# Enviro: C++ based puzzle game

Group project
December 2020

"Enviro" is a barrel pushing puzzle game about hazardous waste removal. We spinned off the classic genre with a modern, environmentally conscious twist.

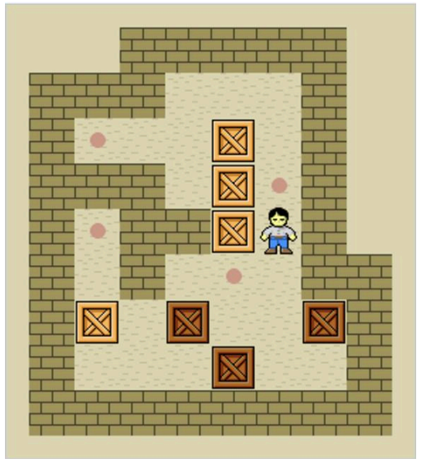
It is entirely written with C++ code, and is not powered by a game engine.

## Inspiration

"Enviro" was inspired by our nostalgia for classic crate-pushing puzzle games. We've crafted a game that transforms the simple mechanical concept into a nuanced exploration of strategic decision-making.

The core mechanics are inherited:
- Predefined layout
- Restricted movement direction
- The objects are only to be pushed - never pulled

Our innovative designs include:
- More puzzle elements
- An incentive to finish the game in less moves

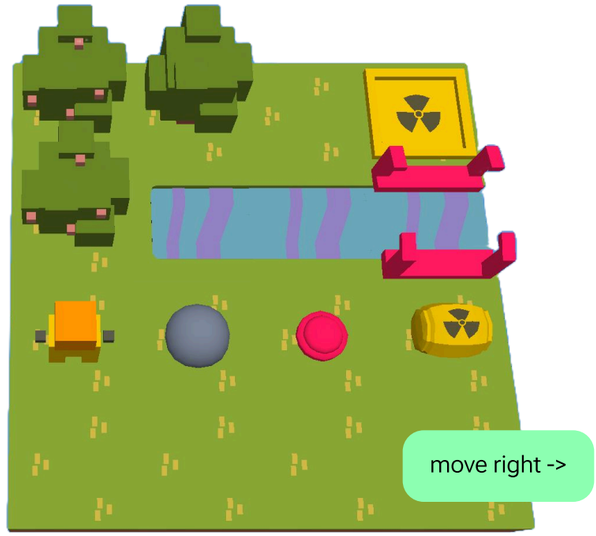


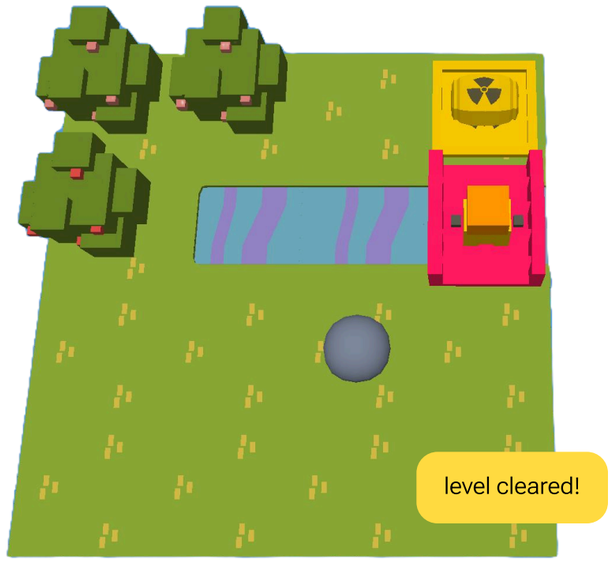
OG box pushing game
*"Sokoban"*

## Gameplay

The goal of the game is to roll barrels of toxic waste into dedicated disposals. To solve the puzzles, the player needs to make strategic use of the game elements such as rocks, buttons, and rotation tiles.

**A "tick" in the game is defined by a single player movement.**



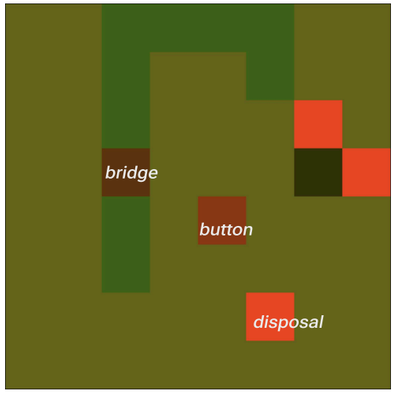



## Efficient Design

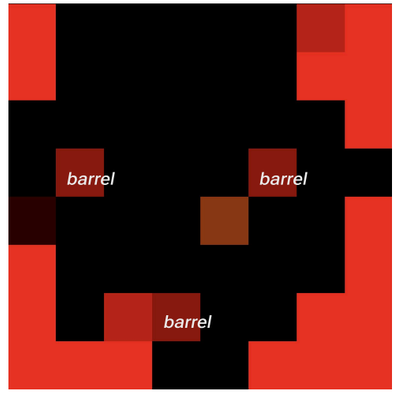
We anticipated the development process would require continuous refinement. To make this process into a streamlined workflow, we developed an efficient system to help us better manage our game assets.

