

Introduction

A serious game is designed with a purpose beyond entertainment, serving sectors such as education, training, healthcare, military, and business to achieve specific learning outcomes and tackle real-world challenges [1].

The proposed game aims to enhance mental computation skills in algebra by immersing players in a 3D maze that promotes quick thinking and efficient calculations. Players must collect three keys to unlock a chest and win, solving algebraic problems to access each key and chest. This game is specifically designed for middle school and high school students who are starting to explore algebra. It offers them an engaging platform to practice their math skills while honing their mental computation abilities.

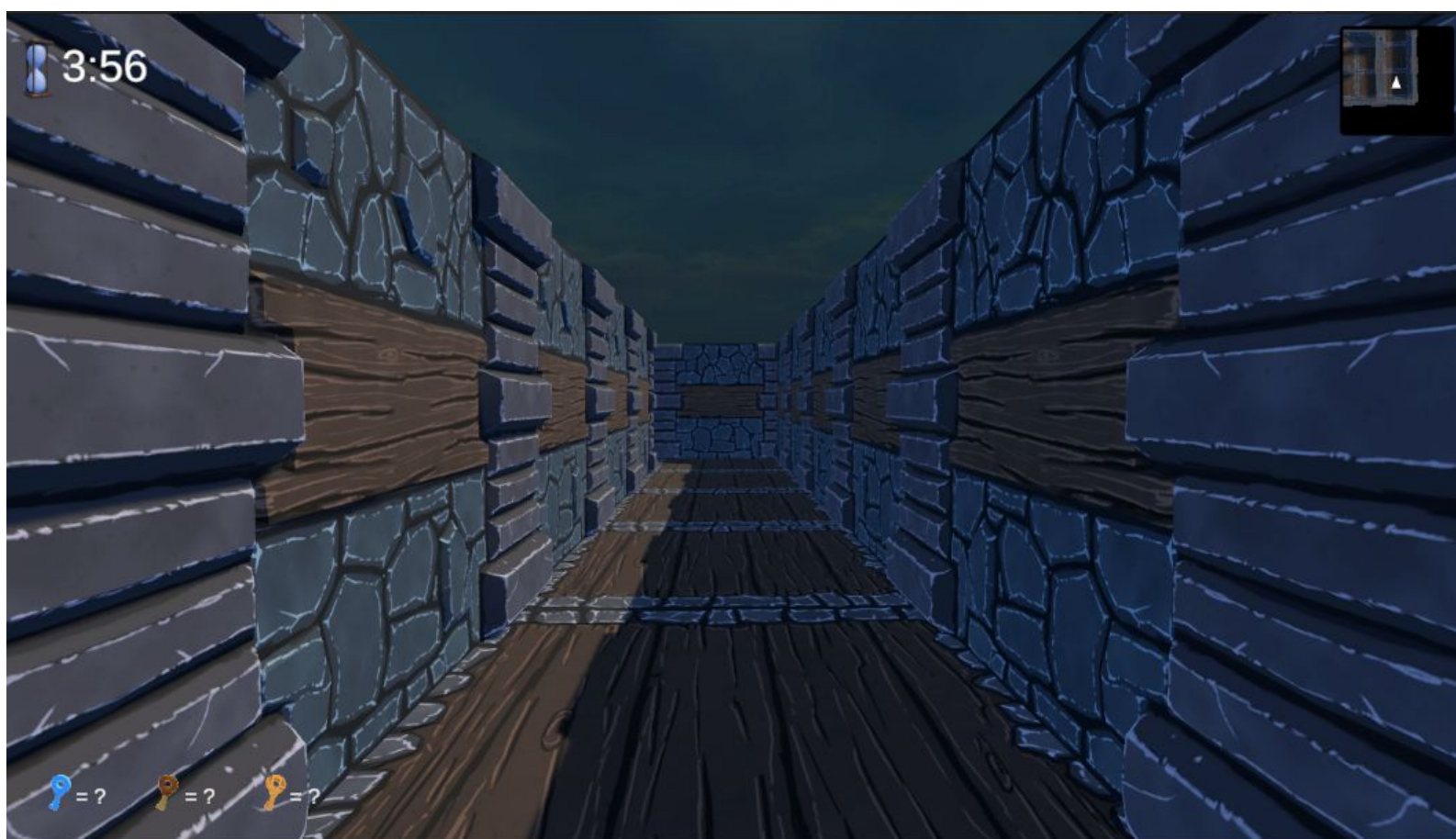
Gameplay

The goal is to open a chest in a maze with a Dungeons & Dragons theme. To open the chest, the player must solve some problems.

