Creation of a mobile game about environmental sustainability

Final Report

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Contents

Abstract

This projects aims to find an application for current research about Serious Games for Education about environmental sustainability into a mobile game application.

Keywords: Serious Games, Sustainability, Environment, Mobile Games, Education, Games.

Acknowledgements

I want to thank my love, Paula, my family and all of my peers and playtesters that contributed to the poject in one way or another.

Special thanks to Guillermo Serrahina, Gerard Belenguer and, last but not leat, to my thesis supervisor, Antonio Chica for his guidance.

Chapter 1

Introduction

1.1 Report Scope

This document aims to provide a insightful description about the process of building a mobile videogame about environmental sustainability using Unity and a detailed explanation of two other approaches that the thesis authors found to be not adequate.

The report, though, does not aim to be a step-by step guide on how to build such a game, as it would prove very tedious and unproductive. It has been chosen to only provide insight on key gameplay elements and technical decisions that will enable future endeavours in this field to build a similar project or extend the current one with easiness.

1.2 Document structure

The document is divided into several chapters, and each one provides different information on the project based on its topic. Below, an explanation for what each chapter aims to tell can be found.

Introduction This chapter explains the investigation work done previous to the project's making, aswell as giving the reader context about how the report is structured and what it is about in detail.

Prototypes This chapter is about the prototyping phase of the project. It will read as a description of the three prototypes developed during this phase, as well as the reasons they were used or not as the final game.

Final game This chapter will dive into the details of the final game's design and its technical features. It will also feature a section in which the questions proposed for the player interviewing phase of the project are written down on.

Project management This chapter explains the methodology followed for developing the project, aswell as the sustainability aspect of this project.

Conclussions The last chapter wraps up and summarizes the work done, then goes off to explain the future work the thesis authon suggest can be done on top of this project, aswell as sharing the project's results with the reader.

1.3 Formulation of the problem

Environmental sustainability has been a key topic for the past few years. It has been demonstrated [Ins17] that our current level of consumption and, by consequence, resource-depletion has and is having a very harmful impact on planet Earth and its biosphere. Several measures are currently being taken [Age16] by corporations and governments alike, but our planet may be calling for a more fast and radical change in our way of perceiving nature.

This project aims to raise questions about our current relationship with nature and our way of understanding it. In our current world of fast and efficient communication, we can no longer trust on old ways of transmitting information [Moy10] for the ever-increasing technologically savvy population. The world of today calls for a new form of thought-provoking projects and manifestos, it is for this reason a mobile video game will be used for this endeavor.

1.4 Objectives of the project

The objectives of this project are

- Study current teaching methods for educating people about environmental sustainability.
- Compare and choose the method that can be best transformed into a mobile gaming experience.
- Implement the method as a mobile game.
- Analyze its impact on players by a face-to-face post-play interview.

1.5 Context

The project is developed having in mind the existence of the Serious Games movement, that is, the movement of game developers creating games that aim to not (exclusively) entertain the player, but rather make them obtain an extrinsic reward through their game-playing experience.

Some examples of serious games are flight simulators, medical surgery practice games or the Animal Equality virtual slaughterhouse experience. [1]

[1] http://ianimal360.com/

This project is a game and it is being developed under the category of a Serious Game and bibliography about them will be cited thorough the length of the thesis.

1.6 Analysis of scope

1.6.1 Scope

The project will mainly consist of three separate phases of development. As this work will follow agile principles, each phase will consist of short sprints of condensed work, and the general flow of the project may not be entirely linear. For example, After interviewing some players, the Developer might detect a design problem in the game, and they will go back to phase 2 for solving the problem.

Prototype development

Based on current research, Various prototypes for the final game will be developed. During this phase player feedback and rapid iteration will be key for sorting out non-working prototypes and for finding the best candidate for the next phase.

Final game development

This phase will transform the best prototype out of all the ones developed in the previous section into a fully-fledged, ready to be distributed mobile game. During this phase, constant communication with the thesis supervisor and some Non-Governmental Organization (NGO)s interested in the project will be very important for bringing in ideas and weight out features to add to the final work.

Player interviewing

Once the final game is tested and ready to be deployed, this phase will begin. Through collaboration with other NGOs, a series of player interviews will be done. Conclusions about the effectiveness of the game for transmitting the ideas laid out by the project's objectives.

1.6.2 Risks

The risks are of different nature depending on which phase of the project we focus our attention on.

On the first phase, there exists the risk of not having developed prototypes of adequate quality or that don't reflect the research they were inspired from. To help minimize the possibility of this happening, several interviews with the thesis supervisor will be scheduled during this phase reporting the initial prototype proposals to them.

During the second phase, there exists a risk of developing a skewed final version of the first prototype that does not meet the required standards for the next phase or for distribution. A close observation of the development by the thesis supervisor and the use of an adequate project management methodology will help mitigate this risk.

During the third phase, it can happen that a shortage of time keeps the interviews from developing in a satisfactory manner. An adequate allocation of time will be sufficient to eliminate the risk. Another threat to consider is the fact that there may be errors in the source code that stretch out development time. To control this, thorough tests will be conducted during the development phase to help ensure the final game is shipped without serious errors in the source code.

1.6.3 Methodology and rigor

The project development methodology that bests suits all the project's phases is Scrum. Scrum, a methodology based on Agile ideas of development, will help obtain a good communication between the thesis supervisor and the developer.

Scrum is an iterative framework for managing product development. A key principle of Scrum is the recognition that customers will change their minds about what they want or need and that there will be unpredictable challenges for which a planned approach is not suited. As such, Scrum accepts that the problem cannot be fully understood or defined up front, and instead focusing on responding to emerging requirements.

Scrum can be used for coordinating research work, developing software or even plan weddings . It is because its flexibility and its focus on iteration and rapid prototyping that this methodology suits the project the best.

1.6.4 Project management tools

Several management tools will be used for this project. Below are described the principal ones.

Trello Trello is an organization tool. It mimics the Scrum board philosophy, and offers the user a virtual version of a board and post-it notes so often used when working with this framework.

Unity Collaborate A git-based version control service built into Unity.

Google Calendar Google's virtual calendar, useful for integrating with Trello and other services and to handle deadlines.

Slack A Slack group will be used for beta testers to post their bug reports and other feedback regarding the final game.

1.6.5 Monitoring

There will be a regular entry posting to the development log in itch.io[2], as a way for writing down findings or problems occurred during development and informing the thesis supervisor and beta testers of the project's development progress.

With this and the other collaboration tools, an adequate monitoring of the project is ensued.

1.7 State of the art

1.7.1 Stakeholders

Researcher and Developer

Those two functions are to be done by the thesis author.

The functions of the researcher during the project will be:

- Understanding the problem the project is trying to solve.
- Search for information.
- From a large stock of information, obtain the most relevant bits and extract the information in them.
- From the most relevant information, find a solution to the original problem by examining it and creating an implementation specification.

The functions of the developer during the project will be:

- Understanding the researcher's specification of the implementation.

[2] wextia.itch.io/rewild/devlog

- Work on the implementation following the specifications laid out by the researcher until the project is finished.
- Send biweekly reports and a development build to the thesis supervisor during the project development.
- Send development builds to the testers during development.
- Correct bugs and adjust the implementation based on the feedback received from the testers and thesis supervisor.

Testers

Testers will mainly be the colleagues and classmates of the the thesis author and various other people that the author consider appropriate for this role.

