EcoFarmer

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Abstract

Agriculture is indispensable for humankind survival, however mankind is leaving the countryside towards urbanized areas, abandoning that most important activity. This thesis describes the serious game developed to portrait the agricultural scenery of Castro Verde region, teaching about the difficulties faced by the local farmers, how agriculture affects the steppe birds, and how the birds influence the local tourism. The game was also designed to be entertaining in order to be played, otherwise players would get bored and avoid playing it, making it impossible to transmit the knowledge to them.

Conclusions of the evaluation of this game showed that it was efficient in teaching about the agriculture impact on the steppe birds, and the difficulties the farmers face in order to get profit from their lands. Gamers have also found the game interesting despite it being an unfinished work which can be improved, by making it more appealing and fun.

**Keywords:** Serious Game, Agriculture, Castro Verde, Steppe Birds
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Chapter 1

Introduction

1.1 Motivation

Agriculture is indispensable for humankind survival considering it is one of its main providers of food. However rural areas are becoming desertified, since man is migrating towards urban areas, abandoning this most needed activity.

It is not only mankind that can profit from this activity, as the lands transformed by agricultural activities became the habitat of many species. For example, in Castro Verde, a region of Portugal, steppe birds need humans to plow the soil, so bushes are cut, and they can build their nests on the floor. Without farming, these birds will not breed on those bushed areas. However if the agriculture activity is too much exploited, their eggs might be smashed. Thus there must be a balance.

Agriculture is perceived by the majority of population as an outdated activity (Esporo, 2010), which does not give much profit or satisfaction in return (Silva, 2009). Nevertheless, there are many ways to improve a farm, making it more profitable and technologically advanced, increasing the farmer’s quality of life.

It is crucial to captivate people to return to the rural world and proceed farming activities. A video game that shows that managing a farm may have many interesting options, as well as profits, might be a good solution to make people’s interest in returning to the countryside and follow a career in agriculture or other activity. But it is also essential to teach the best practices, in order for them to get good harvests while preserving the biodiversity.

This thesis presents Ecofarmer, a serious game developed to portrait Castro Verde’s agricultural reality, teaching about the farmers’ difficulties, how the agriculture options affect the steppe birds.
and that these birds are important to the region.

1.2 Context

This thesis was made in collaboration with Liga para a Protecção da Natureza (LPN) project Rural Value. This project includes the development of a game which shows the agriculture benefits in Castro Verde region. While the developed game is not the projects “official” game, we tried to follow the same guidelines to simulate the economy of a farm in the region.

1.3 Objective

This thesis main goal is to develop a casual game that portraits Castro Verde’s agricultural reality, teaching about the farmers’ difficulties, how the agriculture options affect the steppe birds and that the birds are important to the region, since they attract birdwatchers. The game must also improve the players’ view on agriculture.

However, the game must not be boring, otherwise it would not be played. So it is important to study the characteristics of agriculture games that are attractive to the general public, and how to integrate them into a serious game, presenting agriculture as a modern and appealing activity.

To evaluate if the game fulfills these objectives, three main subjects must be analyzed:

- Determine if the user improves his perspective about agriculture.
- Analyze if the user learns how agriculture affects the steppe birds in Castro Verde.
- Determine if the game is fun and entertaining.

1.4 Contributions

This work has three major contributions to the:

- Analysis of the characteristics belonging to agricultural video games.
- Development of an agricultural serious game.
- Prove that the game improves significantly the players’ knowledge on how agriculture affects the steppe birds.
1.5 Document Organization

This document is divided in 5 chapters.

The current Chapter presents the motivation of this work as well its context, contributions and objective.

In chapter 2 the related work is presented. This chapter is composed by 4 sections. On section 2.1, entitled Serious Games, is described what a serious game is and some examples are given. Section 2.2, entitled Agriculture, analyzes and describes the agriculture in Castro Verde, businesses alternatives to do with a property and the ways agriculture affect the steppe birds. On section 2.3, entitled Other Agriculture Video Games, several agricultural video games are analyzed and compared, and also players profiles are described based on the DGD1 model.

Chapter 3 describes the game's architecture and implementation and it is composed by two sections, section 3.1 called Game Overview in which the high concept of the game is explained in two subsections, and section 3.2 named Solution in which is described the implementation of the several components.

Chapter 4 describes the evaluation of this project. It is composed by four sections, section 4.1 in which the evaluation method is described, section 4.2 in which the surveys used to evaluate the game are described, section 4.3 which has the evaluation results and section 4.4 where the results are discussed.