To create urgency, a ticking timer counts down to zero, ending the game. Players can influence the timer by either completing the game to stop it or finding hidden hourglasses throughout the map, which add valuable seconds. This dynamic enhances gameplay while emphasizing the importance of speed and strategic thinking in solving algebraic challenges.

Implementation

First Person View



- First person view
- Objective: to find all 3 keys within the maze to unlock a chest
- Time constraint (4 minutes to complete the level)
 - Possibility to find extra time in the level (10 seconds each)

Maze (10 x 10)



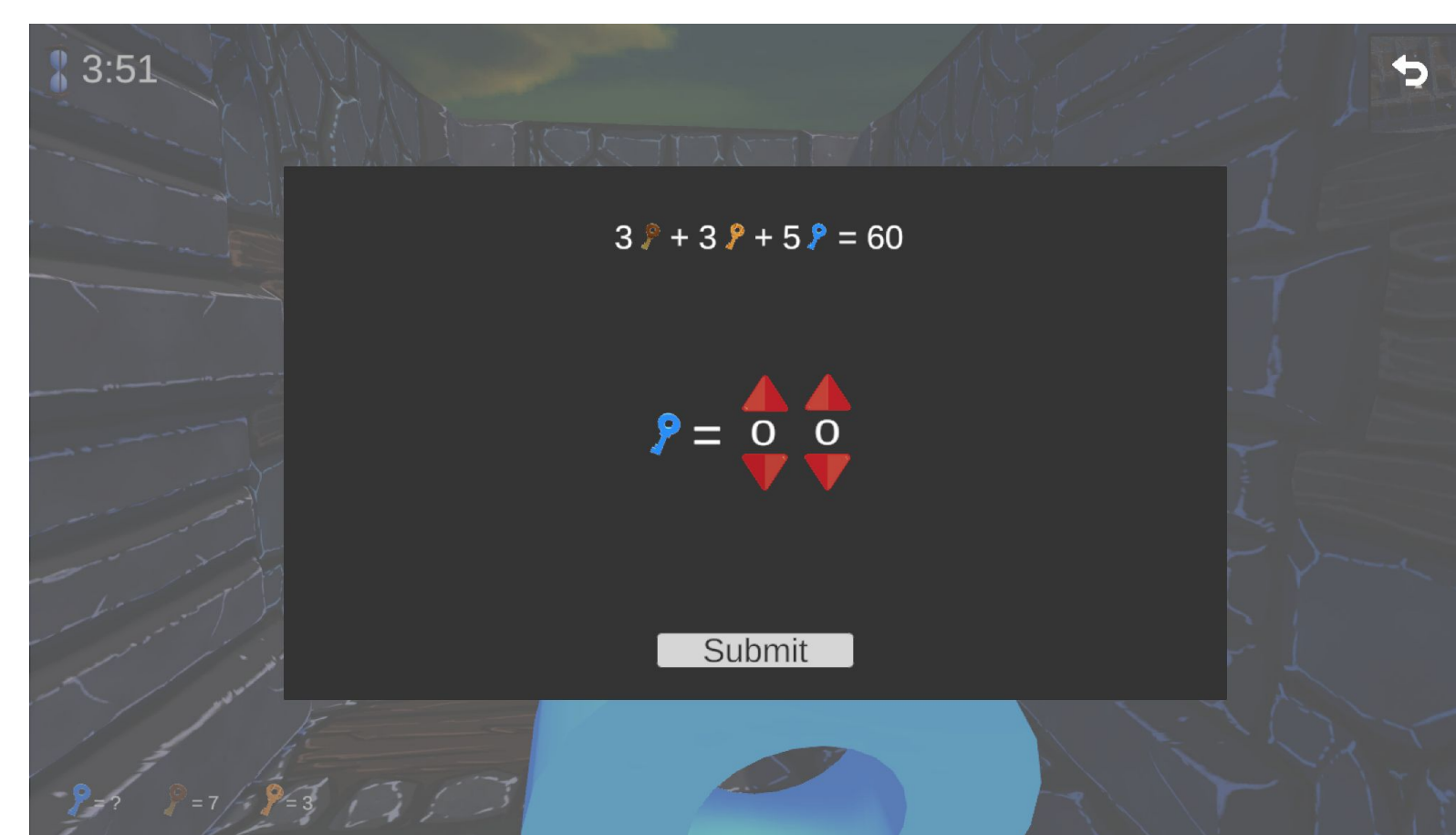
- The maze is a (10 x 10) grid which is randomly generated to create a paths within all points

