3D Echo

This report aims to help in the understanding of the second work developed by José Dias (1190785), Luís Teixeira (1190835) and Rafael Cardoso (1190982), in the scope of the discipline INDES (Interfaces and Design), of the Mestrado de Engenharia Informática, in ISEP.

1. Contextualization

According to the statement, the objective of this second project was to create a program (game, interactive solution, or a portal), written in a language chosen by the students, which would include at least one type of interaction (sensors/gestures, camera, audio, gloves), also of free choice.

Accordingly, the three elements of this group decided to develop a game that consisted of a random 3D simulator of a dungeon/maze, made up of several rooms, in which the player wandered through them, in total darkness, using only the sound of their steps and voice (audio interaction) as a means of locating the environment that surrounds him. The purpose of this game is simple, it just consists of finding the right room that leads to the dungeon/maze exit.

Regarding the name of the game, it was called 3DEcho, since the player, through his voice and steps, will generate an echo, in order to be aware of the structure of the dungeon rooms, facilitating the passage between them.

2. Platform and language used

To develop 3DEcho, Unity was used, a well-known game engine, for helping to create various types of games (2D and 3D), as well as interactive simulations among other experiences, for different platforms, such as desktop, mobile, consoles and virtual reality.

Figure 1 - Unity logo

Additionally, Unity makes it possible to write scripts in C# for handling events and objects through triggers performed by users in the main scene, where all the objects/models that give rise to the game are located.

An example of a script for this game is, for example, the reproduction of the animation of opening the doors of the dungeon rooms whenever the player gets close to them, representing a collision event between the player and the door.

3. Game structure

According to what was said before, the 3DEcho game can be divided into three main components:

1) The dungeon/maze, consisting of several dark rooms, which represent the game's environment

In Figure 2, we can see the model used for the dungeon rooms. It consists of four walls and doors, where the latter were changed when the dungeon was generated.

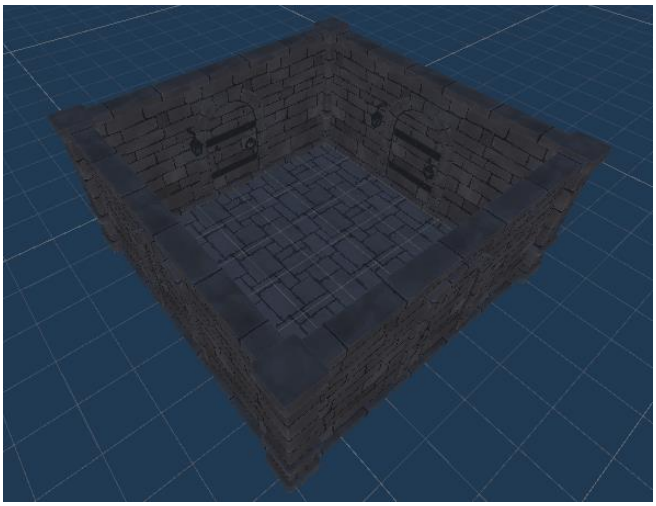

Figure 2 - Model of the dungeon rooms

In the figure below, we see two different dungeons of size 10 by 10 that were created from the script responsible for generating the dungeon.

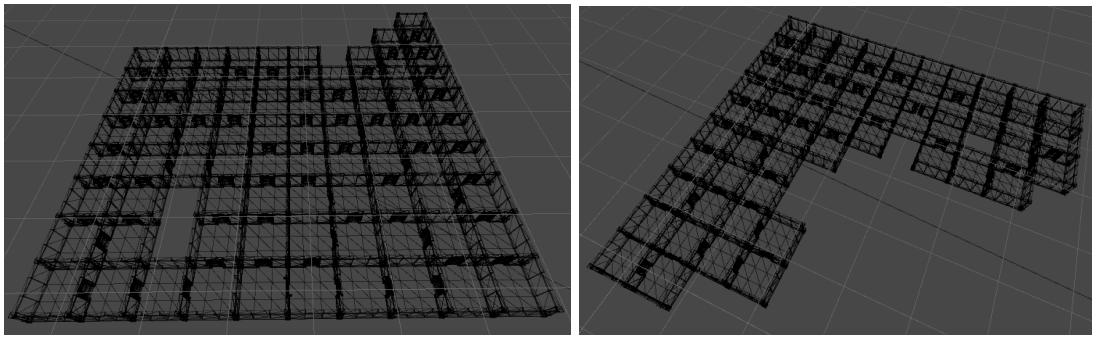

Figure 3 - Two auto-generated 10x10 dungeons

This script was based on the DFS (*Deep First Search*) algorithm, which considers the dungeon rooms as branches of a tree interconnected by a different path each time the algorithm is executed.

