3D MODELLING OF BUILDINGS INTERIORS TO SUPPORT INDOOR NAVIGATION

Francisco Rivero Cabezas

Final Degree Work

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Supervised by: Michael Gould

To my family and best friends

ACKNOWLEDGMENTS

First of all, I would like to thank my Final Degree Work supervisor, Michael Gould, for giving me the opportunity to learn and show my learned knowledge about 3d modelling.

To my friends, for supporting and encouraging me in every moment of this journey.

To my family, for being my home and my will power.

Thank you all for helping me in this project, the first to begin of many.

ABSTRACT

The following document represents the memory of my final work in the degree in Design and Development of Video Games. This project consists of the creation of Espaitec 2 Search, a video game developed with the aim of providing a fun and tourist guide to the Espaitec 2, a building created for investigation at the Universitat Jaume I.

It is a first-person and exploration game, in which there are two modes to choose from: The first one, a free exploration mode where the player can visit the building from the bottom to the top, outside and inside, visiting every floor,room, office, terrace, and the time the player wants; then we have the second mode, an exploration mode but with a challenge, which it consists of an exploration mode with a countdown where the player has to collect all the objects inside the remaining time, being a fun adventure, and visiting and learning all elements of the building at the same time. Being an original way to show the entire building to the public standing out that it was modeled from zero using SketchUp, AutoCAD and CityEngine, and it is programmed and developed in Unity.

Keywords: Video game, 3D Modelling, Architecture, Exploration, Adventure, Tourism, Learning.

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INTRODUCTION

Contents

The following chapter will describe the bases on which this project has been created, explaining which are its main goals, ideas, needs, and its motivations.

1.1 Work Motivation and Objectives

This chapter explains which are the circumstances that motives the development of this project. Throughout my studies in this degree I have realized the potential that 3D has in our lives, for example, how human beings are capable of recreating reality or creating a new fictional one in 3d, with the aim of entertaining, helping and facilitating jobs, or using it in certain areas like for example creating prostheses, mechanisms, designs, objects, or buildings as in the case in this project.

Nowadays 3d is more present in our lives than never was before, and people don´t usually realise it. Many companies and organizations use recreations of their own buildings using 3d so the users can be there in a way or another, and take a look at everything there.

The main goals of this project are two: the first one, giving the user the opportunity to visit the Espaitec 2 building without leaving home, and not only visiting it, but also having fun at the same time, using the didactic part of the video games. With this project you can play visiting a building, not only having fun and exploring the outside

and the inside, but also learning how the user´s mind gradually memorizes each floor, which objects are on each floor, where you can get to one place or another quicker,etc.

The second and final goal is showing how 3d programs were used in order to create this project basing in a recreation of a building almost exact to reality, and taking this part to the way of promoting it and giving the user a tourist, didactic and fun adventure, which it could be an idea of showing buildings but in a more original way and proving how 3d facilities our jobs in life.

1.2   Related Subjects

- **VJ1216**-3D DESIGN : Learn how to model in 3D.

- **VJ1212**-GRAPHIC EXPRESSION: Learn how to use AutoCAD and read views and formats.

- **VJ1221**-COMPUTER GRAPHICS: Learn how to create 3d models programming and details in polygons, and learning about materials and textures.

- **VJ1227**-GAME ENGINES: Learn how to create and develop games in Unity and learn how to program in C# and C++.

Planning and resources evaluation

Contents

This chapter is the technical part of the work. It shows the planning that has been followed to complete the project and its resources.

2.1   Planning

In this section the time planning of the work is structured, dividing it into tasks and sub-tasks, and also the time (in hours) it took to complete each one.

- **Investigation and learning new technologies (SketchUp, Unity and CityEngine)**: 50h.

- **Planning (thinking new ideas)**: 5h.

- **Modelling of the building in CityEngine(plan change)**: 30h.

- **Modelling the entire building in SketchUP using AutoCAD plans**: 90h.

- **Creation and election of textures and materials**: 10h.

- **Placement and modification of furniture and elements throughout the building**: 25h.

- **Modelling the exterior using CityEngine , then Terrain Placement**: 10h.

- **Game Programming**: 45h.

- **Placement of lights along the building(Post processing)**: 10h.

- **Music Creation**: 2h.

- **Final report**: 15h.

- **Final presentation**: 8h.

- **Total: 300h**.

2.2 Resource Evaluation

The following part explains the estimated cost of this project development taking into account licenses and payments, as well as how many people were needed to carry it out, in order to make it in the most profitable way

Talking about workers, it would be nice to have only three persons: the first one who is is charge of modeling the building using AutoCAD plans as a base; the second one who is in charge of the furniture, lights and textures from the building and post-processing; and the last one , the game programmer, i think with one it would be enough since this project consists of simple mechanics. So taking into account all this, it would be around 5000 € (two months) in human resources.

Software resources used for this project:

- An HP Pavilion Power 15-CB012NS ,with a hard disk of 1 TB, 8 GB of RAM memory , and with NVIDIA GeForce GTX 1050. Cost: 600 €.

- SketchUp 2021, used for the modelling of the building. Cost: Free with 30 days free trial, and then +274 € or more depending on the license.

- 3D Warehouse, used for the election and modification of the furniture of the building, Cost: Free, with SketchUP Pro trial.

- AutoCAD Online: used for the lecture of the views of the building. Cost:Free.

- CityEngine 2020.0 , used for the modelling of the exterior and environment. Cost: Free, thanks to the license given by the advisors.

- Unity 2020.3.0f1 version, used for creation of the project, and for the work and post-processing of the game. Cost: Free.

- Visual Studio Code, used for the programming of the project. Cost: Free.

- Logic Pro, used for the creation of the music from the Countdown Mode. Cost: Free with 90 days free trial, and then 229,99 €.

RESEARCH AND GAME REFERENCES

Contents

This chapter explains the concept in which the game is based, which are its references, which are the bases of the project, and the different areas that the project is related with.

3.1 Game Concept and Game Design

This game is mainly an exploration game in first person in order to the user be able to appreciate more the details and give that feeling of realism. The inspiration was taken from other exploration games such us Uru: Ages Beyond Myst (Ubisoft,2003), and Disney´s Atlantis Trial By Fire (Zombie Inc.,2001), taking references such us the mechanics of exploring and collecting objects.

Then we have the countdown mode, taking references from games like Crash Bandicoot 4(Naughty Dog, 2021), in which you have a certain time to collect all the fruits or break boxes, in order to win.

The game design has some references from games like Sims and SimCity, in which the buildings and elements are almost an exact copy of reality, like the case of this project ,in which the game world is an existing part from Universitat Jaume I.

Figure 3.1: Uru:Ages Beyond Myst (Ubisoft, 2003).

Figure 3.2: Uru:Ages Beyond Myst (Ubisoft, 2003).

Figure 3.3: Disney´s Atlantis Trial By Fire (Zoombie Inc., 2001)

Figure 3.4: Disney´s Atlantis Trial By Fire (Zoombie Inc., 2001)

Figure 3.5: Crash Bandicoot 4(Naughty Dog, 2021)

Figure 3.6: Crash Bandicoot 4(Naughty Dog, 2021)

Figure 3.7: Sims 4

Figure 3.8: Sims 4

3.2   Artistic Design

About the artistic design of this game, it is important to mention that this project is trying to look almost like the real one, so the colors and textures are close to the real building ones. As it was mentioned before, the Sims or Simcity are some examples in which there are often physically real houses in which the user can interact, like the project´s one. We can analyse the real building itself.

This is the Espaitec 2, a building specialised for technological companies.

Figure 3.9: Espaitec 2

The building has 7 floors with the parking. We can divided the building into three parts: The first one: Level 0 to Level 2; the second one: Level 2 which is the terrace; and the part three or final one: Level 3 to Level 5 .The first three floors has the same structure composed by rooms and there is a circular structure made of glass in the middle, connecting the main floors to the terrace . Then we have the final last floors, with the same measures.