Hourglass



- Hourglasses are spread out throughout the maze which give you extra time when touched

Puzzle Game



- When you find a key you will be prompted with a menu that displays the puzzle GUI
- Your goal here is to solve the algebraic expression the is displayed above
- While you are solving the timer will continue to count down to emphasis the player's computation speed

Chest



- The chest can only be unlocked when you find and collect all three keys once you do you can then solve the final algebraic puzzle to open it

Key



- Three keys spawn in the maze, each corresponding to different algebraic expressions when touched.

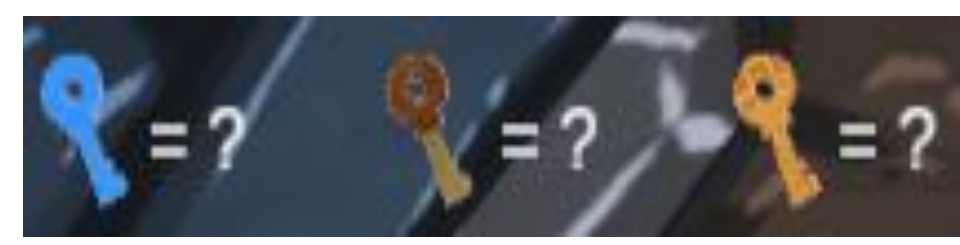
Design

The equations are based on the following model:

- $a1 \cdot x = d1$
- $a2 \cdot x + b2 \cdot y = d2$
- $a3 \cdot x + b3 \cdot y + c3 \cdot z = d3$
- $x + y + z = d4$

$a1, a2, b2, a3, b3, c3, a4, b4,$ and $c4$ are selected randomly in the set $\{1, \dots, 6\}$. $x, y,$ and z are also selected randomly in a new set of $\{2, \dots, 12\}$. $d1, d2, d3,$ and $d4$ are estimated by the selection of these values.

The goal is to determine of the values of $x, y,$ and $z,$ that are represented by the 3 different keys depending on the order you retrieve them.



For the last equation, the goal is to determine the value $d4,$ once all the values of $x, y,$ and z are determined.



Example:

- | | | |
|-------|---------------------|-------------------------|
| Eq 1. | $5x = 70$ | The player must find 14 |
| Eq 2. | $2x + 3y = 82$ | The player must find 18 |
| Eq 3. | $1x + 2y + 3z = 59$ | The player must find 3 |
| Eq 4. | $x + y + z = ??$ | The player must find 35 |

Discussion and Conclusion

Key results

- Depending on what numbers are generated within the mathematical puzzles it can influence the time it takes the player to solve them
- Based on how big the maze is it can distract away from the idea of mental computation and more towards navigation

Limitations

- Game only uses pc controls (WASD Keys, Shift, and Mousepad)
- The game only offers $\{+, -, *\}$ operations when it comes to the math puzzles

Future works

- Add a levels system so that it is more thorough
- Add a main menu to add a layer of completeness
- Add torches or some item so that it's easier for the player to know position within the maze
- Add Game controller option

References

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