And finally chapter 5, where the final conclusions are presented in two sections, the summary in section 5.1 and the future work in 5.2.
Chapter 2

Related Work

2.1 Serious Games

Serious games are games with a primary objective other than entertaining players (Susi et al., 2007). Their primary objective is usually to educate, advertise, make propaganda or to simulate a real life situation. However, in order to reach to gamers, these games must have the entertainment component, otherwise players feel bored and will not play them.

Stories are used since ancient times to teach and share experiences. They are a very effective way to transmit knowledge and messages (Egan, 1988). Serious games may incorporate a storytelling component in order to tech or convey messages to the gamers effectively (Crawford, 2003), making them a good educational and advertising tool. While playing, gamers become immersed into the virtual world, enlarging their attention span (Griffiths, 2002; Prensky, 2003). In fact, video games can have a positive effect over visuospatial attention (Gagnon, 1985; Green & Bavelier, 2006). By keeping players focused, it makes them learn many things unconsciously, from the basic game rules, to a related real life topic. Even if the game’s purpose is not educational the user ends learning something. For example, someone playing Gravity Master (GravityMaster, 2008) will learn about physics. Also, a player can learn something about world history and war strategies as he plays Age of Empires (Microsoft, 1997) or Civilization (MicroProse, 1991). Video games sometimes, also stimulates players to research about their content and related information (Gee, 2003), e.g., while someone play Call of Duty (Activision, 2003), they might do an online search for World War II facts, to check if they are right or just for curiosity. It is also possible to test something that is unlikely to test in real life or it is too risky (Squire, 2003), e.g., a gamer can test his manager skills in Football Manager (SportsInteractive, 2005), or drive a Rally Car in
Serious games take those video games’ characteristics to their advantage in order to fulfill their primary objective. Timez Attack (BigBrainz, 2008) is a game that teaches multiplication to kids and it is a good example of an effective educational video game. Clearahill (Clearahill, 2007) is an advertising game that was made to promote the Clearasil products. La Molleindustria made an anti-McDonald’s game called McDonald’s Video Game (Molleindustria, 2006), which purposes to expose the bad things supposedly made by that company, this game is a good example of a propaganda or anti-advergame. Another example of a propaganda game is America’s Army (U.S.Army, 2002), a video game made by the US’s army to help recruit soldiers, this game was so successful and realistic that it is used as an training tool by American soldiers, simulating combat situations. America’s Army is also used to give Virtual Soldier experiences to people in theme parks, sporting events and air shows. Other game used as a simulation tool is IBM’s CityOne (IBM, 2010), this game is used to simulate real-world city logistical, environmental and business problems.

2.2 Agriculture

2.2.1 Agriculture in Castro Verde

Every region has certain climate and soil properties that influence the kind of crops that can be planted on those lands. For this work, only the characteristics of Baixo Alentejo region, more specifically Castro Verde, will be considered.

Castro Verde has a Mediterranean climate according to the Köppen-Geiger classification (Kottek et al., 2006). This climate is characterized for having warm temperatures, a hot and dry summer, with precipitation mostly on autumn and winter.

The soil in Baixo Alentejo is not very fertile. In fact, since the Wheat Campaign, between 1929 and 1932, the soil got exhausted and erosive (Dias, 2009; M.J. Roxo & Casimiro, 1998).

All these factors affect the types of crops that can be produced on those lands. The most profitable ones are upland cereal, legumes, tomatoes, sunflower, potatoes, corn, olive, cork tree and vineyard. The livestock in this region is mainly composed by sheeps, cows and pigs.

In order to spare the land from exhaustion, a crop rotation system, where part of the land at rest, is used. Usually the cropless lands are used to raise flocks and cattle.
2.2.2 Biodiversity Agriculture Dependent in Castro Verde

Cereal steppe or pseudo-steppe is an habitat man-made, which is characterized by having dry land cultures (cereal and livestock), few trees, high number of fallow lands, low relief and precipitation (LPN, 2002). These habitats are propitious to the Iberian steppe birds to live in, since they nest on the bushless floor, have better hunting sight and consume the local vegetation.

However, people are changing this environment by diminishing the crop rotation cycle, overgrazing, changing the cultures to forestry ones, constructing infrastructures (roads, dams power lines, fences) and abandoning lands (ICN, 2006; Rita Alcazar & Estanque, 2009).