As we can see, the building´s colors are not too dissonant , it has lots of achromatic colors, like grey or white. The building is composed by lots of windows , external ones and internal ones, so it is really bright inside, and thanks to the circular structure made of glass , the light can really go into it.

It was decided to use textures that seems really similar to reality, some of them were created, and other were selected from SketchUp.

So in conclusion, the intention was to do the artistic part of the game look almost like the original.

SYSTEM ANALYSIS

Contents

This chapter presents the requirements analysis, design and its interface design.

4.1   Requirement Analysis

Let's first start talking about how the game works. Mainly when starting the project, the start screen appears, in which there are the following options: Play, Options and Exit. If we choose the Play option, it takes the player to the next screen where the player can choose the game mode: free exploration or countdown mode. Depending on which one the user chooses, it will take the player to one scene or another.

In both modes you only play using the mouse to move the camera and the W, A, S, D keys to move through the scene. There is also a pause menu to stop the game in case you want to stop it or exit. If we continue with the options at the beginning, we have options, in which we can lower the volume, and finally we have the option to exit. It is a fairly easy game to use and understand.

4.1.1   Functional Requirements

Once the game is explained, lets start with the functional requirements, which are the following ones:

- **R1:** The player can start the game.

- **R2:** The player can select the game mode.

- **R3:** The player can mute the game.

- **R4:** The player can quit the game.

- **R5:** The player can move around the scenario.

- **R6:** The player can jump in the game.

- **R7:** The system can generate collectables around the scenario.

- **R8:** The player can move the camera in the game.

- **R9:** The player can pause the game.

- **R10:** The player can leave to the main menu.

4.1.2   Non-functional Requirements

Non-functional requirements are requirements that impose restrictions on design or implementation such as restrictions on design or quality standards.

- **R12:** The world game will be realistic.

- **R13:** The player can´t move furniture in the game.

- **R14:** The controls are easy to learn for the player.

- **R15:** The mechanics are really simple, far less from complex.

- **R16:** The player cannot cross though furniture.

- **R17:** The player cannot control the scene illumination.

4.2   System Architecture

This section should describe the architecture of the projected system, and the requisites needed for the project to be executed. It is important to mention that this project is created to be executed on PC. The requirements (taken from Unity´s documentation) are the following:

- Operating system: Windows 7 SPI+.

- CPU: x86 and x64 architecture, with SSE2 instruction set support.

- GPU: graphic card with DX10.

- Mouse and Keyboard.

This project has been created using a PC with these hardware and software specifications:

- Operating system: Windows 10.

- Hard disk of 1 TB.

- RAM MEMORY: 8 GB.

- Graphics: NVIDIA GeForce GTX 1050.

4.3   Interface Design

The design for the interface is really simple in order that the player can understood everything quickly. The interface is formed by the HUD, which is the part of the game screen in which the player can know the information about how many collectables are left and the time remaining. In the left of the HUD it is the Time and in the right it is the number of collectables remaining.

If the player can´t get all the collectables on time, it will appear a Game Over screen. And if the player gets all of the collectables on time, the Winning screen appears, and the player can go back to the main menu. Let´s see a sketch:
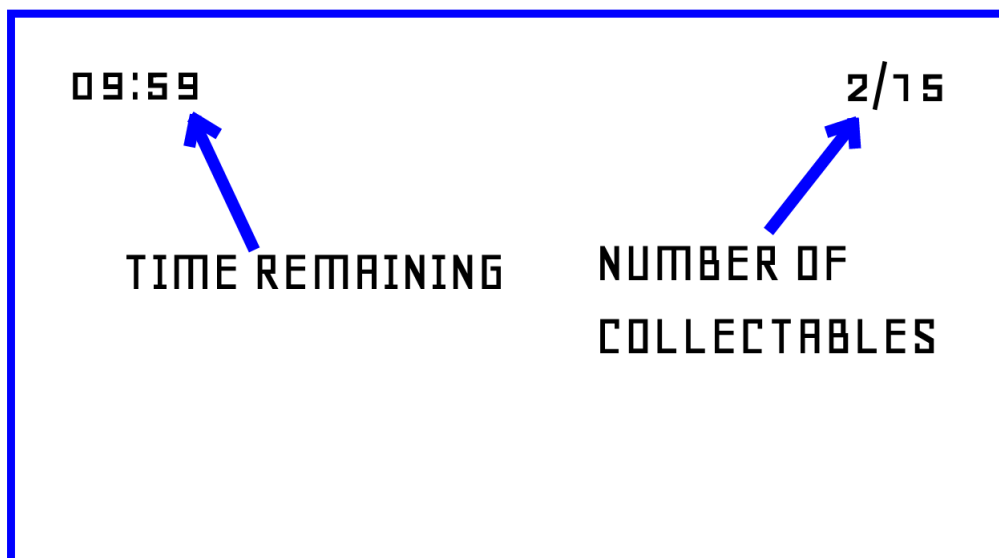
Figure 4.1: HUD sketch

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GAME DESIGN

Contents

This chapter explain the concept behind the game and which are its mechanics and features.

5.1   Overview

The general concept of the game is based on exploring and learning about the structure of the Espaitec 2 building. It is important to note that the genre of the game is a first person game, a decision that was made in order to players could appreciate the details and have the feeling they are inside the building, something that in the case of being in third-person, the player would not feel so mentally involved in the building, and one of the main objectives is to give that feeling of reality.

The concept of the game is not only based on exploration, but also on the freedom that the player has to explore, the power to move wherever the player decides and wants and whose curiosity draws the most attention to go; both in the free exploration mode and in the Countdown mode, the user will always have the freedom of choice. All this mixed gives as a result a funny experience and once the player plays several times, the player will already be able to recognize what is on each floor of the building.

It is a game which public target goes to all audiences and ages, for two reasons, the first: because it is a simple game to use, you only need a mouse and a keyboard, to move the camera and the character, nothing else; and the second one,because it is a didactic

game in one way or another, and it is always good to learn about something new and also the user will have a good time.

5.2 Mechanics and features

In this section we will go into more detail about the mechanics of Espaitec2 Search. We will comment on all the features that base its gameplay and the actions that the player can do

- Walking: you can walk around outside the building and inside the building going upstairs and downstairs searching the elements.

- Collecting things: you can collect the elements needed in order to win the challenge. An important element is the timer, because you have to collect every element before the countdown goes to 0, so the player will get to know about every room of the building but in a funny experience.

- Interaction between elements: The character will always be on the stage, in which there will be lots of obstacles like walls or furniture from the building.

- Collisions:

  1. Character- Collecting Element
  2. Character-Object from Building

- Controls Movement: W, A, S, D key

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WORK DEVELOPMENT AND RESULTS

Contents

This section explains the developed work and the obtained results. All possible deviations from the initial planning are detailed and justified too.

6.1   Work Development

This section will explain the most relevant aspects of the work developed, and in chronological order to understand how it has been carried out from beginning to the end, and in the clearest way possible to understand it even without knowing about the programs used to do it.

To start this project, first It was necessary to study the building in depth, investigating what elements were on each floor, where are the doors, which floor was each window, where each stairs ended, etc. All of this was important since the modelling of the building is going to start from zero and if it wasn´t everything clear, it couldn't be done.

At first the building was going to be modeled using City Engine, a very famous modeling software especially in Hollywood for the creation of cities (Cars, Zootopia) houses, etc. Once the CityEngine tutorials were done, I began to put the ideas on the table and see what would be the best way to model the building, and I remembered that my advisors also gave us plans in AutoCAD, a program in which you can see all the floors of a building and know absolutely everything about it. With all this done, the modeling

started but then after analyzing it well,it wasn´t enough, so the investigating continued until a visual tour of the building made by photos was found on the internet, which really helped to work since it was as if it were inside and this was one of the objectives of the project, so after going through the building several times the idea about what it would look like from the inside was clear.