2) The player, the only actor in the game, who is represented by a capsule and a camera that simulates the player's vision

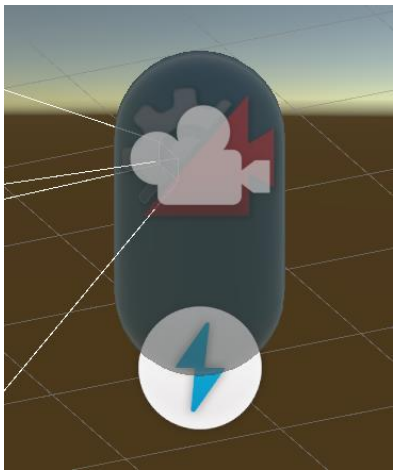

Figure 4 - Player capsule model

The player has the option of using the keyboard controls namely WASD to move forward, backward, or left or right, but the player also has access to voice inputs via a microphone. These voice inputs are handled through a script on the player capsule game object that is always listening to a microphone.

This script will compare the spoken words by the user into a list of pre-selected keywords and then, it will execute a function based on the keyword that it recognized. There are keywords for the four main directions that can be inputted using traditional keyboard controls and a keyword for shouting, so that the player can survey their surroundings, not needing to move quickly in place to make sound waves.

3) The echo, represented by sound waves, generated whenever the player speaks or moves

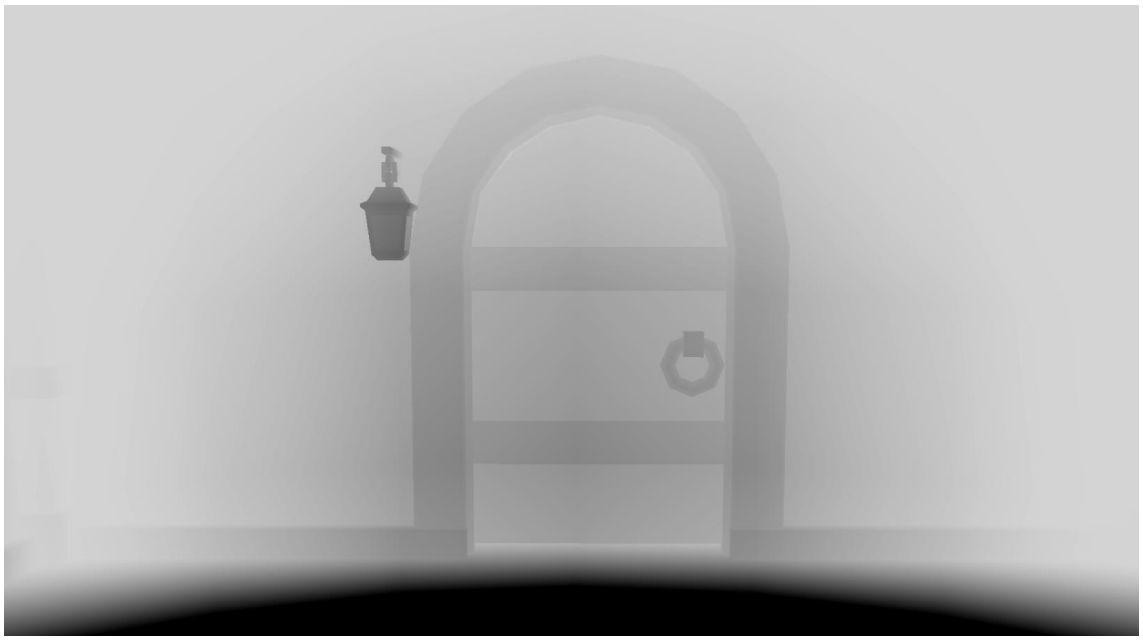

Figure 5 - Echo generated by the player

To achieve this sound wave effect, a script was written which spawns a sphere at the player's feet. This sphere then grows to 10 times its original size and is despawned (destroyed) once it reaches this maximum scale. A custom shader was made and applied to the sphere's material so as to give it a foggier, more stylized appearance that better illuminates the scene while being partially transparent and visible from the inside of the sphere, where the player is standing.

This script is called whenever the player moves or speaks to mimic the effect of using echolocation to traverse the dark dungeon.

4. Controls

To finalize this document below is the list of 3DEcho game controls:

- W - Move Forward (You can also use a microphone and dictate the word "forward").
- S - Move Back (You can also use a microphone and dictate the word "back").
- A - Move Left (You can also use a microphone and dictate the word "left").
- D - Move Right (You can also use a microphone and dictate the word "right").
- Q - Shout (You can also use a microphone and dictate the word "shout").
- P - Pause/Unpause - Show/hide the controls and credits menu.

5. Disclaimer

The echo generated by the player's actions can cause somewhat bright lights when used too many times in a row. Accordingly, gameplay is not recommended for people who may suffer from vision problems such as epilepsy.