Farmers benefit from the birds presence, since they attract "bird watching" tourism to their local villages. The local producers not only receive payments for environment services from local development programs, e.g., the Proder program (Proder, 2010), but can also sell their products to the tourists (Rita Alcazar & Estanque, 2009).

In order to maintain the biodiversity of birds, farmers need to remove fences from their property or signalize them, so birds can walk through properties, see them and avoid colliding with them. Dry land cultures with crop rotation system must continue, with more than 50% of the property being at rest. The number of livestock on the fallow lands must be limited, and in reproduction season machinery work must be avoided, to prevent eggs from being smashed. Local producers can also construct artificial nests, so birds can reproduce in their properties (Rita Alcazar & Estanque, 2009).

The most notorious steppe birds that can be seen in Castro Verde are (Sarmento, 2010):

- Abetarda (*Otis tarda*)
- Sisão (*Tetrax tetrax*)
- Peneireiro-das-torres (*Falco naumanni*)
- Rolheiro (*Coracias garrulus*)
- Tartaranhão-caçador (*Circus pygargus*)
- Cortiçol-de-barriga-preta (*Pterocles orientalis*)
- Grou (*Grus grus*)
- Alcaravão (*Burhinus oedicnemus*)
- Milhafre-real (*Milvus milvus*)

2.2.3 Farming Business Alternatives

There are many activities, other than agriculture, a farmer can do with his property to increase his revenue.
For instance in order to benefit from the local rural tourism, the landholder might create pedestrian, cycling or equestrian routes in his properties. An information stand, that offers horse riding classes and rents or sells equipment (binoculars, maps, canteens, compasses, bicycles, GPS equipment), might get money from this kind of tourism (Sarmento, 2010). A pedagogic farm is another idea that reutilizes the resources the farmer already has, like the crops and livestock, and grants some extra revenue.

Eco-Tourism Housing is a good way to get money from local tourism. The landowner can construct a guest’s house, which can be rented, occupying a small portion of in his land. In addition, a restaurant might be a good complement, offering the taste of the local products and gastronomy. Building a swimming pool or a garden is also a good option, which will not only attract more guests, but can also be used for owner’s leisure.

There are also some activities that a farmer can organize to attract people to the property, like rally papers or tractor rides. In complement, building a mill can be a great opportunity to display the traditional folk art of bread making, supplying the visitors whit the opportunity to experience the process in first hand and consequentially attracting more tourist to the property. The bread and the other farm products could be sold on a selling stand on the property (Sarmento, 2010).

Installing a solar energy system, will not only reduce costs, but will also grant some revenue by selling the surplus electricity to the electric company.

There are many other options that can increase the farms revenue, like creating a four wheel motorcycle circuit or building a paintball camp. But these options will disturb the peace and quiet enjoyed by the rural tourists.

All of these business alternatives have revenues and expenses associated. The consequences of the investments decisions depend on other external variables, e.g., if there is not a large enough number of tourists visiting the property, the businesses will only generate debts, because the relations between expenses and income will not be sufficient to grant profit.

### 2.3 Agriculture Video Games

There are a great number of agriculture video games available in the market. Most of them are simple, low budget, online flash games, mainly targeted to casual gamers. But there are also more complex ones, targeted to a less casual audience. In this section, several of those games will be surveyed and evaluated in order to understand what makes them fun to play.
2.3.1 Video Games Analysis

In order to evaluate and compare those games, an heuristic evaluation was developed. This heuristic evaluation was made by the observation of common patterns between the chosen agriculture games. The metrics considered were:

Appealing characters - characters that represent players or other agents, and were made with the intention to make to player empathize with them.

Unlockable content - in-game content that can only be accessed or used after the player completes some required objectives.

Possible actions - there were four kinds of actions that were familiar to most of the agriculture video games, basic(b), complementary(c), advanced(a) and extra(e). The basic actions (b) are to plow, plant seeds, sprinkle and harvest. The complementary actions(c) are to use pesticides or fertilize the crops. The advanced actions (a) are managing livestock or buying and using tools. The extra actions (e) are those that allow players to edit or embellish their avatars or farms.

Game speed - if the game is in real-time, turn-based or by ticks. Real-time games progress as time goes by. Turn-based games progress, when the user ends the turn. In ticks-based games, players accumulate ticks as time goes by, they can do action by expending ticks. If a gamer runs out of ticks, he needs to wait until the ticks replenish, so he can do the intended action.

Easiness to play - for this evaluation, games that require a great effort to be learned to play are not considered easy.

Clear goals or missions - if the game has predefined missions or goals that the user must accomplish.

