SlimeClimb: A 2D Puzzle Game to Divide and Reach

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Abstract. Introduction*: Digital games can be a powerful tool that can contribute to developing cognitive and social skills. This paper presents the development of SlimeClimb, a 2D puzzle game that stimulates these aspects by presenting challenges with various possible solutions. **Goal***: *This project aims to develop a video game capable of stimulating players' logical and social skills in a fun and interactive way.* ***Steps****: Each problem, or game level, was designed to offer multiple possible solutions that may vary in quality and difficulty.* ***Expected Results****: Players are expected to engage in the resolution of the presented challenges, exploring different strategies to complete each level and possibly collaborating or competing with other players for the best possible solutions.*
Keywords *Game, Cognitive Development, Engagement, Competition, Collaboration.*

1. Introduction

The popularity of electronic games has been growing significantly in recent years and tends to continue rising. It brings entertainment that reaches a substantial portion of the population and encompasses various economic and social profiles. According to data provided by the market research company *Newzoo* [Buijsman et al. 2024], the global electronic games market in 2024 was valued at approximately 184 billion dollars and reached around 3.3 billion players worldwide. These numbers highlight the importance of digital games in contemporary society and their immense reach.

In this context, games can act as a way to unite people and convey ideas, feelings, philosophies, and much more to a broad target audience. This shows the potential of this medium to serve as an effective tool for learning and personal development, capable of impacting a wide range of individuals [Krath et al. 2021].

SlimeClimb [1] is a 2D puzzle game that seeks to explore this potential. The player takes the role of a slime artificially created in a laboratory that gained consciousness after being discarded as a failed experiment. With a new desire to live, the creature must escape the facility and experience the outside world for the first time. The game aims to foster players' cognitive development by providing a series of levels with multiple possible solutions, requiring logical reasoning and problem-solving skills. The game core mechanics revolves around the slime dividing itself to reach new areas, hence the

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[1]https://gabriel-sant.itch.io/slime-climb

title "Divide and Reach", a words play with "Divide and Conquer". Furthermore, the game seeks to promote social interaction among players through exchanging ideas and/or competition regarding different strategies to solve the challenges.

In addition to its educational purpose, the development of SlimeClimb was carried out as the final project of the Game Development course at the Federal University of Itajubá (UNIFEI), representing the practical application of the knowledge taught in the classroom throughout the course.

2. Background

Electronic games can offer more than entertainment, they can also positively impact individuals' cognitive development, stimulating skills such as problem-solving, logical reasoning, selective attention, and creativity. [Granic et al. 2014] highlight that digital games can promote measurable benefits in various areas of cognitive, emotional, and social functioning. According to the authors, games with complex challenges and engaging mechanics encourage players to think strategically, adapt quickly to new situations, and develop innovative ways to solve problems.

In addition to the individual cognitive effects, electronic games can significantly influence players' social cognition, especially in cooperative and competitive contexts. According to [Lee et al. 2018], cooperative and competitive contexts modulate neural responses related to social cognition and empathy in distinct ways, highlighting that how games are structured can have differentiated impacts on individuals' social processing.

The work of [Cardoso et al. 2023] presents a similar approach, with a specific focus on the development of children in the early stages of schooling. The authors also seek to integrate the technology of electronic games into the learning process, using playfulness and interactivity to enhance players' cognitive and educational development.

3. Development

The game presented in this paper was developed with Unity 2022 with the C# language. The current available build is for the Windows Operating System. The following subsections presents the core mechanics of the game.

3.1. Slime Movement

The game's uniqueness revolves around the slime's distinctive movement. It can stick to walls and the ceiling but can only move through jumps in one of the cardinal directions (up, down, left, or right). Once initiated, the jump cannot be interrupted or redirected, and the slime will continue moving in the chosen direction until it collides with a wall or obstacle.

If it collides with a wall, the slime will stick to the point of collision and can perform a new jump from there. However, it will be destroyed if it hits an obstacle, and the player can restart the level to revive it.