The modeling of the building started using CityEngine and here the first problem began, because although the tutorials were done and studied, I realised the program was not aimed at for interior modeling, but exterior modeling. It would look good but I realized that there were several problems with the normals of the polygons and this is important because when we put a 3d model in a game engine, if the normal of that polygon is in the opposite direction, that polygon will not be seen.

CityEngine is a program whose maximum potential could be used by creating huge cities in a procedural way, or exteriors, but the main and primary task was the modeling of the interior and exterior of the building, so I spoke to my advisor and proposed the idea of using a new program: SketchUp. Here, the real interior modeling of the building would really begin.

After several tutorials getting used to the program, the decision to start the modelling was ready. I already had all the tools: AutoCAD for the plans, the visual tour through photos and SketchUp to model the building. It started by modeling Level 0, going over edges and polygons and extruding (lifting up) to create the first rooms. The decision to use a rough measurement was made since in the game engine it would scale the building afterward.

Then it started the creation of windows and doors, so with the entire level 0 too.The most curious part of this building was the central part, which is an oval formed by crystals that goes from Level 0 to Level 3.

Between the modeling of Level 0 and Level 1, several problems were detected with the left part of the building since I could not understand exactly what it was like, because it looked like a corridor but at the same time I did not know if it was supported by columns or was it from level 0 , and in the visual tour, this part of the building didn´t appear. The solution was to keep investigating and investigating until thanks to Google Maps I could access that part of the building. So I continued with both parts of both levels, 0 and 1. I had to go through the building (using the visual tour) several times since it has many windows and doors, and the goal was that it has to look as close to reality as possible.

Then it proceeded with several elements until the building began to take shape. Once all level 0 and level 1 were practically done, there were two complicated parts: the stairs since all the steps had to have the same measure and between floor and plant there is always cement to fill between them, so everything had to be measured to perfection; and the second complicated part was the two parallel terraces that the left part of the building has since they are the main entrances of light to the hidden garages that that part has. But in the end it was done after several hours. The problem that SketchUP had is that it is a program that you have to know how to put the elements of each level in selections called "groups" to be able to work better and the problem occurred when

parts of different groups coincided since they could not work together.

Once Level 0 and Level 1 were done, the part that I wanted the most to began was Level 2 since it is the building terrace, and it was though that it would be the easiest part but it also had its complications, for example, it has like a little roof where the light enters through in the left part and the slopes of the terraces on Level 1. Once these mentioned parts were modelled, I proceed to continue with the modeling of level 2, also made up of columns and more rooms. The oval part was the most tedious because the oval was completed and it was a lot of windows.

When Levels 2 was done, a review of the building was necessary, modeling windows and missing parts like garage ladders and more.Then modelling of levels 3,4,5 started, which are curiously the same, so it makes the task much easier, but on the outside the windows had a different order and it was tried to imitate it exactly.

Once they were finished, the building had almost taken its final shape. So it proceeded to the textures part, although later going back to modeling was necessary. Then it takes places a research about textures that look nearly like the real materials and textures, some were found, and others were created. Here some errors in the modeling were detected since there were some backwards faces so that part of the game would not be visible and I proceeded to fix it.

Later it was time to go back to the modeling part and continued with the windows from the upper levels and with the alley window, and I realized that I had already learned several tricks such as the following: The alley window from the outside (level 0 to level 2) you cannot see what is inside because it acts as a mirror, but from the inside you can see what is outside so I thought: if a face is backwards, it will be seen from one side but not from the other, so if the glass of the room is seen from inside, from outside it will not be seen, and the same with the case of the outside mirror, if the correct face is seen from the outside, from the inside of the building the face will be backwards so it will not be seen either.

The last tasks was almost done, so it´s time to finishing the textures but I had already get used to it so it was easy, but it took hours trying to find the texture that was the closest to reality. Especially the walls of the central corridors of the building, which were made up of colored rectangles of random sizes, so polygons of different sizes were being created to try to make it look real.

Modeling was almost done, there were only a few columns and windows left so it was time to take a look using the Unity game engine, which is where the whole game is going to be programmed. And here it was detected that building objects such as crystals looked strange since they were transparent so you could see what was behind each polygon, and the biggest problem was the glass oval since it was all made of glass. So it was necessary to redo the entire glass from level 0 to level 3 being aware now of how it would look in the game.

Once the modeling, texturing and furnishing of the building were finished, it was time to program.

In this part one of the goals of the project was going to be born: the player mentally entering the game, so it was time to program the player's camera and movement using

first person. Then I thought it would be a good idea for the player to jump as a collectible was going to be in the air to make it more fun.

Once it was done, the colliders were applied to the building and then started visiting it. Everything is correct. So the programming part was paused and the modeling part continued, but this time the exterior part using CityEngine. The exterior part was made looking at some photos references from Google Maps (as you can see in the Bibliography). The intention was to not make an environment too big, because the important part was the interior of the building so only a rectangle part surrounding the building was done. This part includes sidewalks, trees, cars, etc.

So after it was all modeled, the texture part took place, because the player could get out of the building and look for collectibles around the building too. So the textures for the environment were all created in City Engine, and the they were applied.

So the interior and exterior modelling were done, but after proceeding to modelling part one more time, it was important to create the collectable. The idea about it was to make something significant and related to Espaitec 2, so after one hour thinking and trying ideas, the decision about what it could be the collectable was done. The old UJI logo was going to be the collectable, so the modelling was done in SketchUp.

Then something important was missing about the building and it was that it was empty, so the furniture was downloaded using 3d Warehouse from SketchUp, a online shop where user can download furniture to use in creations. It was really important because this part gives realism to the building and because then , after having all part done, it was going to take place the last part: Post-processing, in which the lights and textures are modified and added. After several days trying different furniture and scaling and modifying it, the furniture part was done.

So the programming part continues. And we can divide it into several parts: The player codes, The collectibles codes, the time codes and the Game codes. The player codes contains the programming of the player movement and camera. It is really important because the player has to think that they are inside the game, so the programming had to be clear and correct. After making some tutorials about First-person player, the movement and camera were done, so then the first try of the game took place, so we can see how the player was going to feel playing it.

Then the second part, the collectables codes. After importing it, the first thing done was the rotation of the collectibles to make them more game-friendly, and then it was time to the score system, because it is important that when the player touches the collectables, the game saves the information about it and detect that one collectable was found and at the same time one collectable is not remaining more.So after many hours, it was done. When the player found a collectable, the collectable disappears causing a sound, and in the HUD, the number of collectables found increases.

So it has been done the movement and camera of that player, so they can move and jump around the building; the collectables rotating around the building inside and outside, and it the player found them, they are one more step to win the Countdown mode, so it is time to for the timer because as it has been said: there are two modes: one with free exploration in which there is no time, and one with a timer in which the

player has to found all the elements in time. So it is time to program the timer, looking information on the internet. This was a difficult part because it was done using different managers and not one game manager, so it has to control all the information between the score, the HUD, the time, etc.

So the countdown mode was done, so the explore mode was easy to create because it was the same as the first but without the collectibles and the time. So the two modes were already done, and then it start the final part : the game programming referring to the menus, pauses, music,etc.

The music of the menu and explore mode was downloaded, but the music of the countdown mode was done using Logic Pro X, I tried different combinations of instrumentals and genres, and then the decision to make it more EDM was clear, because the player has time to collect each collectible and if the game has upbeat music it will give them a funnier adventure.