Tutorial - if the game has any kind of in-game tutorial, learning levels or missions.

Rewards - if the game gives any kind of reward to the players as he progresses through the game or as he accomplishes some determined goals.

Story - if the game has any kind of story.

Personalization - if it is possible to personalize the avatar or the farm.

Sound - if the game has sound.

Serious Game - if the game’s primary goal is other than entertainment.

Social - if the game provides any kind of social interaction with other human players.
Twenty seven agriculture video games were tested and compared. The Figure 2.1 shows the results of the evaluation.

By analyzing Figure 2.1 we can conclude that the majority of the games have appealing characters, unlockable content, real-time progression, tutorials, goals or missions, rewards, sound and are easy to play. The most common actions available in the games are the basic, advanced and extra. Most of the games don’t include the complementary actions. Though they add more options to explore in-game they are considered disposable by the majority of the tested games. The story, personalization and social interaction are strongly discriminated by most of the games. Also, only five of them are considered serious games. Despite some characteristics being present

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<td>✓</td>
<td>✓</td>
<td>b, c, e</td>
<td>real time</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SimAgri</td>
<td>X</td>
<td>X</td>
<td>b, c, e</td>
<td>ticks</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
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<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Simfarm</td>
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<td>X</td>
<td>b, c, e</td>
<td>real time</td>
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<td>✓</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
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<td>b, e</td>
<td>real time</td>
<td>✓</td>
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<td>X</td>
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<td>✓</td>
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<tr>
<td>Virtual Farm</td>
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<td>b, a</td>
<td>real time</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
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</tr>
<tr>
<td>Yods Farm</td>
<td>✓</td>
<td>✓</td>
<td>b, e</td>
<td>real time</td>
<td>✓</td>
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<td>X</td>
<td>✓</td>
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<td>✓</td>
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<td>✓</td>
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</tbody>
</table>

*Figure 2.1: Heuristic Evaluations of Several Agriculture Video Games*
in most of the games, it does not necessarily mean there are indispensable for a game to be successful. For example, FarmVille does not have clear goals and is social, but still it is the most successful of those video games.

Despite being neglected by most of the games, the social component is very important to players, since the most successful agriculture games have this component (FarmVille, Farmerama and FrontierVille). This might be caused by the viral behavior of these kind of games, i.e., in order to progress faster in the game players need their friends help, so they invite them to play. These friends get caught in the game and to progress they ask their own friends to play, and so on (Poole, 2010).

2.3.2 Players’ Profile

One other important thing to consider when designing a game is the profile of its users, in order to make a product that is appealing to them. There are various player type models, but in this work only the Demographic Game Design model (DGD1) (Chris Bateman, 2005), represented in Figure 2.2, will be considered. This model was made taking in consideration the “Hardcore vs Casual” model, the Myers-Briggs Type Indicator for classifying personality preferences of individuals.

The Myers-Briggs model has four different individual characteristics, each one being a dichotomy.

<table>
<thead>
<tr>
<th>Extraversion (E)</th>
<th>vs</th>
<th>Introversion (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing (S)</td>
<td>vs</td>
<td>Intuition (N)</td>
</tr>
<tr>
<td>Thinking (T)</td>
<td>vs</td>
<td>Feeling (F)</td>
</tr>
<tr>
<td>Judgment (J)</td>
<td>vs</td>
<td>Perception (P)</td>
</tr>
</tbody>
</table>

Table 2.1: Myers-Briggs Model Dichotomies.

The description for each of the characteristics on Table 2.1 are:

**Extraversion (E)** - people that like to contact with lots of other people and the outside world. They usually act before thinking.

**Introversion (I)** - people that prefer contacting with few people at the time. They like to be alone. They think before acting.

**Sensing (S)** - people that build conclusions based on past experiences and concrete information.
They live the present and remember details about past events.

**Intuition (N)** - people that build conclusions based on theoretical models. They live the future and remember patterns, and connections between events.

**Thinking (T)** - people that make decisions rationally, using logic and facts. They focus on tasks and do not avoid conflicts.

**Feeling (F)** - people that make decisions based on their emotions and feelings. They focus on consequences of their action tasks. They tend to avoid conflicts.

**Judgment (J)** - people that plan everything before acting. They like routine. They do one task at the time, avoiding stress.

**Perception (P)** - people that do not plan in advance before acting. They do not like routine. They do several tasks at the same time. They work better closer to deadlines.