Testers will:

- Play several minutes of the development build the developer has previously sent them.
- Send feedback and bug reports to the developer based on the gaming experience.

Thesis supervisor

The thesis supervisor for this project will be Professor Antonio Chica Calaf.

The functions of thesis supervisor during development will be:

- Oversee and control the project deadline
- Make sure the objectives are completed
- Help and give feedback to the thesis author during the length of this project.

Activists and NGOs

Independent environmental activists and NGOs may be interested in this project's conclusions, as those can be used as a tool for activism and/or for gaining reach and support.

Target audience

The target audience for this game will be people with a capacity for understanding the dynamics of natural resources exploitation and the implications in the environment - and also has a smartphone.

This population segment will consist of a subset of mobile game consumers that pass the age of 8, as this age has been demonstrated [DH09] to be enough to grasp concepts as abstract as the one previously mentioned.

1.7.2 Research on the subject

There are numerous papers that work on the subject of serious games about education for sustainability. The majority of the work on this field relies on more traditional gaming experiences, such as board games or role playing experiences in the classroom or via interviews with real life stakeholders.

During the course of the research process, several games have been analyzed and will be briebly explained further below.

From UNESCO's guide on simulation and gaming for environmental education [Tay83]

Spring green motorway It is a roleplaying game about the building of a motorway through a village and its outcomes on all stakeholders. It is thought of as a classroom experience, with each student getting the role of a different stakeholder in a sutuation of conflict regarding the building of

a highway that runs through the middle of a once quiet and pacific english village.

The houses game On a A4 sheet of paper, students must stick some previously built paper houses to it following a certain criteria. The game aims to teach students about the implications of urban planning and pushes them to understand new criteria and ways to understand city layout design.

The poverty game It is a card game about poverty and disease and how they relate to farming practices and the environment. The players take the role of an Central African village and have to plan ahead the various inconveniences that may arise during the season.

Caribbean fisherman This is a game about understanding the issues with exploiting the environment and the problems it causes to workers and their families alike. This game in particular focuses on fishing in a caribbean island.

From Sage Publishing's Simulation and Gaming special issue on Climate Change

In this issue of Simulation and Gaming, connections between climate change education and simulation, gaming and debriefing are drawn.

The issue highlight the importancy and effectiveness of raising awareness about Climate Change (CC) via gaiming experiences.

The following paragraphs will consits of the game's title and a citation to the paper it was originally developed in. Then, a brief description of its focuses and teaching methods will be provided.

A Simulation of International Climate Regime Formation [KA13] Present a classroom simulation that specifically addresses the international relations dimension of global warming.

Keep Cool [Eis13] Integrates issues of GreenHouse Gas (GHG) mitigation, climate-change adaptation, and global politics.

Greenify [LCJCS13] Game that uses social networks to promote actions against climate change.

A Perspective-Based Simulation Game to Explore Future Pathways of a Water-Society System Under Climate Change [VvdBO+13] The case study is water management in the Netherlands under future climatic conditions. The game dynamically maps the involved actors' norms and beliefs relative to water management within a scenario exercise.

It is about conflicting points of view and is played with field professionals.

Land Policies for Climate-Change Adaptation in West Africa: A Multilevel, Companion-Modeling Approach [DB13] The game presents another local-level adaptation study in West Africa.

If Local Weather Was Our Only Indicator: Modeling Length of Time to Majority Belief in Climate Change [SWR13] Focuses on the perception of climate change. The long-term, gradual process of climate change is difficult to apprehend for both individuals and communities because local, fast-fluctuating weather patterns vary from year to year.

Integrating Climate-Change Mechanics Into a Common-Pool Resource Game [FKK13] This paper reflects on the challenges in the design of climate-change games.

From Sage Publishing's Simulation and Gaming issue on Natural Resource Management

The following games' investigation focus is natural resource management.

Each game focuses on one or more resources and simulates one or more in game stakeholders that have special interests on the resources being focused upon.

The following paragraphs will consits of the game's title and a citation to the paper it was originally developed in. Then, a brief description of its focuses and teaching methods will be provided.

SHRUB BATTLE [DM07] Shrub battle is a game about understanding the development of vegetation in rural areas, and how its development may affect the landscape and, in turn, the touristic interest of the region, all while having in mind the necessities of local farmers and ranchers.

KARKONOSZE [KKM+07] This game explores the conflict over the exploitation of the Karkonosze mountains in Poland. The skiing industry is rapidly taking over the natural resources the mountains produce for its own benefit. This is a game about balancing nature conservation efforts versus economic development in the region.

Microworld gaming of a local agricultural production chain in Poland [MMS+07] This game explores sustainable farming and Ecoagriculture.

BUTORSTAR [MLE+07] Butorstar explores the complexity of the Wetland ecosystem and its conservation by focusing on the principal stakeholders that benefit from it. From herder to scientists, the wetland is a very valuable ecosystem that affects animal welfare and the livelyhoods of many people.

VPA-KERALA [WE07] In this paper, a game was developed to explore the topic of the management of coastal zones.

The authors use video-filming techniques to create an interactive educational tool, a Visual Problem Appraisal (VPA) on integrated coastal zone management in Kerala, southern India.

First, students are given a fictional mission and initial knowledge of the context by watching a documentary. Then they get the opportunity to perform "virtual interviews" with local stakeholders based on audiovisual material. Finally, they explore the use of VPA directly with stakeholders and they discover that the mere projection of these filmed interviews succeeds in enhancing social learning and collective management principles.

From other papers

ATOLLGAME [DPJ+06] A game about managing freshwater lenses, that is, water reserves built up by rainfall below tropical islands, accessible through a well. This lenses provide its own set of challenges when managing them, as their overexploitation may lead to saltwater entering the wells because of the wet limestone the lenses are found on top of. The game simulates the relations between landowners, public officers and other stakeholders.

RIVER BASIN GAME [LSY04] A River basin management game, where the water is simulated using marbles and a board on a slope to represent the river basin. Players use small sticks to derive marbles for their own use just like irrigators would do.

On the basis of several experiments in Africa, the authors discuss the ability of this simulation game to generate new ways to efficiently manage this resource.

PIEPLUE [BLP07] Pieplue is about river basin management. It's a game that combines the use of the Non-Governmental Organization (NGO) and computerized simulation, as it facilitates the exploration of a large range of time scales, the thesis authors explain.

The authors designed a test bed that makes explicit the diversity of interactions among water users. It also provides an opportunity to establish a debate on water sharing amidst overall water use.

This game aim to explore the relationship between farmers and the water in river basins.

DUBES, MÉÉRVISTIE, and others [BvD07] A series of games about policy development. Players may take upon the roles of stakeholders, clients, analysts and much more to explore the relations of changing policies to a large ammount of natural resources.

Propose a six-dimension typology of functions associated with games in policy-oriented contexts.

JOGOMAN [CJD07] A game about water management in peri-urban areas. Players will explore the various dynamics in urban development regarding to land and water usage by taking upon the roles of various stakeholders. Architects, enterpreneurs, public officers and tennants will have cooperate to find sustainable solutions to their needs.

The authors point out that games provide a useful learning environment to construct and share understanding about concepts, procedures, and behavioral patterns.

FISHBANK-ILE [QUSM97] A game about fisheries management and its delicate dependance on the natural resources it depends on.

The author uses traditional experimental economics to simulate the problem and proposes a formal approach to evaluate the benefit of a debriefing session after a gaming experience.