Then the creation of the menus started: first the Pause menu, it was really important because the player has to pause the game using the P key in order to exit the game, or go back to the main menu. And it has to be done in the two modes. After finally getting it, the pause menu goes to the main menu, so it start the creation of the main menu.

The main menu consist of: Play, Options and Quit. In Play the player goes to the level screen in which they can select what mode they want to play and discover what are the controls, and go back to the main menu; In Options the player can modifies the volume of the game; and with Quit, the player exits the game. So in this part of the programming it has been involved : audio managers for the volume sliders, and scene managements elements.

So we have all the programming part done, so it is time to the final and most important part: Give realism to the building adding the illumination and retouching some elements in order that the player can discover and have a good experience there. It was done reviewing some tutorials on YouTube to try to create the better illumination inside and also outside. After many days trying to find and get everything perfect, the game was done, so the final work too.

6.2 Results

The initial goals of this project were two: showing how 3d programs were used in order to create this project basing in a recreation of a building almost exact to reality, and taking this part to the way of promoting it and giving the user a tourist, didactic and funny adventure. A goal that I can say it is achieved because the final game shows how the Espaitec 2 is from inside and from outside, and as I explained in previous lines, it was done using really good programs for each part of the building. Using SketchUp for the interior modelling and using CityEngine for the exterior modelling. And the final result of the building is really similar to the real one, even in the majority of textures, so the users or players can look inside and outside and discover how using 3d we can recreate a real building and try to make it realistic.

And the second goal was giving the user the opportunity to visit the Espaitec 2 building without leaving home, and not only visiting it, but also having fun at the same time, using the didactic part of the video games. With this project you can play visiting a building, not only having fun and exploring the outside and the inside, but also learning how the users mind gradually memorizes each floor, which objects are on each floor, where you can get to one place or another quicker,etc. Something that with the final game done, it is achieved, because the player can have a really good time playing around the building and not only going from bottom to top , but jumping and having fun collecting each collectable, and enjoying it thanks to the music and the challenge too.

So in conclusion the final goals are: showing the real power of 3d and show how players can visit and learn about places playing video games, without moving from home.
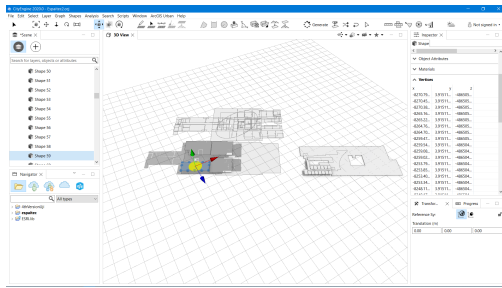
Figure 6.1: Espaitec 2-Development.
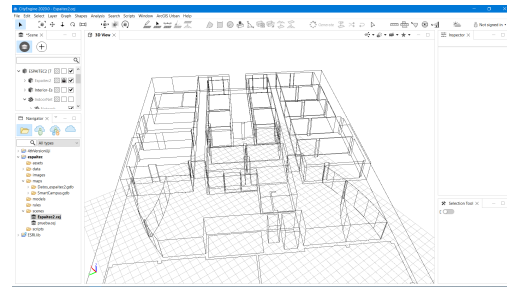
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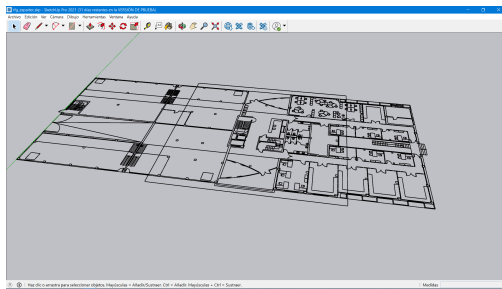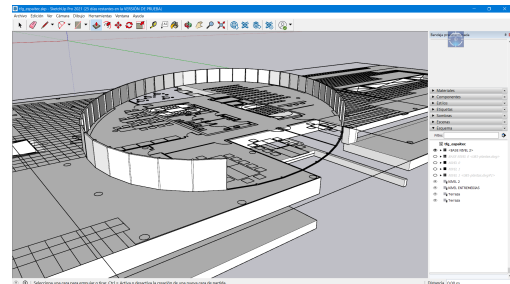

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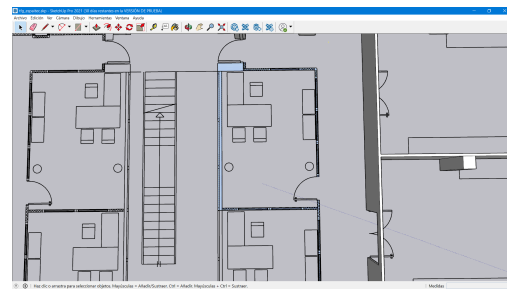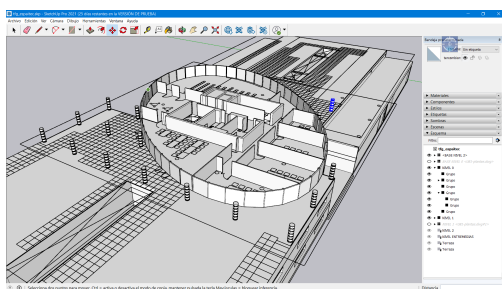

Figure 6.4: Espaitec 2-Development.
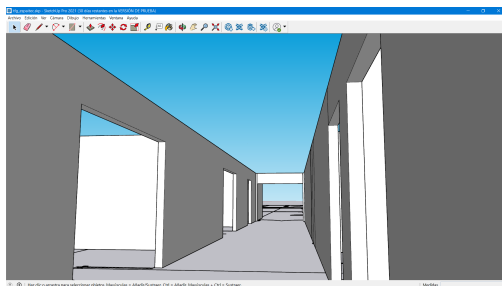
Figure 6.5: Espaitec 2-Development.
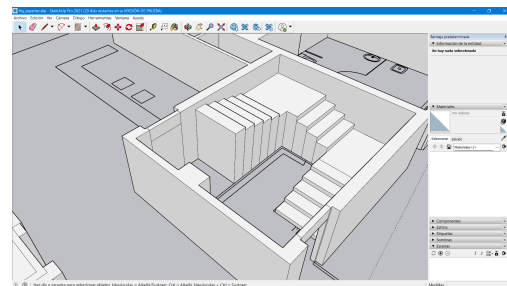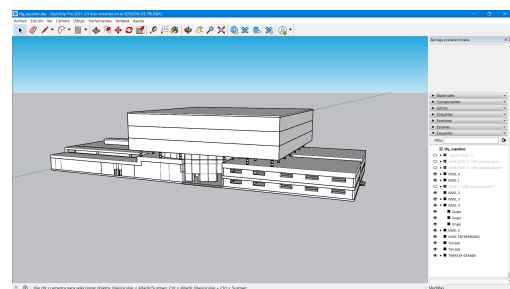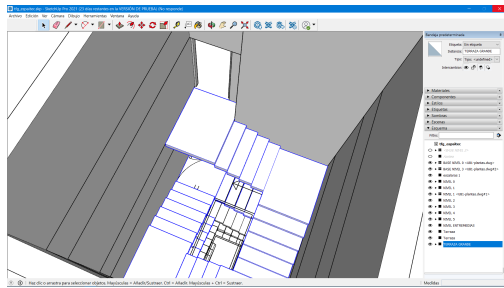