However the DGD1 model only considered the TJ vs FP dichotomies to understand the players’ motivations as shown in Figure 2.2. The E vs I dichotomy was not considered since it evaluates how the games are played, and the N vs T dichotomy was also left out it considers how the players learns and solves the problem.
Each player type has 2 dimensions, the casual and the hardcore gamer. The player types are:

**The Conqueror (JT)** is a player that likes to dominate the game and other players. He also enjoys fast paced games with hidden contents.

**The Manager (PT)** is a player that likes to explore the world and strategies. He also enjoys stable paced games with clear goals and good story.

**The Participant (JF)** is a player that likes to socialize other people or interact with the game. He also enjoys games with story, and he connects to both narrative and characters.

**The Wanderer (PF)** is a player that seeks experiences that are not available in the real world. He enjoys slow paced games with lots of items to try and use. He also identifies with the story’s characters.

Considering the features on Figure 2.1, the Conqueror likes the unlockable content. The Manager prefers the clear goals or missions. The Participant enjoys games with story and social component. And the Wanderer likes rewards, appealing characters and personalization.
Chapter 3

Architecture and Implementation

LPN was much supportive in the development of this project. During the design and definition period they gave as many information they could, through several interviews and meetings, giving also related documentation, which allowed to develop the game mechanics closer to reality then what it would ever be without this help.

3.1 Game Overview

Ecofarmer is a game that was developed in order to make players aware of the importance of agriculture, not only to humans but also to other species. This game represents Castro Verde’s reality, where the agricultural activity isn’t very profitable but the steppe birds depend on it to nest and inhabit the region.

3.1.1 The Game

When the game begins, the player is shown a diamond grid representation of an abandoned farm, with each diamond representing a terrain portion. One of the diamonds has a house on it, the rest of them represent farmable land. Since the farm was abandoned, all the farmable land is full of bushes. These bushes prevent the steppe birds from inhabit and nest in there, therefore there aren’t birds at the property, neither birdwatchers. In order to succeed in the game, the player has to manage his property, restoring the local steppe birds’ population, while profiting from the agricultural activities. To fulfill these objectives, the player starts with 50000€ to manage the farm. To get extra revenue, the player can apply to the ITI agricultural subsidy and build some
infrastructures to reduce the seasonal expenses and gaining income from the local tourism.

### 3.1.2 Objectives

Through the game the player will be faced with some immediate challenges. His primary goal will be to meet the ITI subsidy requirements, while generating as much profit as possible from the crops and cattle. Afterwards the player should focus on taking care of his farm in order to collect as many steppe birds as possible, getting an increasing number of tourists visiting the farm to watch them. Finally the player will maximize his profits as much as possible, by building and upgrading the infrastructures. The water mill and the solar panel will reduce water and electrical expenses of the other structures, which will generate revenue from the local tourism. To check his own progress, the player must see how much money he has, how many birds are in his land, and how many tourists are visiting it.

### 3.2 Solution

#### 3.2.1 Technologies

LPN asked the game to be persistent and easily integrated on Facebook. Considering that the game was to be in 2D with isometric view and Facebook integrates flash easily, the Adobe Flash CS3 Professional was chosen to develop the game in flash. Considering that to make the game persistent a database is needed, PHP can be used as a middleware between the flash game and the database, and the Facebook’s API it is in PHP, XAMPP was chosen since it includes PHP and database (MySql) in one product. Finally XML was chosen to store the default settings, since it can be easily changeable, without programming and recompiling the game. These technologies are related between them as shown in figure 3.3.

![Figure 3.3: Relations between the technologies used to develop the game](image)

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3.2.2 Game Mechanics

Ecofamer is a turn base game, where each turn corresponds to a season (spring, summer, autumn and winter). The first season is autumn, and at the beginning of each autumn an annual report with the values of the income and expenses is shown, allowing the player to study and reconsider his game decisions. The player can group several terrains into an area, making it easier to do the same actions to several terrains at the same time. The terrains have several states, they might have bushes, crops, cattle or nothing, they change their states if some actions are made following the model presented in figure 3.4.

![Figure 3.4: Tillable Terrain States](image)

Cereal crops take three seasons to reach their maturity and legumes only one season. The cereal crops must be planted in the autumn in order to be harvested in the summer, otherwise they will die in the summer from the drought and heat. However the legumes can be seeded in all seasons except summer, or they will die from the drought and heat.