In this paper, the authors deemed noteworthy that players who benefited from knowledge exchanges tended to perform better than those relying on their own judgment.

Surfing global change [Aha06] This game allows one to walk through the complex argumentative landscape along changing roles and to identify societal consensus.

Water Wars [Hir10] Game about water distribution in New Mexico.

MAE SALAEP [BPTB07] In its paper, the authors describe a series of simulation games involving members of a community in Northern Thailand. The paper's authors have developed a sequence of three different simulation games representing the same area.

Each one of them deals with a specific issue brought up during the previous gaming session.

The benefit of this iterative approach is to allow stakeholders to deepen their understanding of the dynamics of natural resource management while, at the same time, refining what aspect of it is more important to them.

This games focus in watershed management. They provides a context to simulate water and land management in watersheds and how farmers and other stakeholders are affected by it.

1.7.3 Video games on the market

A variety of videogames have explored the subject of environmental sustainability.

Below there can be found a brief explanation of the basic mechanics of some videogames.

Mobile games

Several games in the mobile market loosely follow the tone of this project, based on a keyword search on the Android Play Store, we can extract a collection of games that are valuable to get inspiration from based on the project's objectives.

Although a lot more games have been downloaded and played by the Researcher, only a handful have been found to be related with the project's objectives. Below it can be found a list of those games with an analysis of it in the context of the project.

Pixel Farm Farming simulator game played in portrait mode with a pixel art aesthetic. Some mechanics about planting and harvesting seem interesting.

My Oasis Zen game about growing a garden in your mobile device. It is a clicker game with low-poly 3D graphics. The player experiment a bonding experience with their tiny simulation, and can be a viable way to communicate with them.

Dont Starve It is a survival game about resisting the harshness of nature and various monster attacks. Some mechanics like exploration and the dynamics of creature Non-Playable Characters (NPCs) might be useful for the project.

Animal Crossing Pocket Camp A simplified version of the original Animal Crossing series for mobile devices. An industry giant with a very high ammount of polish. The general tone of the game generally is harmonious with nature, and its mechanics can be used to convey a sense of connection with nature

Desertopia An idle clicker game that consists of watering a desert to help nature in it sprout again. The general idea behind it aligns nicely with the objectives of the project and some ideas and mechanics could be used for it.

Pocket Plants A garden simulator game with a cartoon-y art style. Some of its mechanics and tone might be useful for gaming experiences oriented towards children.

Greening 2 An idle game about terraforming tiny planets by absorbing water and several other elements from asteroids and using them to fertilize the planet's soil. Very in depth with its mechanics and achievments, might be worthy to further explore for implementing a late game progression system.

Phone Story Phone Story is a game for smartphone devices that attempts to provoke a critical reflection on its own technological platform.

Other platforms

Eco Online MMO about crafting resources and coordinating to help save the planet from climate crysis.

Climate Game Climate Game is an interactive online game that sets you on a quest to settle on an uninhabited island covered by green trees and thick forests.

SimPachamama SimPachamama is an agent-based game to reduce deforestation and make policy maintaining happy and developed society without biodegradation.

McDonald's Game Players indulge themselves in the complex process of managing a supply chain in the food-focused corporation like McDonald's.

Cities: Skylines Cities: Skylines is an interesting computer simulation game focusing on city building and management.

1.7.4 Game Engines

Different Game Engines were considered for developing this project. Amongst all possible solutions, the Unity game engine was chosen for this project.

The reasons for this choice are the flexibility and extensibility of the engine, the affordable price for personal use (Free until the project receives 100 thousand dollars in funding or revenue) and its powerful capabilities for multi platform development.

1.7.5 Conclusions

Despite extensive research in the subject, it is evident that not much of it has been applied to mobile gaming experiences. The project will be developed with one of the most popular and well-tested Game Engines in the market, and having in mind various mobile video games that are somewhat related to the project's objectives. All of this is done in order to ensure that the idea and the implementation of it on a mobile device is executed having in mind all the possibilities, both from the point of view of academic research and of mobile player-game interaction for obtaining interesting and applicable results.

Chapter 2

Prototypes

2.1 First prototype

It was intended to be a game about Landscape management, much like SHRUB BATTLE [DM07]. A social component for the game was also outlined.

Gathering inspiration from GREENIFY [LCJCS13], it was thought that a social component for the game would greatly benefit the overall impact it had amongst several players. A mechanic where, upon completing certain milestones, the player would be prompted with a screen asking for them to share a screenshot of their "garden" to social media. This mechanic would create a competition behaviour amongst the player's connections, thus increasing the likelyhood of other players to download, play, and learn from the game through competition.

2.1.1 Idea

The idea for the first prototype was basically managing a natural environment by extending flora and fauna through it. The players would "own"

a garden they could fill with several types of plants, those plants providing more resources for the player once planted. When a certain ammount of time would pass, fauna would emerge from groups of plants and will reward the player for caring for them.

The player would learn plantation dynamics, and how certain plants influence certain behaviours through gameplay.

2.1.2 Mechanics

The player would move around their garden via an avatar they could interact with by tapping and swiping with their fingers through the screen. In figure 2.1 we can observe the initial state of the game.

The players can also buy plants from the shop screen, as seen in figure 2.2. Once a plant has been bought, they can access their inventory (Figure 2.3) to choose which plant to place down (Figure 2.4).

Once a plant has been planted, the players must wait for it to grow (Figure 2.5). One grown, it gives players a reward 2.6).

Using this basic loop, players could build up interestingly-looking and complex gardens, and share them amongst their firends.

2.1.3 Teaching methods

This prototype was intended to teach respect for nature through its awe-inducing beauty and equilibrium. No direct method of teaching was going to be used, nor the player would be faced with "greener" alternatives to its actions.

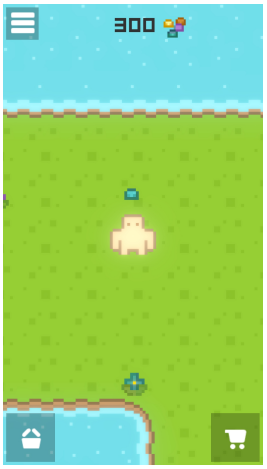


Figure 2.1: The player (center) surrounded by an empty "garden"

Figure 2.2: The shop window

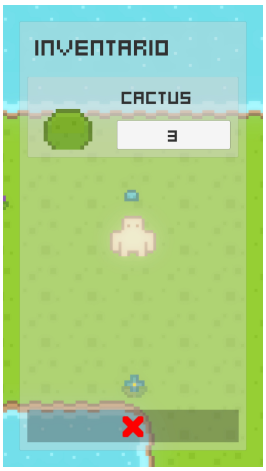


Figure 2.3: The inventory window. The window shows the plants owned by the player

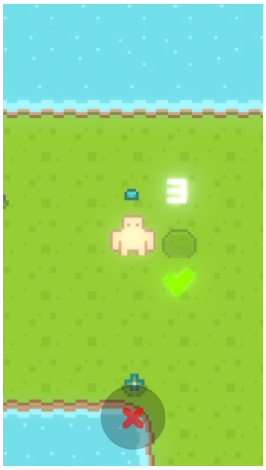


Figure 2.4: The player choosing wether to place the plant. The number above the plant shows the ammount bought. A confirmation button can be found below the plant. When the player presses it, the plant is placed.