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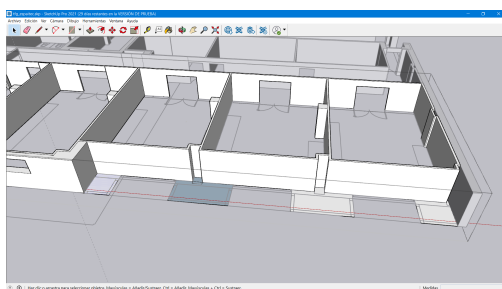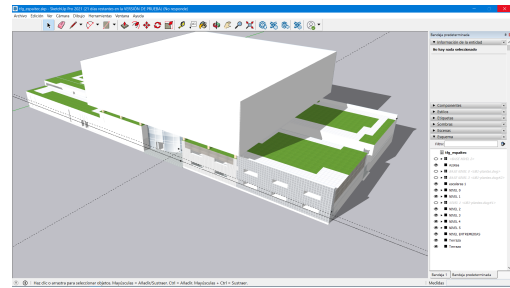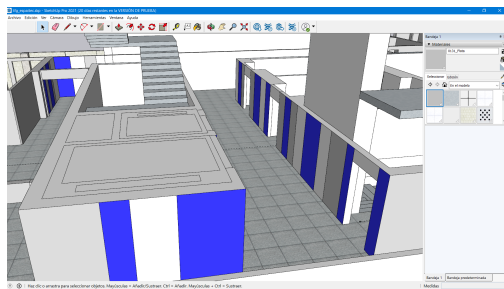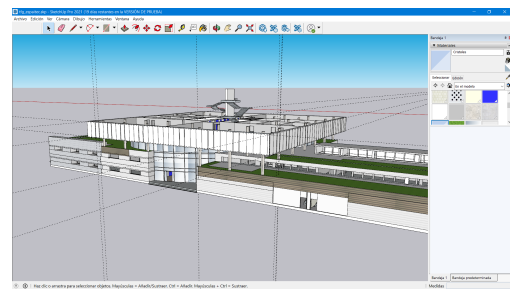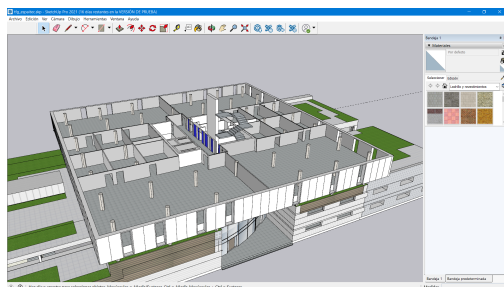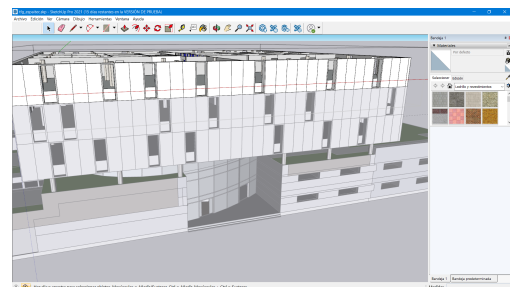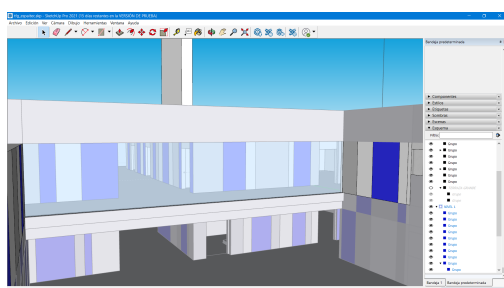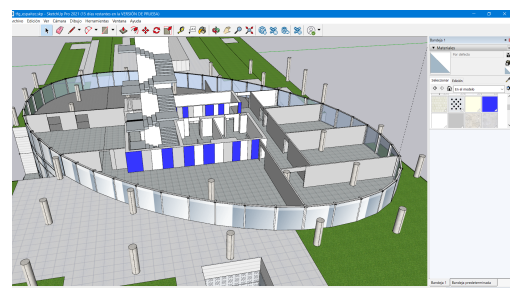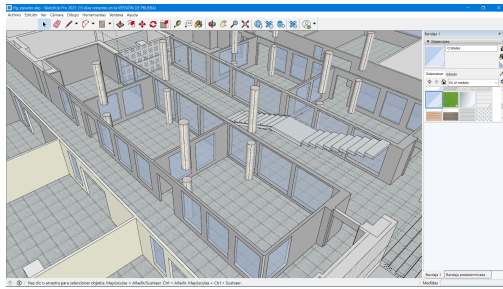

Figure 6.7: Espaitec 2-Development.
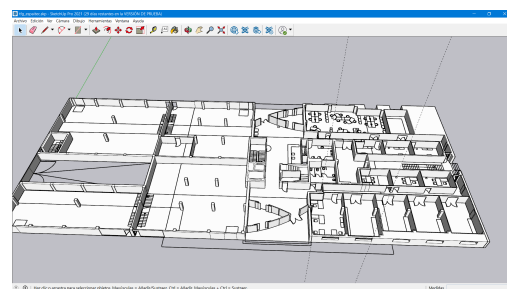
Figure 6.8: Espaitec 2-Development.
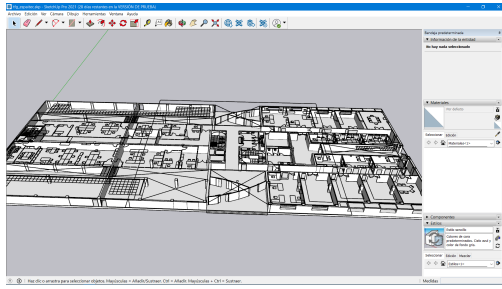
Figure 6.9: Espaitec 2-Development.
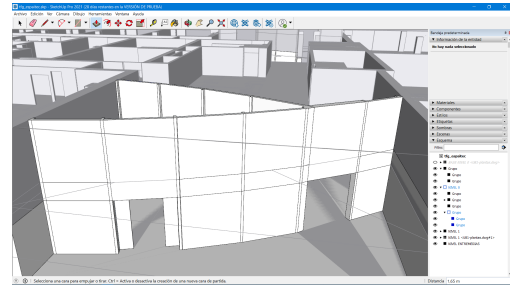
Figure 6.10: Espaitec 2-Development.
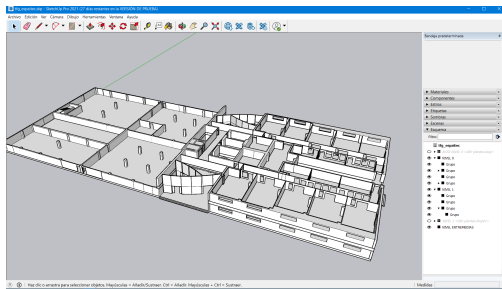
Figure 6.11: Espaitec 2-Development.
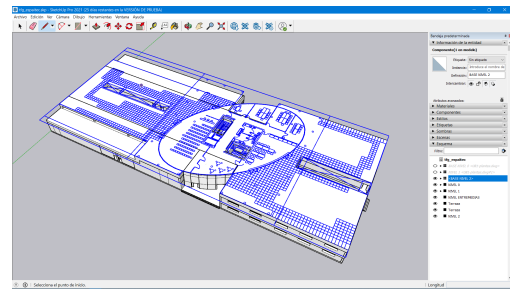
Figure 6.12: Espaitec 2-Development.
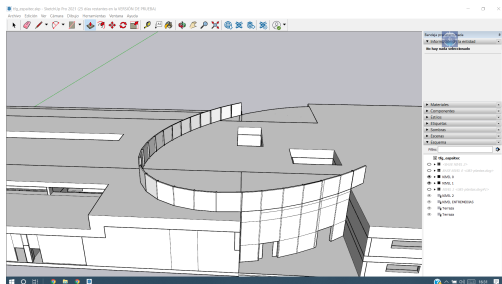
Figure 6.13: Espaitec 2-Development.

Figure 6.14: Espaitec 2-Development.

Figure 6.15: Espaitec 2-Development.

Figure 6.16: Espaitec 2-Development.

Figure 6.17: Espaitec 2-Development.