Infrastructures have a different approach, instead of being possible to make any structure available in any allocated space on the structures view, each structure as a specific allocated space, in which it is only possible to upgrade or downgrade that specific infrastructure, as it is presented in figure 3.5. The lowest level possible is 0, in which the terrain is presented as empty, on the other hand the highest level possible for all structures is 3.

![Figure 3.5: Structures Terrain States](image)

The various game components interact with each other as shown in figure 3.6. There are three types of relations between game components, benefic (it will improve the other), harmful (it will be damage the other), or hybrid (in some conditions it will be benefit while in others it will damage
the other component).

Figure 3.6: Game components and the interaction between them

3.2.3 Architecture

The game architecture is modeled as shown in figure 3.7.

- The Ecofarmer is the main class, it is it that has the information on all the other classes and Movieclips in the frames. It is responsible to generate all the other classes, and to define the behavior of the menus when the terrains are clicked.

- An Area is a class that is composed by several Terrains classes, and it has functions that change its contained Terrains.

- The Terrains class has all the information and defines the behavior of each terrain that is represented in the screen. It might have Cattle classes associated with it if there is cattle in the Terrain.

- The Scorebar class is responsible for all the games’ scores (money, birds, tourists and seasons).

- The ValuesManager class is the class that gets all the configurable parameters from the config.xml file (see more in section 3.2.12).

- The Infrastructures class is the parent class of every other infrastructure class.
Figure 3.7: Game architecture overview

- A Cattle instance is generated for animal that is bought or born, and contains its corresponding information.

- ReportValue is the class that stores information to be shown in the annual report.

- The CattleCounter class is an auxiliary class of the Scorebar class, that was made to count the cattle more efficiently and without mistakes.

Only ReportValue, Scorebar, Infrastructure, Terrains and Cattle connect to the MySQL database, which is organized as shown in figure 3.8. The Scorebar is responsible generate, load and update the user table information, all the other classes are responsible to do the same to their corresponding SQL tables.

3.2.4 Interface

The game window is composed by three parts, the top hud (or scorebar), the bottom bar and the main view (see figure 3.9).

The top bar or scorebar it’s used to give the player game information. It contains the amount of money available, number of tourist visiting the property, number of birds at the property (see
Figure 3.8: Database organization

Figure 3.9: Game game window. It is composed by scorebar (green), main view (red) and actions bar (blue)

more details at section 3.2.9), number of cattle heads owned, recommended number of cattle heads and the current season (see figure 3.10).

The bottom bar is used for making actions (see figure 3.11). It is composed by two parts, on the left the local action buttons, and on the right the global action buttons. The local action buttons are linked to actions the user made on the main view, while the global buttons are used to change view, get help or progress the game.

3.2.5 Login

Since the game was developed to be integrated in Facebook, and flash games developed to that social network don’t need to be registered in order to be played by a user, Ecofarmer’s login
system took the same approach.

To start the game a user ID is needed. After the id is inputted, the database is checked in order to verify if the user already exists, if it exists, the game loads all user data, if it doesn’t exist, a new user with that id and the default settings is created on the database and is loaded.

However the game isn’t yet integrated on Facebook, so a Facebook login system is simulated. When the game starts the login menu pops-up, and the user is asked to input his id. If his id exists, his previous game is loaded; otherwise a new user is created with that id and the default settings.
3.2.6 Information Menu

There is an information menu that can be accessed by the player by clicking in the information button on the bottom bar. This menu has detailed information about agriculture, steppe birds, infrastructures and the games' interface.

Since from the games’ earliest stages, players did not know where the action buttons were, they complained about not knowing what were the right actions to do and when to do them. So the games' information menu was developed. However this didn't solve the problems at first, since users didn't knew about this menu, and continued with a trial error approach. So the menu was changed to pop up for the first time the user logged in, in the interface explanation submenu. This way users not only knew about the interface, but also took knowledge about the existence of this menu, and could check more information on the game mechanics before starting exploring.

3.2.7 Crops View

This is the view where the player manages the tillable lands and the cattle (see figure 3.13). It is on this view that the player will spend most of his time, planting, fertilizing and harvesting crops, cutting bushes, buying or selling cattle and putting or removing fences on terrains.

In this view the user can group terrains by clicking in the group terrains button, and after confirming the group selection, he can perform the same operations to all the terrains members of that group. This group can also be edited or deleted.

If a terrain is planted, the user can watch the plants grow throw seasons. If the player doesn't rotate crops, the soil will lose productivity. This loss of productivity is represented as a loss of green tone on the terrains at the harvest action. The greener the terrain is the more productive it is.