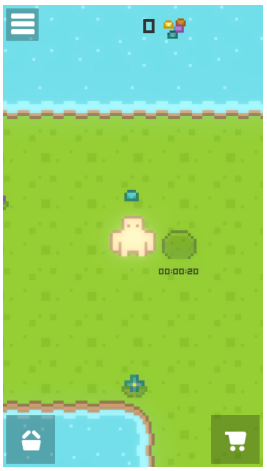


Figure 2.5: A placed plant. The number shown below is the time left until the plant is grown.

Figure 2.6: A placed plant. The number shown above it is the reward amount added to the player's resource pool

2.1.4 Conclusions

The idea was cancelled after building the prototype, as its mechanics were considered too sublte to make effective teaching through it. The players may had understood the underlying idea of the beauty in nature, but the connection between their actions and its impact on it would be lost.

2.2 Second prototype

The idea begind the second prototype was one of cooperation and social dynamics behind product consumption and natural resource management. It consisted of controlling several stakeholders inside the videogame to learn about how each one's decisions impacted the entire chain of relations they had one to another.

It was inspired by KARKONOSZE [KKM+07] because of its approach to understand natural resource management as a multi-process endeavour, and by MAE SALAEP [BPTB07], as the prototype also relied on findings brought up during a previous gaming session to reconsider its players approach to the problem.

2.2.1 Idea

The main idea for this prototype was to explore the production chain through the lenses of various stakeholders in a fantasy setting. This fantasy setting would be an island with a serious goblin infestation.

The players would need to take action upon this problem by providing solutions to it. Players would take the role of various stakeholders during the process of ending the plage, finding the links between their actions and the repercusions of them on the production chain.

Two forms of gameplay would have been drawn depending on their long term environmental sustainability.

The unsustainable one would have been offered to the player as a first contact with the game, the sustainable one being unlocked once the unsustainable one is completed, as a way of providing the player with a contrasted version of what actions have they used on their first run as opposed as to the second one.

There would have been three stakeholders the player could control in this game:

Adventurer The Adventurer helps control the population of goblins in the area.

Shopkeeper The Shopkeeper buys and sells various items to and from the Adventurer and the Farmer. It also produces refined items.

Farmer Sows and harvests the land. Produces raw items from it.

Each one of them would perform different actions wether the game is trying to make the player choose the unsustanable path or the sustanable one.

Game objectives: Unsustainable path The adventurer has to eliminate all goblins on the island because they attack the population. Once the goblin population dies out, the island would be safe, but the ecosystem would suffer greatly.

Game objectives: Sustainable path The adventurer has to plant plenty of trees to help the forest grow again and keep goblins from attacking the

village. This means that the goblins get to live in peace, and the island retains its ecosystem health.

2.2.2 Mechanics

The game flow and the mechanics vary greatly depending if the player is playing through the sustainable path or the unsustainable one.

Game loop: Unsustainable path

The main focus of this path, as said previously, is for the Adventurer to kill goblins. Each battle depletes the Adventurer's health, so she has to fill it up with Health potions.

Health potions are made from Salamandertail, a ficticious ingredient harvested from Salamanders. Each time an adventurer buys a health potion, then, the whole process of obtaining it is reinforced.

Salamanders need to be fed Palmroot, a ficticious plant.

In this path, though, the names of the stakeholders are changed. The Shopkeeper, given that she produces magical potions, is the Magician. The Farmer, given that she gathers resources from animals, is the Rancher.

Adventurer

1. The Adventurer kills Goblins.
2. The Adventurer levels up if experience is enough.
3. Goblins drop Gold.
4. The Adventurer buys Health Potions from the Magician.
5. The Adventurer uses Health Potions to tend his wounds.

6. Go to 1 if the number of killed Goblins is < 100.

7. The Adventurer has exterminated all goblins, the game is over.

Magician

1. Buys Salamandertail from Rancher.

2. Brews Health Potion from Salamandertail.

3. Sells Health Potion to the Adventurer.

Rancher

1. Plants Palmroot.

2. Buys Salamander Eggs.

3. Waits for the eggs to hatch.

4. Waits for Palmroot to grow.

5. Harvests Palmroot.

6. Feeds Palmroot to Salamanders.

7. Harvests Salamandertail from Salamanders.

8. Sells Salamandertail to Shopkeeper.

This path accelerates the deforestation of the island, and drives the goblins further into the town, fact that causes the Adventurer to be increasingly more brutal taking them down. goblins, in turn, get angrier at humans.

The path culminates with the destruction of the island's ecosystem, then, the game asks its players if they are interested in other kind of approach to the problem.

Game loop: Sustainable path

The main objective of this path is to control the goblin population using non-violent tactics while rebuilding their natural ecosystem.

As a ways of controlling the population, the Adventurer must feed Goblincake, a ficticious meal, to captured goblins before releasing them back to nature. Goblins who are fed will take longer to attack the town again.

Goblincake is baked from Goblinfruit, a fictitious fruit the Farmer produces.

It is the job of the Farmer to win the game this time, as it's her duty to plant trees in her lot of land.

In this path, the Adventurer, given that her job is one of a more pacifist kind, is dubbed the Ranger, and the Shopkeeper becomes the humble Cleric, now selling hand-crafted pies to the Ranger.

Ranger

1. Buys Goblincake from Cleric
2. Captures Goblins.
3. Feeds captive Goblins with Goblincake.
4. Releases Goblins to the wild again.
5. Goblins drop Gold.

Cleric

1. Buys Goblinfruit from Farmer.
2. Bakes Goblincake from Goblinfruit.
3. Sells Goblincake to the Ranger.

4. Buys Treeseed from Farmer.

5. Makes Treesprout from Treeseed.

6. Sells Treesprout to the Ranger.

Farmer

1. Plants Goblinfruit.

2. Collects Goblinfruit.

3. Sells Goblinfruit to Shopkeeper.

4. Collects Treeseed from trees.

5. Sells Treeseed to Shopkeeper.

6. Buys Treesprout from Shopkeeper.

7. Plants more trees.

8. Go to 1 if the number of planted trees is < 100.

9. Game won, Goblins will stop attacking the village because the forest is restored.

This approach helps reduce the conflict and harm between humans and goblins, an also helps convey the idea that wild animal "infestations" are a man-made problem that calls for a efficient solution that attacks the root of the problem.

The path finishes when enough trees are planted back, and the goblins now have enough land to roam free.

2.2.3 Teaching methods

The game would teach players about social dynamics and consumer responsibility through its mechanics. The metaphor of this prototype calls for taking a deep look onto society's already established loops and reflect upon how, as consumers, interact with them.

2.2.4 Conclusions

The prototype was considered unadequate at the end of the designing phase, considered too complicated and its design too rigid to organically convey this project's objectives.

2.3 Thrid prototype

The design behind the third prototype was about managing a whole community and seeing the effects of human consumption from an eagle-view perspective. The player had to manage an entire town by building certain structures to keep productivity up, as more and more villagers enter the town.

It gathers inpiration from The Houses Game [Tay83], as the main mechanic is about space management, DUBES and others [BvD07], because of their focus on policy development, and MAE SALAEP [BPTB07] because of its approach of dealing with chains of issues.

It strove to teach the player about how industries arise from individual needs and how the former can greatly impact the natural resources in the area.

This prototype was chosen to become the final game because it was thought to be an interesting challenge and a useful learning device for the

players.