Figure 6.18: Espaitec 2-Development.
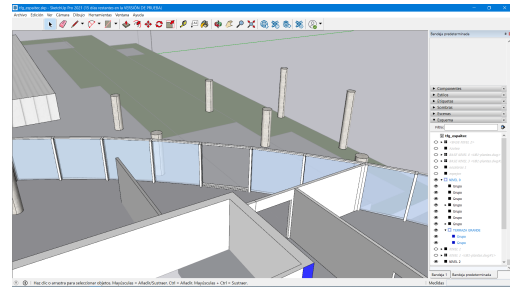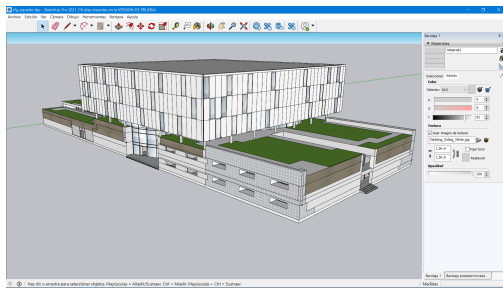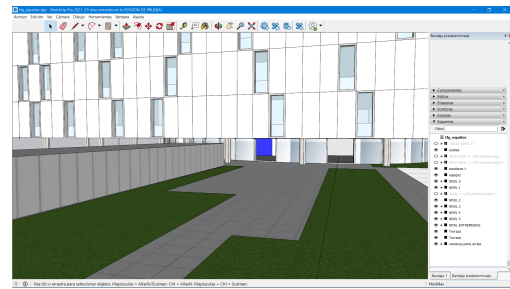

Figure 6.19: Espaitec 2-Development.

Figure 6.20: Espaitec 2-Development.

Figure 6.21: Espaitec 2-Development.

Figure 6.22: Espaitec 2-Development.

Figure 6.23: Espaitec 2-Development.

Figure 6.24: Espaitec 2-Development.

Figure 6.25: Espaitec 2-Development.

Figure 6.26: Espaitec 2-Development.

Figure 6.27: Espaitec 2-Development.
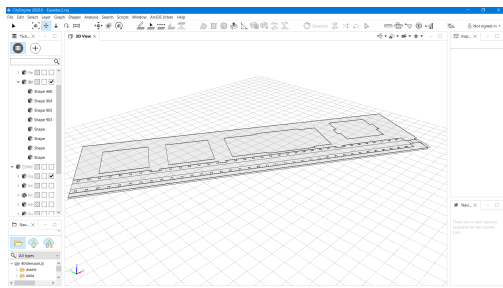

Figure 6.28: Espaitec 2-Development.

Figure 6.29: Espaitec 2-Development.

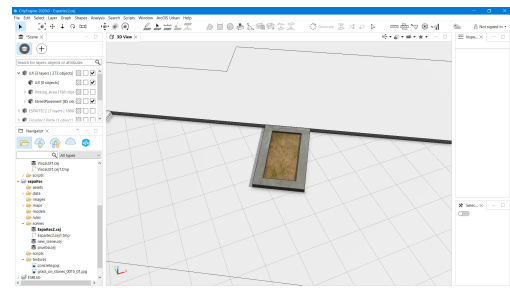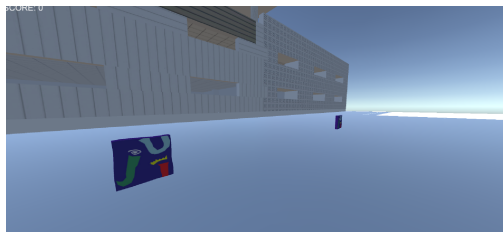Figure 6.30: Espaitec 2-Development.

Figure 6.31: Espaitec 2-Development.

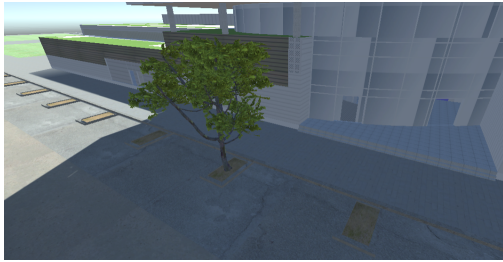Figure 6.32: Espaitec 2-Development.

Figure 6.33: Espaitec 2-Development.

Figure 6.34: Espaitec 2-Development.

Figure 6.35: Espaitec 2-Development.

Figure 6.36: Espaitec 2-Development.

Figure 6.37: Espaitec 2-Development.

CHAPTER

7

Conclusions and Future Work

Contents

This chapter shows the conclusions of the work, as well as its future extensions are shown.

7.1 Conclusions

During my studies in this degree, I had to work in different teams and in different games, and each of them were really different, but I was always calm because I knew that in the end I would get it because I wasn´t alone. However, the idea of making a DFP alone has always scared me a bit, because I did not know if I was going to be able to be prepared for it, but thanks to doing my practices at the same time of developing my final work, I improved my skills and knowledge. From the third year of this degree I discovered that what really caught my attention was the world of 3d, and I was decided that my final work was going to be about this topic.

This project really shows how 3D can be used in order to try to recreate reality, which it is an awesome idea, in the world we live nowadays. For example, not everyone can move from their cities, and some people want to travel, so in case anyone wants to visits the UJI or the Espaitec 2 building, now they can. And one thing I really liked about the creation of this DFP was that at the same time I was developing it, I acted as a future player too, because my intention was that the player would feel that they

are inside the building or that it is near to reality, so I was really careful about camera angles, textures, lightning, etc.

In conclusion, this project has made me grow as an artist by expanding my knowledge. I have learned to do many things in a few months and in hard months, and this means that as time passes I will gain a great amount of knowledge and I will know what I am capable of doing.

Finally, I would say that if before this project, the buildings and characters modelling already caught my attention, after carried out this project, I really know that I want to specialize in this area and I will try to be better and better, and by doing something that the players can learn either by playing or exploring, excited me a lot, so I really want to continue learning.

7.2 Future work

I am really proud of the work done, and it is always possible to improve everything to make it perfect. An idea that would have been great would be that this project could be taken to the field of virtual reality, because if my main idea was for the user to mentally enter the game and the building, if we used virtual reality glasses, the objective would be almost completed, which is something that I don´t discard.

I would also like to speak with Espaitec 2 itself to know their opinion of the project, in case they would be interested in the project, and I would have no problem giving it to them so that people can learn more about them and help them grow as a company.

Finally, I would like to say that thanks to this project, I have been able to create a game like the ones I played as a child and having achieved it, my mind has opened and I have thousands of ideas about future cities and buildings, whether real or fictitious,I want to create, and it would be great to give a new aesthetic touch to the Espaitec 2 in order to have some vibes from Halloween, Fallas Of Valencia, or another holiday, to make it even more striking.