Cattle is also managed in this section. The farmer can only buy adult cattle, however he can sell both adults and juveniles. Adult cattle may reproduce themselves with a chance of 1 in 8 per season. As a simplification, it is assumed that all cattle are female, and the farmer contracts male cattle owners in order to impregnate his cattle (this is automatic and not visible to the player). Juveniles take four seasons to reach adulthood. The player can manage his cattle has he wants, however if the cattle is in a terrain without fences or if there is not a shepherd working at the property, the cattle will run away in the next season. Shepherds can be hired in the main house (see section 3.2.8), and fences can be bought when a selecting a confirmed group of terrains.
3.2.8 Structures View

In this view the player can access and manage the infrastructures that can be built in the property, in order to increase his seasonal income. This view has eight selectable buildings that can be upgraded up to level 3 or downgrade to level 0 (see figure 3.14).

The infrastructures belong to one of three types:

- Profit from tourists - it gets extra income from tourists visiting the farm. These buildings also attract a small percentage more tourists to the property.

- Cost reducer - it reduces the maintenance costs of the other buildings. The solar panel reduces the electric costs and the water mill reduces the water expenses.

- The main house - this is where the player can apply to the subsidy, buy a shepherd, and build artificial nests or a pedestrian circuit. The pedestrian circuit will give tourism bonus (both visits and income per tourist). The nests are a requirement to attract some kinds of birds. The shepherd is the alternative to fences that does not damage the birds.
One of the most important objectives of the game is to restore the property's steppe birds fauna. In order to do it the player must take care of his lands without damaging the birds. There are nine collectable birds in the game, each has a different requisite do appear and flourish on the farm. Also, since some birds are more common than others, the rarer birds are harder to collect and fewer specimens will be in the property. There are three categories to evaluate the rarity of a bird, common, rare, rarest. The common birds can flourish up to eight birds per specie and they have only one requirement. The rare birds can flourish up to six birds per specie and they have three requirements. Finally, the rarest bird can flourish up to six birds and it has six requisites (all the requirements).

Bird listing, considering rarity and requirements:

- *Grous* (common) - at least one terrain must have legumes in the spring.
- *Cortiçol-de-barriga-preta* (common) - artificial nests must be putted in the property.
- *Tartanhão-caçador* (common) - at least half of the property mustn’t have crops or bushes.
• *Peneireiro-das-torres* (rare) - all the previous three requirements.
• *Milhafre-real* (common) - the number of cattle heads must be limited to 6 per ha.
• *Alcaravão* (common) - there can’t be fences.
• *Rolieiro* (common) - there can’t be any swine cattle.
• *Sisão* (rare) - all the previous three requirements.
• *Abetarda* (rarest) - all the above requirements.

![Figure 3.15: Menu with the number of birds per specie in the property](image)

The player can always access the information about the birds in his farm by clicking the bird symbol on the top hud. This action will pop-up an menu with the numbers of each species in the property (figure 3.15). If the user clicks on a bird, detailed information of the bird will pop-up, containing a larger image of the bird, the requirements to collect it and a small description and trivia about the bird (figure 3.16).

### 3.2.10 Tourism

Tourism is greatly influenced by the number of birds present at the property, considering only bird watching tourists would visit it.

Bird attraction factors:

- *Grous, Cortiçol-de-barriga-preta, Tartanhão-caçador, Milhafre-real, Alcaravão and Rolieiro* - 1 tourist per bird.
• *Peneireiro-das-torres* and *Sisão* - 3 tourists per bird.

• *Abetarda* - 6 tourists per bird.

The existing infrastructures also influence the tourism. Some structures increase the percentage of tourists visiting the property while others generate income from the tourism.

Tourists visit the property to watch birds, however this doesn’t generate any revenue to the player, in order to get money from them the player has to build some structures where the tourists will spend some money on. The buildings that generate income from the touristic activity are the stable, bird watching tower, hotel, restaurant and tourist post. These buildings also attract a larger number of tourists to the farm.

To calculate the income generated by each structure it is used a simple formula. There is a maximum income per tourist, that can be configured (see section 3.2.12), which represents the mean expense per tourist in one season, each structure has a percentile of that maximum income. So to get the tourism income, the combine percentile of the maximum income is calculated, and then multiplied to the number of tourists on that season. The hotel and restaurant have 30% each of the maximum income, the tourist post and the stable have 15% each and the bird watching tower 9%. These values are only valid to structures in the highest level (level 3), for level 1 the percentile value is one third, and for level 2 two thirds.
3.2.11 Reports

At the end of each year (in the autumn) a financial report is shown, to help the player evaluate his managing performance. The annual report has three tabs, the summary, the income and the expenses (see figure 3.17). The summary has the values of the total income, total expenses and the annual balance. The income/expenses tabs have detailed information on the origin/destiny of the money.