We encoded each level as compact pixel-based bitmaps of the background tiles and foreground objects. Each pixel in the bitmap is mapped to a particular type, and we built a dedicated builder class that constructs the scene with the respective assets. This was beneficial because:

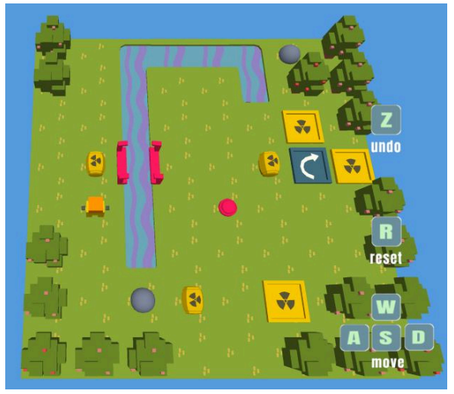
- Less overhead when defining the level layouts, enabling rapid prototyping
- Reduced memory footprint - replaced memory-intensive 3D assets with lightweight 8x8 pixel PNG files and reusable individual assets
- Simplified version control
- Decoupled level design from asset rendering




*background tiles*




*+ foreground objects*

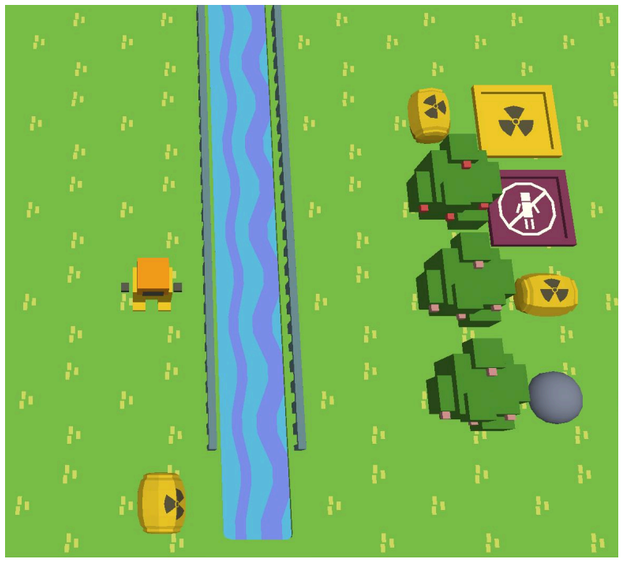


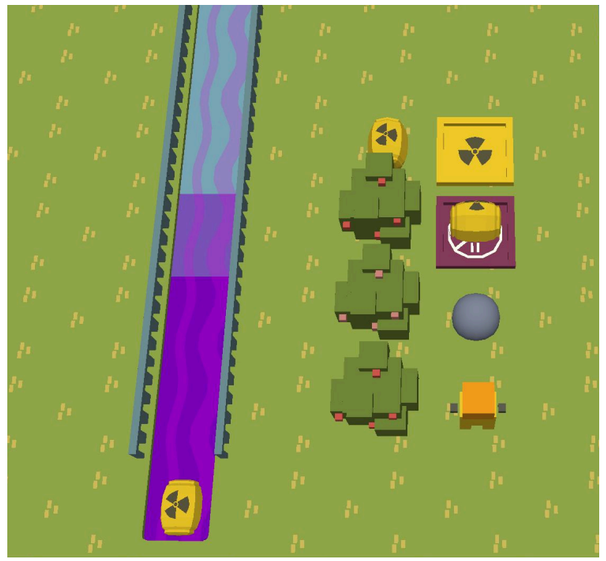

*= resulting level grid*

## Player Incentive

We designed a compelling incentive to finish the game in as little moves as possible.

In some levels, we designed a critical circumstance where a barrel needs to be pushed into the water in order to clear the level. Upon the move, toxic waste will spread through the water with every tick, visibly damaging the environment. The player needs to be minimize unnecessary actions and complete the task strategically.