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A

OTHER CONSIDERATIONS

A.1 Appendices: AutoCAD Schemes
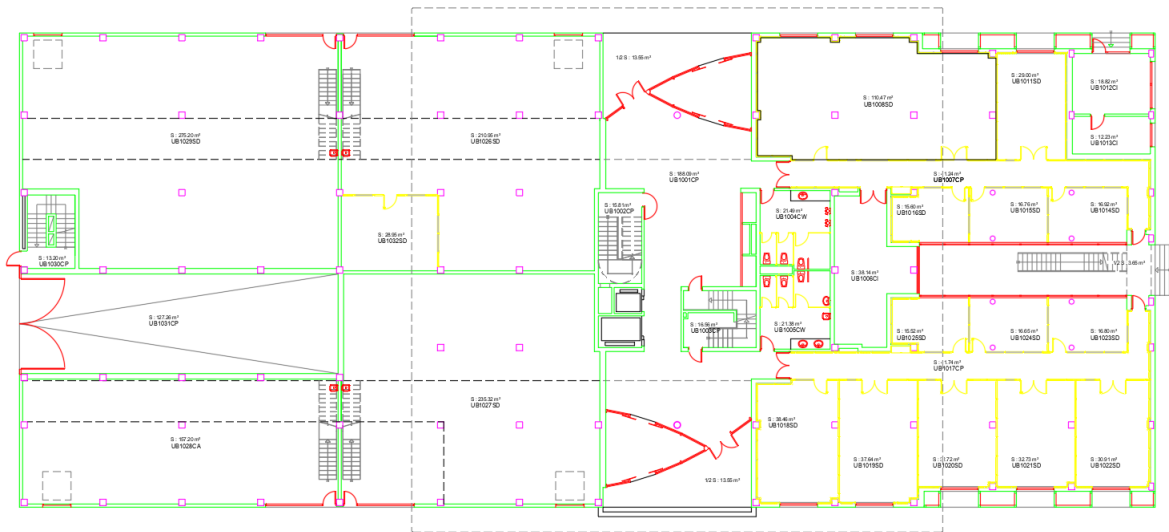

Figure A.1:

fig: Level 0
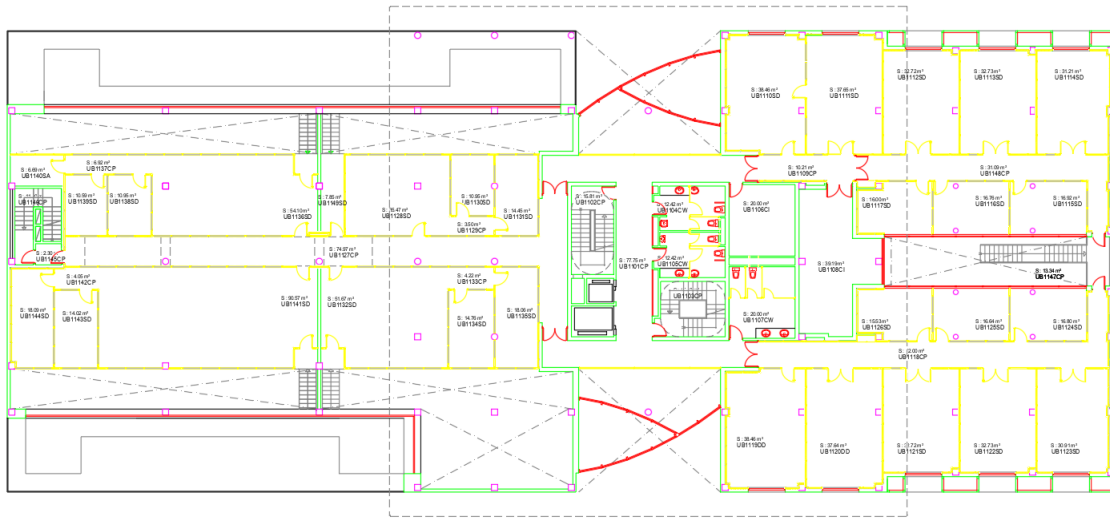
Figure A.2:

fig: Level 1

Figure A.3:

fig: Level 2

Figure A.4:

fig: Level 3
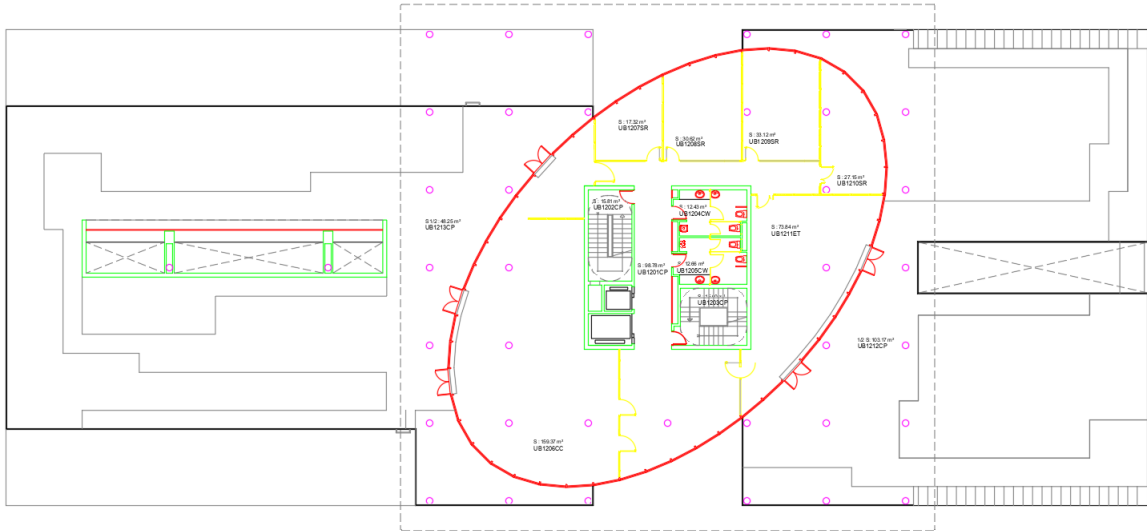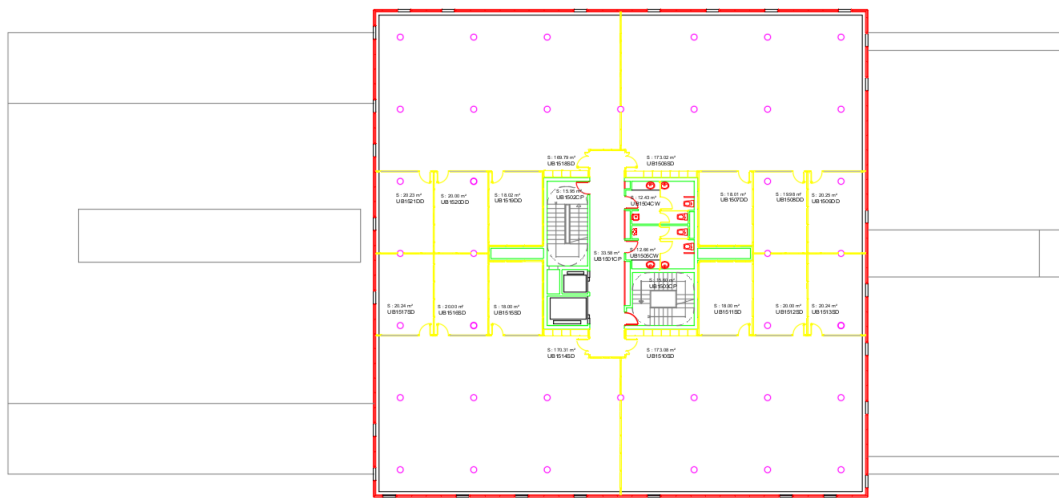

Figure A.5:

fig: Level 4

Figure A.6:

fig: Level 5

B.1 MainMenu.cs

```csharp
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class MainMenu : MonoBehaviour
{

    public void Explore()
    {
        SceneManager.LoadScene("Explore");
    }
    public void PlayGame()
    {

        ScoreSystem.theScore = 0;
        Timer.timeValue = 30;
        SceneManager.LoadScene("Countdown");
    }

    public void QuitGame()
    {
        Application.Quit();
```

```
24        }
25
26 }
```