This section will not be expanded further, as in chapter 3 there will be a more in-depth explanation of it.

Chapter 3

Final game

3.1 Introduction

The thesis for the final game is about animal agriculture and its impact on planet earth. Animal agriculture is one of the biggest contributors to GHG emissions and climate change [GSH+13].

Because this issue is widespread and easy to mitigate (consume more plant based options that replace meat in some meals, replacing dairy with plant based drinks, etc.) it was decided to be the main focus of the final game and the project.

3.1.1 Idea

Summary

The final game is about managing a small islander town by building the right structures in the right spots. It is a game about minimizing commute times as much as optimizing space for letting the industries operating in the community the space they will need.

Specifically, the final game will simulate two industries: the meat industry

and the tofu industry. The player will be able to assest which one of them is more space-intensive and which one is not.

The meat industry will yield lower ammounts of food for the same space needed for the tofu industry to yield more. Because of this design decision it is hoped that the player will understand the ecological benefits of reducing and/or replacing meat in meals.

In depth

The game is a town management simulator, with inspiration from other games like Dwarf Fortress [1], Oxygen Not Included [2], and Rimworld [3], .

Story The main objective of the game is to finish all missions. The missions involve building new buildings, surviving a certain ammount of days, etc.

The first missions revolve around setting up the basic town structure: building homes, farms and ovens to produce bread, the first and most basic edible in the game. The villagers will hold onto this diet until the villagers start eating meat.

The missions become increasingly challenging as time goes on, up until the player gets to the point where the players gets a special mission, in which they are notified that their villagers no longer eat meat.

When the game reaches this point, the players will find out that it is actually easier for them to feed their villagers a plant based diet, as it's more space efficient.

Some days after the last diet shift, the game will end and the player will be prompted with a survey to fill up.

[1] `http://www.bay12games.com/dwarves/`

[2] `https://www.klei.com/games/oxygen-not-included`

[3] `https://rimworldgame.com/`

Gameplay The players does not interfere directly in the islanders life (the town's inhabittants), they engage by placing orders for the villagers to execute. The orders are set by building new buildings that the villagers will engage with.

Buildings Each building, depending on its nature, creates certain orders that effect the town and its villagers differently.

Buildings have also a price for each of them. Money is obtained from the villagers each 3 days. Each villager adds between 25 and 45 resources to the resource pool.

Below there can be found a description of the buildings and its prices.

- **House** - A building where villagers can sleep. It costs 50 resources to build.
- **Warehouse** - Building that enables villager to store resources into. It costs 100 resources to build.
- **Dock** - Special building that makes possible new villagers coming to the town. It cannot be built.
- **Wheat farm** - A building that produces 1 wheat after a seed has been planted on it by a villager. It costs 25 resources to build.
- **Oven** - Building that transforms 1 wheat into 2 bread. It costs 75 resources to build.
- **Pig pen** - Building that transforms 50 wheat into 1 pig. It costs 100 resources to build.
- **Slaughterhouse** - Building that transforms 1 pig into 25 meat. It costs 120 resources to build.

Figure 3.1: The shop window

- **Soy farm** - A building that produces 1 soybean after a seed has been planted on it by a villager. It costs 25 resources to build.
- **Tofu fermenter** - Building that transforms 1 soybean into 1 tofu. It costs 75 resources to build.

Art The art for the final game has been freely obtained from kenney's assets [4]. They belong to the roguelike/RPG pack [5] and to the UI RPG expansion pack[6].

3.1.2 Mechanics

Players engage with the game by placing buildings. They can buy buildings (Figure 3.1), choose where to place them (Figures 3.2 and 3.3) and finally, placing them down (Figure 3.4).

[4] https://kenney.nl/
[5] https://kenney.nl/assets/roguelike-rpg-pack
[6] https://kenney.nl/assets/ui-pack-rpg-expansion

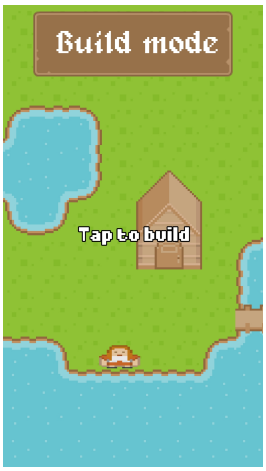


Figure 3.2: The player has to tap a part of the screen for the building to appear in

Figure 3.3: The player can choose where to build the building. In green, a "blueprint" is being shown to the player for them to know where it will end up in. Also, buttons have been added to move the building more precisely

Figure 3.4: After the player chooses the location, the building can be seen placed in the desired position

3.1.3 Teaching goals

The final game's aim is to teach the player the correlation between a community's eating behaviours and its impact on its sustainability.

As the game goes on, it becomes increasingly harder to feed all the communitie's population off their initial meat based diet. As the diet changes, the player will hopefully see the correlation between their community's diet change and the change in farmland demand.

3.2 Player interviewing

After the players completes the game, they will be prompted with a survey about their experience. This survey aims to provide insight as to what the players have obtained from the experience, and wether if they think about taking further action thanks to the knowledge obtained from it, aswell as gathering feedback about the technical quality of the game.

The questions have been deliberately kept short and few as to maximize

player engagement with it.

In section 3.2.1 all of the survey questionst can be read.

3.2.1 Survey questions

Game experience Questions related to gameplay and entertainment.

1. I hold my experience with the game to have been an entertaining one.
2. I noticed that the game was finished, complete and free of bugs.

Game premise ReWild is a game about the environment. In this case, we've chosen to focus on meat consumption and its harmful impact on the planet versus meat alternatives.

1. I understood the game's premise through its mechanics.
2. I think ReWild is a good metaphor for exploring the premise.

Reflections Questions about reflections that the game prompted upon the player's behaviours.

1. The game has made me reevaluate my relationship with nature and i'm considering taking action in response to it.

3.3 Technical features

In this section, the tecnical features implemented for the final game will be explained in detail.

3.3.1 Notification system

Notifications are sent between C# classes using a notification system. Classes can subscribe to an event and, when the event is triggered, all subscribed functions are called. This notification sistem is implemented with function pointers.

3.3.2 Town

The town is an entity that controls all the occurrences in the village. It holds references to each villager and building, aswell as to every resource that's on the ground.

Orders

The town manages all Orders that the villagers have to perform.

An order is composed of a location and a type, aswell as an auxiliary number to help keep track of resource ammounts the order manages.

Orders are stored on a `Queue` data structure.

As for references to other objects, they are stored in a generic `List` structure.

Time management

As to process the events as ingame days go on, a notification system is used.

A manager singleton class keeps track of time, and triggers a day change whenever the time for it is adequate.

When the class triggers a day change, all callbacks subscribed to this action type are triggered. This allows several classes to execute portions of their code whenever a day change is triggered although the time manager class does not "know" of their existance.

3.3.3 Map and Pathfinding

The Map is a simple Unity tilemap.

The tiles in this map are programmed in a way that change their aspect according to the number of neighbours of the same type as theirs have.

Pathfinding is done with the A* algorithm, and it operates over the tilmap.

The tilemap in of itself consists of various abstractions and to fully integrate it with the game and the pathfinding, several transformations have been executed.

The Unity Tilemap component is read by a `TilemapController` class, that provides a useful API for the `NodeMap` class to read from. The NodeMap is then encapsulated into a more useful `CellMapController` that contains `Cell`s, that in turn encapsulate the `Node`s of the previous class.

