Entanglement Game: Project Report

Introduction

The Entanglement Game is a two-player, collaborative online game designed to introduce players to the concept of quantum entanglement in an engaging and interactive way. The game is set in a space-themed environment where two astronauts must work together to collect a series of items scattered across different maze-like levels. The core mechanic of the game is a metaphor for quantum entanglement, where the actions of one player have an immediate and corresponding effect on the other, regardless of their individual circumstances.

Gameplay and Features

The game is played in a web browser and consists of the following key features:

- **Two-Player Collaboration:** The game is designed to be played by two players who join a shared game session using a unique game code.
- **Entangled Movement:** The two players navigate separate mazes, but their movements are "entangled." When one player moves up, down, left, or right, the other player's character also moves in the same direction within their own maze. This creates a unique challenge where players must consider the consequences of their movements on their teammate.
- **Different Mazes:** Each player experiences a different version of the maze (Maze A and Maze B). This means that a path that is open for one player might be blocked for the

other. This asymmetry is a key part of the game's challenge and reinforces the theme of entanglement.
- **Item Collection:** The primary objective of the game is to collect a series of items that appear one by one. These items can be located in either player's maze, requiring communication and coordination to retrieve them.
- **Timed Levels:** Each level is timed, adding a sense of urgency and encouraging efficient collaboration.
- **Communication:** The game provides a chat interface with preset messages to facilitate communication between players. This is essential for coordinating movements and successfully navigating the mazes.
- **Multiple Levels:** The game features four distinct levels, each with a unique set of mazes, providing a progressive challenge.

Educational Goals

The Entanglement Game aims to provide an intuitive and experiential understanding of quantum entanglement. It achieves this through the following:

- **Metaphorical Representation:** The "entangled" movement of the players serves as a direct metaphor for the behavior of entangled quantum particles. Just as measuring the state of one entangled particle instantly influences the state of the other, the movement of one player in the game has an immediate and predictable effect on the other.
- **Shared Fate:** The players share a common goal (collecting items) and a shared fate (the timer). They must work together to succeed, mirroring the interconnectedness of entangled particles.
- **Communication and Observation:** The need for players to communicate about their different environments and coordinate their actions highlights the non-local nature of entanglement. Players cannot directly see their teammate's maze, so they must rely on communication and observation of their own movement to deduce their partner's situation.

Technical Implementation

The Entanglement Game is built using a combination of web technologies:

- **Backend:** The server is built with **Node.js** and the **Express.js** framework. It handles the game logic, player connections, and real-time communication.
- **Real-time Communication: Socket.IO** is used to enable real-time, bidirectional communication between the players' browsers and the server. This is crucial for synchronizing player movements, chat messages, and game state updates.
- **Frontend:** The game's frontend is built with **HTML**, **CSS**, and **JavaScript**.
- **p5.js:** The game's visuals and interactive elements are rendered using the p5.js library, a JavaScript library for creative coding. It is used to draw the mazes, players, and items on an HTML5 canvas.

- **Bootstrap:** The user interface elements, such as the information cards, chatbox, and buttons, are styled using the Bootstrap CSS framework.

Assets

The game utilizes a variety of image assets to create its space-themed environment. These include:

- **Player and Maze Sprites:** Images for the player characters and the different maze layouts for each level.
- **Item Icons:** A collection of images representing the various items to be collected, such as a "Computer," "Experiment," "First Aid Kit," "Fuel Tank," and "Moon Rock."
- **UI Elements:** A banner image and other UI elements that contribute to the game's visual identity.

These assets are stored in the `public/res` directory and are loaded into the game using p5.js.