B.2   PauseMenu.cs

```
 1 using System.Collections;
 2 using System.Collections.Generic;
 3 using UnityEngine;
 4 using UnityEngine.SceneManagement;
 5
 6 public class PauseMenu : MonoBehaviour
 7 {
 8     public static bool GameIsPaused = false;
 9
10     public GameObject pauseMenuUI;
11     void Start()
12     {
13         GameIsPaused = false;
14     }
15
16     // Update is called once per frame
17     void Update()
18     {
19         if (Input.GetKeyDown(KeyCode.P))
20         {
21             if (GameIsPaused)
22             {
23                 Resume();
24             } else
25             {
26
27                 Pause();
28             }
29         }
30     }
31
32     public void Resume()
33     {
34         Cursor.lockState = CursorLockMode.Locked;
35         pauseMenuUI.SetActive(false);
36         Time.timeScale = 1f;
```

```
37          GameIsPaused = false;
38      }
39
40      void Pause()
41      {
42          Cursor.lockState = CursorLockMode.None;
43          pauseMenuUI.SetActive(true);
44          Time.timeScale = 0f;
45          GameIsPaused = true;
46      }
47
48      public void LoadMenu()
49      {
50          Time.timeScale = 1f;
51          SceneManager.LoadScene("MainMenu");
52      }
53
54  }
```

B.3   WinMenu.cs

```
1   using System.Collections;
2   using System.Collections.Generic;
3   using UnityEngine;
4   using UnityEngine.SceneManagement;
5
6   public class WinMenu : MonoBehaviour
7   {
8       public GameObject winMenuUI;
9
10      // Update is called once per frame
11      void Update()
12      {
13          if (ScoreSystem.theScore == 2){
14              if (PauseMenu.GameIsPaused==false){
15                  Win();
16              }
17          }
18      }
19
20      void Win()
21      {
```

```
22        Cursor.lockState = CursorLockMode.None;
23        winMenuUI.SetActive(true);
24        Time.timeScale = 0f;
25        PauseMenu.GameIsPaused=true;
26    }
27
28    public void LoadMenu()
29    {
30        Time.timeScale = 1f;
31        SceneManager.LoadScene("MainMenu");
32    }
33
34 }
```

B.4   GameOverMenu.cs

```
1 using System.Collections;
2 using System.Collections.Generic;
3 using UnityEngine;
4 using UnityEngine.SceneManagement;
5
6 public class GameOverMenu : MonoBehaviour
7 {
8     public GameObject gameOverMenuUI;
9
10    // Update is called once per frame
11
12    void Update()
13    {
14        if (Timer.timeValue == 0){
15            if (PauseMenu.GameIsPaused==false){
16                Loose();
17            }
18        }
19    }
20    void Loose()
21    {
22        Cursor.lockState = CursorLockMode.None;
23        gameOverMenuUI.SetActive(true);
24        Time.timeScale = 0f;
25        PauseMenu.GameIsPaused=true;
26    }
```

```
27
28     public void LoadMenu()
29     {
30         Time.timeScale = 1f;
31         SceneManager.LoadScene("MainMenu");
32     }
33
34 }
```

B.5   SettingsMenu.cs

```
1 using System.Collections;
2 using System.Collections.Generic;
3 using UnityEngine;
4 using UnityEngine.Audio;
5
6 public class SettingsMenu : MonoBehaviour
7 {
8     public  AudioMixer audioMixer;
9
10    public void SetVolume (float volume)
11    {
12        audioMixer.SetFloat("volume", volume);
13    }
14
15 }
```

B.6   CameraLook.cs

```
1 using System.Collections;
2 using System.Collections.Generic;
3 using UnityEngine;
4
5 public class CameraLook : MonoBehaviour
6 {
7     public float mouseSensitivity = 80f;
8
9     public Transform playerBody;
10
11    float xRotation = 0;
12
```

```
13
14     void Start()
15     {
16
17     }
18
19     // Update is called once per frame
20     void Update()
21     {
22         float mouseX= Input.GetAxis("Mouse_X")* mouseSensitivity * Time.deltaTime;
23         float mouseY= Input.GetAxis("Mouse_Y")* mouseSensitivity * Time.deltaTime;
24
25         xRotation -= mouseY;
26         xRotation = Mathf.Clamp(xRotation,-90f,90);
27
28         transform.localRotation= Quaternion.Euler(xRotation,0f,0f);
29
30         playerBody.Rotate(Vector3.up*mouseX);
31
32     }
33 }
```

B.7   PlayerMove.cs

```
1 using System.Collections;
2 using System.Collections.Generic;
3 using UnityEngine;
4
5 public class PlayerMove : MonoBehaviour
6 {
7     public CharacterController controller;
8
9     public float speed = 10f;
10
11     public float gravity= -9.8f;
12     public float jumpHeight = 3;
13
14     public Transform groundCheck;
15     public float groundDistance= 0.3f;
16     public LayerMask groundMask;
17
18     Vector3 velocity;
```

```
19
20     bool isGrounded;
21
22     void Start()
23     {
24         Cursor.lockState = CursorLockMode.Locked;
25     }
26
27     // Update is called once per frame
28     void Update()
29     {
30         isGrounded = Physics.CheckSphere(groundCheck.position,groundDistance,groundMask);
31
32         if (isGrounded && velocity.y<0)
33         {
34             velocity.y = -2f;
35         }
36
37         float x = Input.GetAxis("Horizontal");
38         float z = Input.GetAxis("Vertical");
39
40         Vector3 move = transform.right * x + transform.forward * z;
41
42         controller.Move(move*speed*Time.deltaTime);
43
44         if (Input.GetButtonDown("Jump") && isGrounded)
45         {
46             velocity.y = Mathf.Sqrt(jumpHeight * -2 * gravity);
47
48         }
49
50         velocity.y += gravity * Time.deltaTime;
51
52         controller.Move(velocity*Time.deltaTime);
53
54     }
55 }
```

B.8 Timer.cs

```
1 using System.Collections;
2 using System.Collections.Generic;
```

```
3  using UnityEngine;
4  using UnityEngine.UI;
5
6  public class Timer : MonoBehaviour
7  {
8
9      public static float timeValue = 30;
10     public  Text timeText;
11
12     // Update is called once per frame
13     void Update()
14     {
15         if (timeValue > 0)
16         {
17             timeValue -= Time.deltaTime;
18         }
19         else
20         {
21             timeValue = 0;
22         }
23
24         DisplayTime(timeValue);
25     }
26
27     void DisplayTime(float timeToDisplay)
28     {
29         if (timeToDisplay < 0)
30         {
31             timeToDisplay = 0;
32         }
33         else if (timeToDisplay > 0)
34         {
35             timeToDisplay += 1;
36         }
37
38         float minutes = Mathf.FloorToInt(timeToDisplay / 60);
39         float seconds = Mathf.FloorToInt(timeToDisplay % 60);
40
41         timeText.text = string.Format("{0:00}:{1:00}", minutes, seconds);
42     }
43 }
```

B.9   ScoreSystem.cs

```csharp
1  using System.Collections;
2  using System.Collections.Generic;
3  using UnityEngine;
4  using UnityEngine.UI;
5
6  public class ScoreSystem : MonoBehaviour
7  {
8      public GameObject scoreText;
9      public static int theScore;
10
11     void Update()
12     {
13         scoreText.GetComponent<Text>().text = "SCORE: " + theScore + "/15";
14     }
15 }
```

B.10   CollectStar.cs

```csharp
1  using System.Collections;
2  using System.Collections.Generic;
3  using UnityEngine;
4
5  public class CollectStar : MonoBehaviour
6  {
7      public AudioSource collectSound;
8
9      void OnTriggerEnter(Collider other)
10     {
11         collectSound.Play();
12         ScoreSystem.theScore +=1;
13         Destroy(gameObject);
14     }
15 }
```

B.11   Rotate.cs

```csharp
1  using System.Collections;
2  using System.Collections.Generic;
3  using UnityEngine;
```

```
4
5  public class Rotate : MonoBehaviour
6  {
7      public float speed =2f;
8      // Start is called before the first frame update
9      void Start()
10     {
11
12     }
13
14     // Update is called once per frame
15     void Update()
16     {
17         transform.Rotate(new Vector3(0f, 0f, 1f));
18     }
19 }
```

LIST OF FIGURES