This layered approximation is done in order to not add overhead to the pathfinding algorithm (the algorithm works with `Node`s, more lean than its counterpart, the `Cell`) and helps the developers build on top the already existing Tilemap component by using the `TilemapController` class as a wrapper.

Pathfinding

The algorithm A* is a quite simple but relatively accurate and efficient way to find paths in a connected graph.

The connected graph, in this case, is our `NodeMap`, and its connectedness with neighbouring tiles depends on their colliders. If a tile in the `NodeMap` has a collider, its neighbouring tiles that do *not* hold a collider will be connected to it.

On the contrary, if a tile does not have a collider, all its neighbours that, like the previous one, do not have a collider, will be connected to it.

It could be useful for the reader to consider the presence or abscence of colliders as a sign about wether the tile that has or does not have the collider is walkable (does not have a collider) or it is not (it does have a collider).

Considering a tile to be walkable means that it will be navigable by our agent in this explanation of the A* algorithm.

The function for invoking the A* algorithm is given the starting node and the destination node.

An open set of nodes O is defined, containing the initial node.

At each iteration of tis main loop, the algorithm determines which of its initial paths to expand. It picks the node O that minimizes the f function, that function being

$f(n) = g(n) + h(n)$

With n being the node the calculation is being executed upon and h being the heuristic function that calculates the distance between n and the target node.

In this implementation of the algorithm, the distance between two adjacent non-diagonal nodes is 10, and the distance from a node to and adjacent one that lies diagonally adjacent to it is 14.

This approach is used in order to approximate the value of $\sqrt{2}$ by multiplying it by 10 and rounding it up. As the reader may already have intuited, the reason why $\sqrt{2}$ is used to calculate distances between two diagonal nodes is because if we interpret the nodes to be all 1 distance away from each other and to be squares of 1 unit times 1 unit for its sides, a distance of $\sqrt{2}$ is, effectively, the distance separating two adjacent diagonal nodes.

With this cleared up, we can continue on discussing the algorithm's implementation.

If the chosen node n happens to be the destination node, we simply report the path and end the algorithm.

If this is not the case, we add n to the closed set C and start iterating over its neighbours, i.e. the nodes adjacent to it.

If a neighbour m happens to not be in C, we add it to O.

If m happened to belong to O, we update its g and h cost and not add it to O again.

The new g cost will be the distance from n to m (the addition of all the nodes distances from the start to n plus the distance from n to m.

The new h cost will be the distance from m to the target node.

We delete n from O. If no more nodes exist in O, the algorithm has finished: no path has been found. On the contrary, the algorithm loops again.

3.3.4 Villager

Villagers operate following a set of rules stablished by their AI.

Villagers ask for orders to the Town as long as they don't have any unattended needs that need to be fullfilled.

Villagers break down those orders into several other phases, and then they approach each one of them differenty according to its type.

An other has three phases: Initialisation, Transportation, Completition.

More complex orders are actually given to villagers by joining several orders.

For example, for a villager to put a piece of wheat in the oven, the villager needs to first go to the warehouse and then to the oven. This is achieved by enqueuing the order to feed the oven at the completition phase of its predecessor.

Villagers use the pathfinding algorithm explained above to navigate the island through the tilemap.

3.3.5 Resources

In the final game are several resources. Resources are every object that can be dropped on the ground and picked up.

The town keep track of how many resources are stored in the warehouses at any given time.

3.3.6 Buildings and Factories

Buildings are all objects that are static and cannot be picked.

Factories are special buildings that, given a resource and enough time, they can transform it into another one.

3.3.7 Level Configuration

For tweaking each game's variables such as the seconds a day lasts or the villager's walking speed, a singleton class has been used. Its values can be controlled through Unity's Inspector, which makes it very easy to tweak.

3.3.8 Serialization

Serialization is done in order to keep player's progress stored across several play sessions.

Various data is being serialized in the game.

The map has to be serialized in order to not rebake the whole navigation on top of it each time the game is loaded.

All the buildings, factories and villagers's positions and types are serialized.

The ammount of resources stored in the town's warehouses is serialized aswell, as the number of days passed and several other metrics.

3.3.9 Translations

The final game con currently be played in two languages: Spanish and English.

The translations are stored in a .cvs file, and the games pick the text to be shown to the player according to the language the player selected.

3.3.10 Day/Night cycle

The game operates in daily cycles. Because of that, a system to help emulate a day and night cycle was developed to help the player get a better grasp of the passing of days with a visual feedback.

The way this is done is by altering the values of the PostProcessingStack's shaders that alter the final color composition of the image, turning it into a blue color when the night is upon the village, and reverting the image back to its inaltered state once daylight is again restored.

3.3.11 UI components

Several UI components have been developed for the game, the majority of them being simple UI elements found in Unity by default such as the Button or the ScrollField.

3.3.12 ReWild console

A language and a console to interpret it were developed to help on the game's prototyping phase.

The language is a very simple one, cansisting of natural language phrases to indicate a certain act to be performed in the game.

For example, a valid sentence in the ReWildConsole language would be:

```
build house 1 1
```

That means that a house must be built at the tile x = 1; y = 1.

3.4 Cut out features

Logger

The Logger was an utility that reported important happenings in the game world.

It worked in a way that text was shown on the bottom half of the screen, a line for each happening.

It was cut out of the final game because it occupied a lot of screen space and made having on-screen buttons very difficult.

Chapter 4

Project management

4.1 Temporal planning

4.1.1 Programme

The approximate length of the project is four months and three weeks, from February 19th until june 29th.

It is important to note that the duration of the project is approximated and that it can be affected by the chosen project management methodology and several other seatbacks.

4.1.2 Project phases

The project consists of several phases of development, each with their different parts.

Initial milestone

The phase this section belongs to. During this phase, several aspects of the project will be thought out to help a better and more effective development of the project, such as the project's sustainability rating, its scope, its budget,

etc. Work on this phase can begin as early as the requirements for it are laid out, because it does not depend on any other phase of the project to be finished.

Prototype development

This phase consists of three parts:

- Research
- Prototype development
- Prototype testing & final prototype choice

Each one of them being dependant on the one above it. Research can begin as early as wanted, as it does not depend on any other task.

Final game development

Once prototype development is finished, the final game's development can begin. It is necessary for a final prototype to be finished before further expansion of it.

The development of the final game from the final prototype will span for four entire weeks. It is a tight deadline, although a lot of code and work will be recycled from the prototype.

Player interviewing

Interviews will be done in one week. The first days will be destined to find players and the rest to actually do the interviews, either being in person or online. For this phase to begin, the final game has to be both finished and stable to ensue a correct development of this phase.

Final milestone

This phase is the last one of the project, and depends upon the finishing of both phase 4.1.2 and 4.1.2, as the final documentation cannot be written without those other phases concluding.

4.1.3 Schedule alterations

It is probable that some alterations have to be applied to the project's schedule. Given the use of an Agile methodology, deadline modifications are to be expected, although the use of short sprints can help the development to be adapted to run at a higher pace if falling behind schedule.

There is a variety of seatbacks that can happen during the project's development. It could happen that the researcher does not find a sufficient ammount of information or cannot extract the needed information from the scientific papers in time for the project to begin development. In this case, help will be needed from the thesis supervisor for gathering information and recommending investigation lines. If the research finally yields a poor result, the developer will not start until a needed minimum of theory is available to work with. This may hinder the quality of the final game, but because the development methodology used is incremental, it is sure that a playable game will be produced nontheless, although with a lesser number of the expected features.

