**THE DESIGN METHOD IN ENGINEERING**

**First Phase: identification of the problem**

Problem: A group of friends find themselves deciding what to play in an arcade but face the challenge of finding a maze video game that offers a satisfying and challenging gaming experience. Currently, many of the games available lack balance in maze levels and do not present significant challenges, which can lead to an unsatisfying experience and diminish player enthusiasm. The group seeks a solution that optimizes the fun and appeal of the game without prejudging specific changes to the mazes, allowing the exploration of creative strategies to ensure a more rewarding and engaging gaming experience in the arcade.  
  
This problem can serve as a starting point to improve the gaming experience in your maze game, which could attract more players and maintain their interest over time.  
  
**Second Phase: Compilation of the necessary information**

Gathering valuable information about game design involves diving into a variety of sources that address both the theory and practice of creating immersive user experiences. A crucial starting point is participating in industry-leading conferences such as the Game Developers Conference (GDC) and the Computer-Human Interaction Conference (CHI). These events serve as platforms for the presentation of research and discussions related to user experience in video games, providing deep insight into emerging trends and best practices.

Additionally, reading specialized books is essential to gain a more detailed understanding of game design. "The Art of Game Design: A Book of Lenses" by Jesse Schell offers a unique perspective by presenting multiple lenses through which game design can be analyzed and improved. "Game Design Workshop: A Play-centric Approach to Creating Innovative Games" by Tracy Fullerton provides a hands-on, game-centric approach to creating innovative games, while "Rules of Play: Game Design Fundamentals" by Katie Salen and Eric Zimmerman delves into the essential fundamentals of game design.

* Conference and events:

Game Developers Conference (GDC) and the computer-Human Interaction Conference (CHI), where research and discussions on user experience in games are presented.

* Books on video game design:  
    
  "The Art of Game Design: A Book of Lenses" by Jesse Schell.

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**Third Phase: Search for creative solutions**

**Dynamic change maze**

Instead of designing static mazes, a maze game can be created in which the mazes themselves change dynamically and react to the players' actions. Each maze would be procedurally generated and evolve in real time.  
  
***Details:***

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**Procedural Mazes:** Every time a player starts a new level, the maze will be procedurally generated, meaning it will be different every game. This adds an element of surprise and constant challenge.

**Environment Interaction:** Allows players to interact with the maze environment to change its shape. For example, players could activate switches that open and close doors, change the layout of walls, or create new passages.

**Reactions to player decisions:** Have player actions influence the evolution of the maze. For example, if a player chooses a path, they could change the layout of the walls based on that choice, which would affect other players who follow them.

**Strategy Elements:** Encourages strategy and cooperation as players must work together to solve the ever-changing maze. Communication and decision making become essential.

**Adjustable Difficulty Levels:** As players progress, the game can adjust the speed or complexity of the maze changes, providing a suitable challenge for players of different levels.

**Fourth phase: Transition from idea formulation to preliminary designs**

**Procedural Mazes:** This idea is a solid choice due to its ability to offer a new and exciting gaming experience with each game. Procedurally generated mazes provide variety and keep players interested and engaged. Additionally, it prevents players from memorizing mazes, which would be a disadvantage in a maze game. Procedural generation also allows the difficulty and size of mazes to be adjusted according to the player's preferences.

**Interaction with the environment:** This idea adds an interactive dimension to the game that encourages active participation from players. By allowing players to influence the shape of the maze through changes and actions, a strategic and challenging element is added to the game. Players must consider how their choices will affect their progress through the maze, adding depth and excitement to the game.

**Adjustable Difficulty Levels:** The ability to adjust difficulty levels is crucial to ensuring the game is accessible to a wide audience. By allowing players to choose their difficulty level or adjust the difficulty dynamically based on player performance, it is ensured that both beginners and experienced players will enjoy the game. This expands the player base and ensures a satisfying gaming experience for everyone.

**Fifth phase: Evaluation and selection of the best solution**

**Prim algorithm:**

Prim's algorithm is a minimum spanning tree algorithm used to find a minimal subset of edges that connects all nodes of a weighted graph, without forming cycles. This algorithm is commonly used in maze generation, but its implementation is based on randomly selecting edges while ensuring that no cycles are formed. A similar approach will be used for maze generation. Cells are initially locked and then unlocked, following a set of specific rules.

**BFS algorithm:**

BFS is a breadth-first search algorithm, meaning it scans all neighboring nodes at once before moving on to the next nodes in the hierarchy. In the context of a maze, this involves exploring all cells within a given distance from the starting point before moving to cells at a greater distance. This is useful for finding the shortest route from the start to any given point in the maze.

Since BFS explores nodes in layers, the first time a specific node is reached, it is guaranteed that the shortest path to that node has been found. Therefore, if you are looking to find the shortest route from the starting point to a specific destination in a maze, BFS is an efficient choice.

**Definición Matemática del Algoritmo de Prim:**

Let G = (V, E) be an undirected and connected graph with weights on the edges w: E→ R. Prim's algorithm constructs a minimum spanning tree T using the following steps:

1. Initialization: Select an arbitrary vertex as the start of the T-tree.

2. Iteration: In each iteration, choose the lightest edge that connects a vertex in T to a vertex outside T and add that vertex and the edge to T.

3. Termination: Repeat step 2 until all vertices are in the T-tree.

In mathematical terms, the algorithm can be expressed as follows:

Let T be the minimum spanning tree we are building, and VT be the set of vertices that belong to T. Initially, T contains only one arbitrary vertex v0, and VT={v0}.

At each step of the iteration, we select the edge (u, v) of minimum weight such that u ∈ VT and v ∈ VT. We add VT and (u, v) to T.

We repeat this process until VT contains all the vertices of the original graph.

The result is a minimum spanning tree T that covers all vertices of the original graph with the sum of the edge weights in T being minimal.