The game focuses on finding a series of movements that will lead the slime to the next level. Given the peculiar movement of the slime, there may be various reasonable combinations to solve a single challenge. Figure 1 shows an example of the slime's movement in one of the game's levels. In this Figure, the slime (green) was glued to the wall on the left, and a movement was initiated to the right.
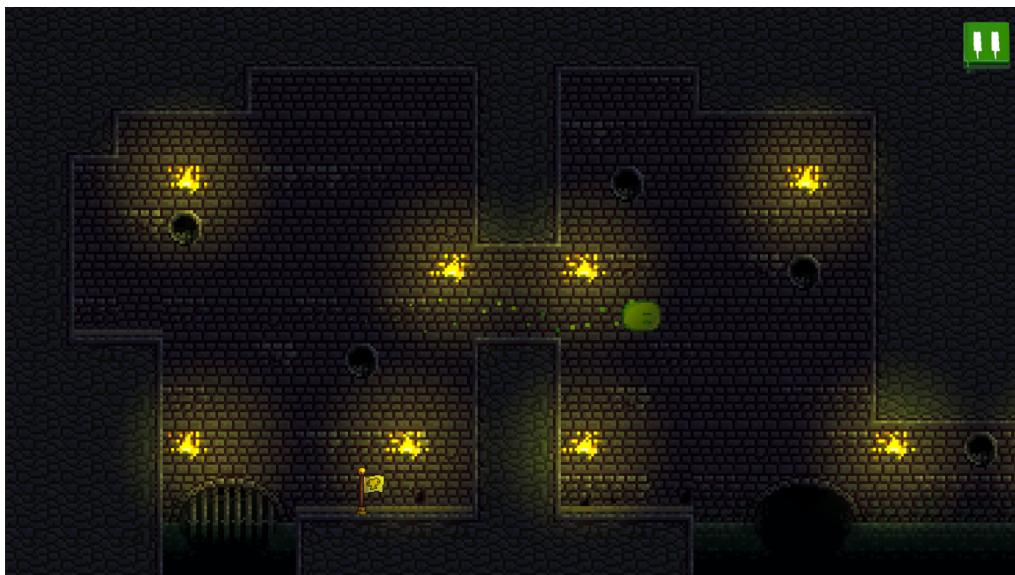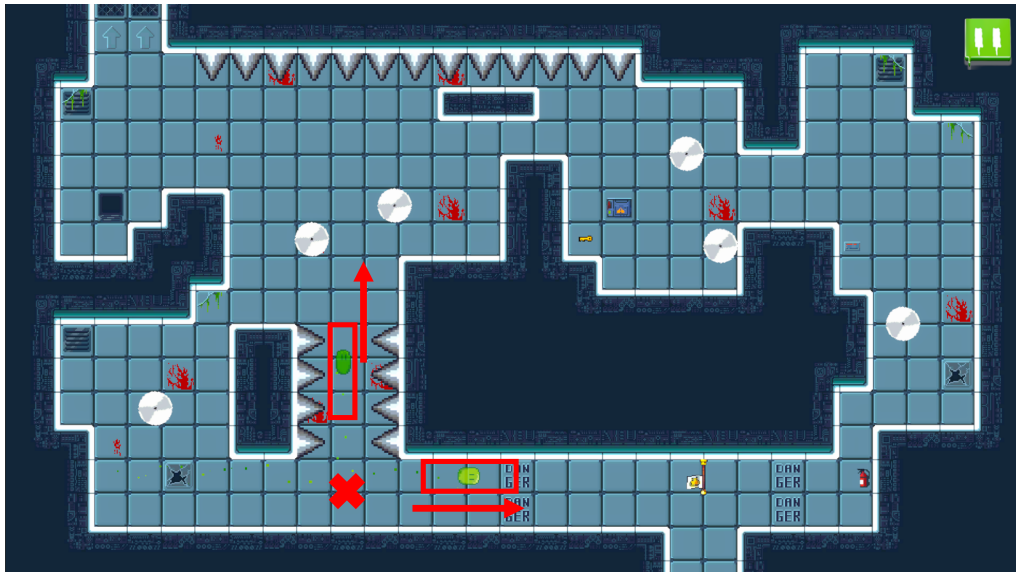
Figura 1. Slime moving from left to right

3.2. Split Mechanics

As part of the game's challenges, the slime cannot reach certain areas with its normal movement alone. To overcome these obstacles, it has the special ability to split, creating identical copies of itself.

The split reduces the size of the original slime and generates a new copy that is thrown in the chosen cardinal direction until it hits a wall or obstacle. What makes this mechanic unique is the possibility of using it during a jump, allowing the player to launch copies into areas that would otherwise be inaccessible. This adds complexity to the challenges and expands the possible solutions, requiring more reasoning from the player. Figure 2 shows an example of the split mechanic in action. In this example, the player was in the middle of a jump to the right, and during the movement, it triggered a division. It was aimed in the upper cardinal direction, so the copy was created and sent in this direction. Both red rectangles show where the slime and its copy are located. The red arrow points in their direction of movement. Finally, the "X" in the Figure is roughly where the division occurred. The original slime kept moving to the right, while the copy was sent moving upwards.

The split can only be performed by the original slime and is limited by its size,i.e, if it becomes too small, it will no longer be able to perform further splits. The same applies if the original slime dies. However, the player can continue attempting to complete the level by controlling the copies. They behave exactly like the original in all aspects: movement, interaction with items, and the possibility of dying or completing the level, with the only exception being that the copies cannot split further.

When multiple slimes are active simultaneously, all respond to the same movement commands, except those already in the middle of a jump. If two slime entities collide, they merge into a larger slime: if both are copies, a larger copy is formed; and if one of the entities is the original, it recovers the lost size and the copy is destroyed.

Figura 2. Slime moving from left to right throwing a copy upwards

3.3. Score System

Throughout the game, the system keeps track of various actions the player can perform, quantifying their performance. The following are the tracked attributes:

- Number of jumps made;
- Number of splits performed;
- Number of deaths occurred;
- Number of level restarts made.

Each attribute can be monitored by accessing the pause menu as shown in Figure 3. In this interface, the statistics of the current level are displayed, along with the total accumulated sum of all levels previously completed. The same interface appears on the screen at the end of a level. The attributes of the completed level are added to the total sum, and the tab for "current level" is reset and prepared for the next level.

This scoring system aims to give the game a competitive and social character, allowing players to cooperate in the search for more efficient strategies or challenge each other to find the best possible solution. Moreover, since reducing one statistic often implies increasing another, obtaining the strategy that provides the best possible combination of attributes can be difficult and encourages the formation of a community focused on this goal.

4. Final Considerations

In this project, a 2D puzzle electronic game was developed as the final project for the Game Development course at the Federal University of Itajubá. The goal was to create a game capable of stimulating its players' cognitive and social development through unique mechanics and complex challenges. The development of this game was an excellent exercise to practically apply the knowledge acquired in the classroom throughout the course.

Figura 3. Menu with General Statistics

Additionally, the game has great potential for expansion, with room for new levels and mechanics. Future works include designing empirical experiments with players to effectively measure the game's impact on social behavior and cognitive skills.

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