Another problem that may happen is that the game development takes too long of a time to be developed, either because of several bugs in the code or because extensibilty issues. This risk is mitigated by the fact that a very particular coding architecture will be used: Application Model View Controller Component (AMVCC). This architecture is used to handle large and complex codebases in Unity. Also, using an Agile methodology will

greatly help overcome any issue with bugs and non-functioning code, as it offers great flexibility and adaptability to the development team.

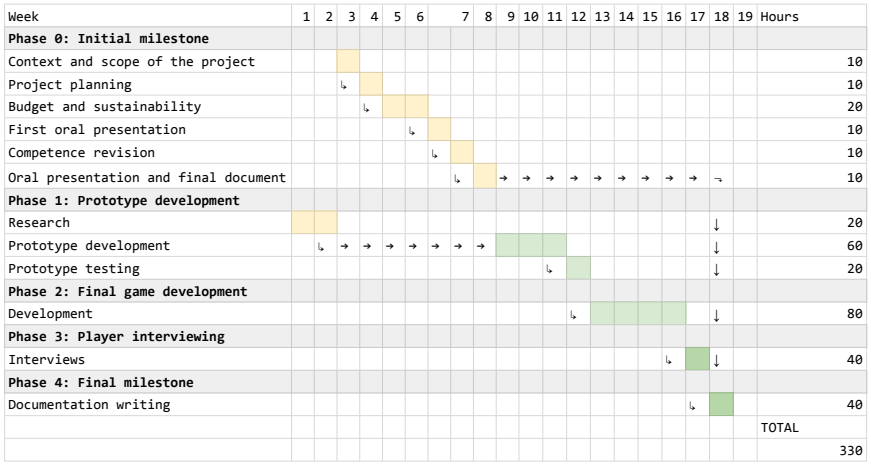
At the end of the project, a review will be made detailing to what extent the original plan has been followed thanks to the reports sent to the thesis supervisor.

4.1.4 Gantt diagram

Below there can be observed a Gantt diagram depicting the duration the previously mentioned phases (and of its corresponding parts).

On the leftmost column it can be observed the phases' name, and on the rightmost one the hours each one takes to be completed. The topmost row depicts the week of development the work will take place in. Arrows indicate task dependance.

The colors on the cells represent the intensity of the work given a current time and a task. Yellow indicates medium intensity, while green and dark green depict high and very high intensity.



4.1.5 Approximate duration

A condensed version of the information on the duration of each phase presented on the Gantt diagram can be observed in the table below:

Phase	**Hours**
Initial milestone	70
Prototype development	100
Final game development	80
Player interviewing	40
Final milestone	40
Total	330

4.1.6 Resources

Several tools and resources will be used through the duration of this project:

Hardware

The hardware used for this project will be:

- Smartphone OnePlus A5010 5T
- Laptop computer Lenovo NB ideapad 110-15ISK

Software

The software tools that'll be used will be, amongst others:

- Unity 3d
- LaTeX
- Trello
- Google Drive
- itch.io
- Ubuntu 16
- Windows 10
- Git / Github
- Android

4.2 Economical Management

In this chapter, a breakdown of the various costs the project will have is detailed. This chapter is divided in various sections where each of them explore the budget from a different angle.

This first proposal for a budged will later be revised at the end of the project with the aim of correcting any possible deviation from the original plan.

4.2.1 Human Resources

The budget for the various personnel working on the project. As the project evolves, the ammount of hours each professional works on the project may vary.

Role	**Hours**	**Hourly wage**	**Total**
Project Manager	70	50,00€	3500,00€
Researcher	60	35,00€	2100,00€
Software developer	140	20,00€	2800,00€
Interviewer	40	15,00€	600,00€
Quality Asssurance	40	20,00€	800,00€
Total			9800,00€

4.2.2 Hardware

The price of every piece of hardware used during the duration of the project and a calculus for the amortization [1] of each one.

Product	**Price**	**Useful life**	**Amortization**
OneOnePlus A5010 5T	559,00€	3 yrs.	69,88€
Lenovo NB ideapad 110-15ISK	609,59€	3 yrs.	45,72€
Total			115,59€

[1] Price for using those products during the project.

4.2.3 Software

The price for the subscriptions or for the full programs used for this project. The price detailed always corresponds to a comercial license, in case it is desired for the project to be distributed and charged for.

Product	**Price**	**Useful life**	**Amortization**
Unity 3d	125,00€	1 mo.	563,00€
Rider IDE	349,00€	1 yrs.	131,00€
Windows 10	145,00€	3 yrs.	[2]0,00€
Android SDK	0,00€	–	0,00€
iOS SDK	0,00€	–	0,00€
Total			693,00€

4.2.4 Licensing

Several other fees have to be payed in order to publish the final game on a mobile marketplace. Below it can be found the price for a developer license for both the Android and the iOS app stores.

Product	**Price**	**Useful life**	**Amortization**
Android developer license	25,00€	10 yrs.	1,00€
iOS Developer Program	75,68€	1 yrs.	28,38€
Total			29,38€

4.2.5 Indirect spending

Several other spendings will be taken into account, mainly in form of utilities and office material. This budget is approximated using various sources [3] [4].

[2]Included in laptop price

[3]https://comparadorluz.com/faq/precio-kwh-electricidad

[4]https://comparadorluz.com/faq/precio-kWh-gas-natural

Product	Price per unit	Units	Total
Electricity	0,12€/kWh	1050kWh	47,25€
Gas	0,05€/kWh	2000kWh	37,50€
Internet	65€/mo.	4,5 mos.	110,00€
Office material	32,50€	1	32,50€
Total			226,95€

4.2.6 Total budget

Once all sections are budgeted, a final budget can be drawn from all of them.

Concept	Price
Human Resources	9800,00€
Hardware	115,59€
Software	693,00€
Licensing	29,38€
Indirect spending	226,95€
Total	10865,25€

4.2.7 Conclusions

It is possible that budget deviations occur if any piece of hardware needs repairing or schedule alterations occur. Hardware reparations will be reflected on the final draft of the budget (if any). Schedule alterations, although likely, are not very prone to destabilize the entirety of the budget, given that the total ammount of hours spent on the project will not vary much.

It is important to have in mind that project is not aimed to generate revenue. The final game will be published as a free to play experience, and alternate sources of revenue will be explored to help mitigate the costs of the project. Contact with the goverment and several NGOs will be key to help boost the project's funding.

It is possible that, given the final product will be usable for education, public funding is a attainable.

4.3 Sustainability

Previous to the analysis on sustainability, it will be introduced an answer to the survey filled by the thesis author.

" I feel fairly confident about assessing wether a technological project is sustainable, in all of its aspects.

I am familiar with the techniques for developing a project in a sustainable manner and for identifying problems with an existing one.

I strongly feel that every project one participates on should strive for the benefit of society in one way or another as opposed to personal gain or enrichment.

As for the economical part, i feel that a project should generate revenue as a consequence for its positive impact on society and of its efficiency when dealing with the environment. Every endeavour should be initiated with only that in mind.

Collaborative work tools are very familiar to me, as i have used them extensively, and still do. I feel that collaboration tools have a great impact on how efficiently a project is developed, and i particulary admire their capabilities of bringing together teams of various ethnicities and culture backgrounds to the office through video-conferences via Internet.

