old, coming of age, constantly wants to experiment, on a basic level, analyze and optimize.

6.0 UI Mock-Up

This simulations UI is designed for simplicity as well as clarity and engagement. It features:

Simple character icons and grid based movements

Interactive buttons for changing and modifying parameters

Statistics panel summarizing post gameplay data

Audio guidance to assist some young learners

7.0 Testing Strategy

7.1 Unit Testing

Test individual methods, such as *moveCharacters()* and *checkEncounters().*

Ensures characters follow the correct movement logic.

7.2 Integration Testing

Verifies interactions between in-simulation components (e.g., grid initialization, movement updates, encounter detection).

Ensures consistency across different grade levels.

7.3 Usability Testing

Evaluates ease of use for students across all age groups.

Focuses on intuitive controls, clear instructions, and engaging feedback.

7.4 Validation Testing

Confirms that the simulation meets all specified requirements.

Ensures data-driven aspects align with expected learning outcomes.

Secondary set of use cases:

3.1 Use Case 1: Wandering in the Woods (Grades K-2)

Primary Actor: Students (ages 5-7)

Preconditions: The game is launched in K-2 mode.

Description:

Two characters start at opposite corners of a square grid.

The characters move randomly without player input.

A counter tracks the number of moves taken.

The game plays music and features simple animations.

When characters meet, a happy animation plays, statistics are announced audibly, and the game resets.

Acceptance Criteria:

Characters move independently.

Encounter detection works correctly.

The game resets automatically after an encounter.

3.2 Use Case 2: Wandering in the Woods (Grades 3-5)

Primary Actor: Students (ages 8-10)

Preconditions: The game is launched in 3-5 mode.

Description:

Students can modify the grid size (rectangular or square).

Players place 2, 3, or 4 characters at specified positions.

Characters move randomly, but if two meet, they continue moving together.

Statistics (such as longest run without meeting, shortest run, and average moves) are displayed.

Players can replay multiple rounds to compare results.

Acceptance Criteria:

The grid size and character count can be modified.

Characters move according to the rules.

Statistics update correctly after each round.

3.3 Use Case 3: Wandering in the Woods (Grades 6-8)

Primary Actor: Students (ages 11-13)

Preconditions: The game is launched in 6-8 mode.

Description:

Students can modify all settings from the 3-5 mode.

Players conduct experiments to analyze how grid size affects encounter time.

Players can test different movement strategies to optimize search efficiency.

Graphs are generated to visualize patterns and trends.

Students make data-driven decisions to minimize search time.

Acceptance Criteria:

Players can modify movement rules and analyze outcomes.

The game generates graphs and displays statistical trends.

Players can draw meaningful conclusions from the data.