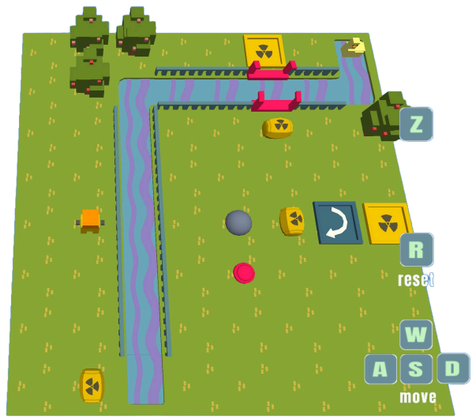


*5 ticks later...*

## Playtesting

Playtesting was crucial for ensuring our puzzles are engaging instead of frustrating. Our methodical playtesting sessions, like the one detailed below, allowed us to refine the levels such that complexity never overshadowed player enjoyment.

### Level being tested




advanced

Barrel rolling | No-go zone | Rock pushing

Button activation | Rotation tile | Environment meter

### Playtester demographics & feedback

Age range: 18-55
67% of them were experienced with mobile puzzle games

“I didn’t understand how the barrel would rotate until my third attempt.”
“The environmental meter felt punishing.”
”I wish there were more intermediate steps to learn each mechanic.”

Overall, players showed a difficulty in deducing the multi-step solution path and frustration is kicking in very soon. The tested level was introducing too many complex mechanics at once without sufficiant tutorials.

## Iteration part I: “Teach, then Challenge”

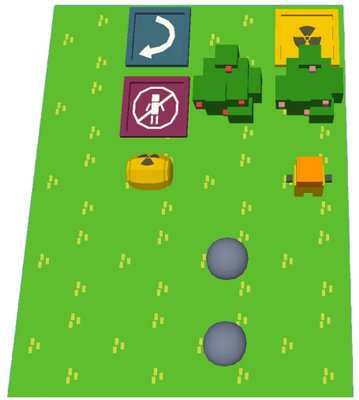
We broke down the mechanics and added 10 new tutorial levels, gradually increasing in difficulty.

e.g. A new level to introduce the parity concept when interacting with rotation tiles.
We provided the choice to use 1 or 2 rocks when pushing the barrel onto the rotation tile.
In this simple grid, the player can experiment and see the different outcomes.

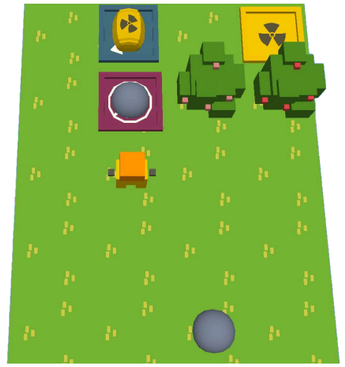
intermediate

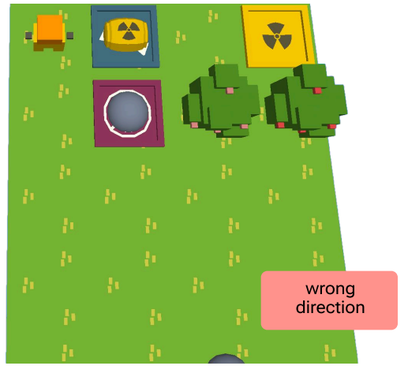
Barrel rolling | No-go zone | Rock pushing

Button activation | Rotation tile | Environment meter

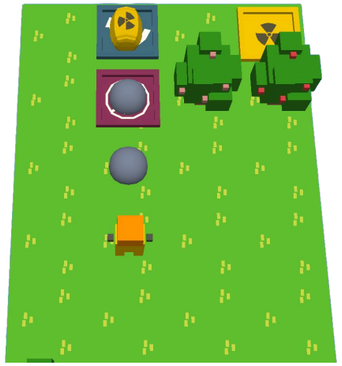


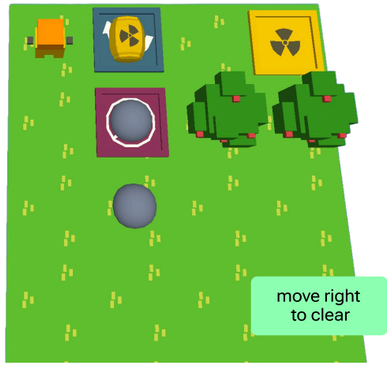
1 rock: incorrect parity






2 rocks: correct parity






## Iteration part II: “Carrot and Stick”

To compensate for the frustration of having to push the barrel into the water, we added a redemptive level to encourage further gameplay.
This level is set up with seeds and soil tiles. When a seed is pushed into the soil, it instantly sprouts and remediates the environmental meter.

easy

Barrel rolling | No-go zone | Rock pushing

Button activation | Rotation tile | Environment meter