As far as professional ethics go, i am familiarized with the Spanish IT professionals' ethics code [5] . I've read it and i apply it as much as i can on my dailiy work.

I am very concerned about sustainability in and out of my work, but as

[5] http://cpiiand.es/wordpress/download/CPIIA-Codigo_Deontologico-fCPIIA.pdf

a kind of collateral aspect to my personal ethics. I personally don't believe that, for example, respect for other people's ethnicity should occur because of the notion of "social sustainability", but because it is the *correct* way of treating people. I don't think we should respect nature because we *need* it, but because it is the *correct* way of treating it. Looking for sustainability in a project just means that it is wanted for the project to last a long time. I am more concerned about making ethical projects. I don't really care if they don't last a lot as long as they serve their purpose to its fullest. "

4.3.1 Economical area

The information for the economical area and its inpact on the project's sustainability rating is extracted from chapter 4.2.

4.3.2 Social area

Gaming and education have proven to be a difficult couple to pair. It has been demonstrated that simulations and videogames can vastly improve the learning experience of a person , but its full potential is far from being achieved. Currently, much of the education methods currently in use are branches of the British academic education method from the 18th century .

A project like this one may open the doors for a richer understanding of gaming as a key stone for learning in Spain, and as it will be distributed on worldwide markets, it could spread worldwide.

On a more realistic scale, the project aims to improve the people's ability to understand nature and sustainability, which yield a more cultured and informed group of people just for the sake of having played a game. The fact that people will get enjoyment out of this project as much as they will get an education is in itself a very positive impact the project will have if we look

at it from a social prespective.

As for the personal gain extracted from this project, it is expected that all the people invested in this project gain further understanding about nature and our relationship with it, and that they gain confidence in videogames as a useful tool for learning other than for entertainment only.

4.3.3 Environmental area

This project is centered around environmental sustainability. Its aims are to teach environmental sustainability and respect for nature using modern and effective techniques. Because of this, the final goal of the project is to make all players take into consideration their actions with nature in mind. This, in of itself, is very positive for the environmental sustainability of the project.

4.3.4 Conclusions

A table summarizing this project's scores on the sustainability matrix will be included below. It is important to note that it is incomplete, as as the project advances more of the matrix will be possible to fill.

	Economical area	**Social area**	**Environmental area**
Planning	7	9	10

As this project is not thought of to generate revenue, the economic area is rated lower than the other ones.

It would be possible, of course, to get funding from the local government of Catalonia or from the Spanish Minstry of Culture because of the positive impact the final game could have on the environment and the planet.

Another possible sources of income could be activists and NGOs because of their interests being aligned with the project's objectives.

Chapter 5

Conclussions

5.1 Work done

A working game has been built and published to the play store. The game has been built over the course of 5 months. It contains 172 C# scripts with over 8000 lines of code in total. A great effort has been made to ensure the game would meet the requred personal standards the thesis authors hold themselves worthy of.

Also, thanks to many playtersters and players, enough data has been gathered about the effectiveness of the game as a teaching tool.

The source code for the project can be found at `https://github.com/wextia/rewild/`.

5.2 Interviewing results

Over 20 individuals, ranging from the ages 18 to 27 have completed the survey. If we recall section 3.2, 5 questions were given out to the players to fill up. The results for this questions will be given now.

- I hold my experience with the game to have been an entertaining one.

- I noticed that the game was finished, complete and free of bugs.
- I understood the game's premise through its mechanics.
- I think ReWild is a good metaphor for exploring the premise.
- The game has made me reevaluate my relationship with nature and i'm considering taking action in response to it.

Players were asked to rate from 1 to 5, from a strong disagreement with the question's statement and to a strong agreement of it.

For question 1, the median is 3; and the mean 3.65. The answers are pretty scattered in this one. Several players have not had many fun with it, although a significant group of people rated it a 5. This may be beacause players are biased towards not expressing their honest thoughts to the thesis authors, despite the submission process being anonymous.

For question 2, the median is 2 and the mean is 2.33. There were known bugs to the developer at the beginning of the interviewing process, and this has impacted the quality of the game very negatively. Time constraints were a factor, and with a tight deadline polish was very hard to achieve. Nontheless, many players finished the game without encountering any game breaking bug and only noticing visual glitches.

For question 3, the median is 4 and the mean 4.35. This has been great news for the thesis authors, as it makes the project's objectives be reflected onto the game.

For question 4, the median is 4 and the mean 4.24. This only solidifies what has been already noted in question 3.

For question 5, the median is 3, and the mean is 3.32. This question has also had polarized results. Approximately 30% of the interviewed rated it 4 or higher, and roughly 40% 2 or lower. Nontheless, the authors are very

pleased with the results, as it highlights that as much as 30% of the players that played this game have understood its premise and want to take action on it.

5.3 Future work

Although the final game yielded pretty positive results, the thesis authors are certain about that some aspects of the game would benefit from more work put onto those.

To help polish the experience up, some extensions for the work have been proposed.

1. Adding more levels and variety to the game. This could be done in a way that enables players to experiment with other harmful behaviours a community may engage with the natural resources that benefits from, such as oil drilling, intensive farming, etc.

2. Adding sound effects would help players be more immersed in the experience.

3. Adding real data in game to show the players the cost of their actions. It would need to be done in a way that feels integrated with the game.

The mentioned extensions are thought to be a good starting point for future research on the subject.

Acronyms

AMVCC Application Model View Controller Component. 48, *Glossary:* AMVCC

CC Climate Change. 10

GHG GreenHouse Gas. 11, 32

NGO Non-Governmental Organization. 4, 5, 9, 54, 57

NPC Non-Playable Character. 16, *Glossary:* NPC

RPG Role Playing Game. 14

VPA Visual Problem Appraisal. 13

Glossary

clicker A type of game the principal mechanic of which is to repeatedly press a single button to add an specific amount of resources to the player. A great volume of mobile games are clicker games. 16, 17

collider Unity component that calculates collisions for an object. 40

goblin A fantastic humanoid creature with long, sharp ears and green skin, roughly the size of a human child. 24

idle A type of game where the player interaction is minimized and waiting often is the principal mechanic. 17

late game Phase of games that starts when the player has a firm grasp of the skills of the game and the majority of the content has been explored by them. 17

low-poly A 3D game art style based upon 3D models with a very reduced amount of triangles in them and a preference for not smoothing or hiding it. It is done to resemble the 90's style of 3D graphic rendering or just for obtaining a cleaner and more minimalistic feel to the game. 16

pixel art An art style for video games that aims to emulate the technical

boundaries that ancient 2D games possessed because of the limited resolutions of old displays. 16

portrait mode A way of playing mobile games. Games played in portrait mode are played with the phone in vertical position. 16

progression system The set of mechanics that control and define how the player can feel a sense of progression through their playing experience. The rewards a progression system offers to the player ofter are a new set of mechanics, permanent resource gains or new content for the player to explore. 17

serialization The process of transforming objects in memory to plain text, for achieving persistance. 43

singleton A class that only has one instance in the project, and that instance can be accessed in a static manner. 39, 43

survival game A type of game where the objective of the player is to survive -usually alone- in the wild. Survival games are characterized by their crafting mechanics and their focus on the fulfillment of the player's avatar basic needs. 16

tilemap A data structure that stores tiles (square sprites) that construct a map. 40

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