![Figure 3.17: Report example - view of the expenses tab](image)

3.2.12 Configuration File

The default economic settings are stored in a XML file (config.xml). This file can be easily changed without programming, and facilitates the task of adjusting settings during game testing.

Using this file it is possible to change the initial money, cattle prices, crops prices, infrastructures costs, terrains dimensions (in ha), incomes and expenses values and the birds descriptions. By adjusting these values it is also possible to change the game difficulty.
Chapter 4

Evaluation

4.1 Evaluation Methodology

The objectives of the tests are:

- Determine if the user improves his perspective about agriculture.
- Analyze if the user learned about the way agriculture affects the steppe birds in Castro Verde.
- Determine if the game is fun and entertaining.

The game evaluation was made using casual and hardcore gamers, which played the game for the first time. Before playing the game the players were asked to answer a survey about their gaming skills, opinion on agriculture, knowledge about agriculture and steppe birds. Then the users were giving a user ID and asked to accomplish the in-game objectives in five years:

- Level the house up to level 3.
- Collect all the steppe birds.
- Maintain a positive money balance.

Finally the players were asked to answer a final inquiry on their opinion about agriculture and the game, and their knowledge on steppe birds and agriculture was again surveyed.
By comparing the mean results of both inquires it was concluded if the objectives were fulfilled. The final inquire was also be useful to perceive if the players were satisfied with the game and to define future improvements on it.

4.2 The Surveys

The surveys were both written in Portuguese since the game was only tested with Portuguese gamers. Scales questions are made using an even scale (between one and six) to prevent people to vote in the middle value. this way it can be identified if their opinion is more negative or positive than the average value (three point five).

The first questionnaire (Q1) was composed by eight questions:

- I.1 - How often do you play computer games?
  (Answers: Never, Rarely, Sometimes, Often)

- I.2 - Have you ever done any agricultural work?
  (Answers: Yes, No)

- A.1i - What is the probability of you making career in agriculture in the future?
  (Answers: 1 - Impossible, . . . , 6 - Certain)

- A.2i - Do you think agriculture is profitable?
  (Answers: 1 - Not profitable, . . . , 6 - Very profitable)

- A.3i - Do you think agricultural subsidies are important to farmers?
  (Answers: 1 - Dispensable, . . . , 6 - Indispensable)

- A.4i - Do you think agriculture is indispensable to . . .
  (Chose from the following: The human being; The human being and some other species; The human being and all other species; Any animal species.)

- A.5i - Pick the steppe birds from the following:
  (Chose from the following: Pigeon; Bustard; Eagle Owl; Kestrel-of-towers; Crow; Imperial Eagle; Little Bustard; Stork; Don’t know)

- A.6i - From the following measures, pick the ones that benefit the steppe birds:
  (Chose from the following: Fence the terrain; Make artificial nests; Plant all property; Plant up to half the property; Have swine cattle; Don’t have swine cattle; Plant legumes in the Spring; Plant legumes in Autumn)
This survey has the objective of knowing the thoughts and knowledge of the gamer on agriculture and steppe birds.

The final questionnaire (Q2) was composed by eleven questions:

- **A.1ii** - What is the probability of you making career in agriculture in the future?  
  (Answers: 1 - Impossible, . . . , 6 - Certain)

- **A.2ii** - Do you think agriculture is profitable?  
  (Answers: 1 - Not profitable, . . . , 6 - Very profitable)

- **A.3ii** - Do you think agricultural subsidies are important to farmers?  
  (Answers: 1 - Dispensable, . . . , 6 - Indispensable)

- **A.4ii** - Do you think agriculture is indispensable to . . .  
  (Chose from the following: The human being; The human being and some other species; The human being and all other species; Any animal species.)

- **A.5ii** - Pick the steppe birds from the following:  
  (Chose from the following: Pigeon; Bustard; Eagle Owl; Kestrel-of-towers; Crow; Imperial Eagle; Little Bustard; Stork; Don’t know)

- **A.6ii** - From the following measures, pick the ones that benefit the steppe birds:  
  (Chose from the following: Fence the terrain; Make artificial nests; Plant all property; Plant up to half the property; Have swine cattle; Don’t have swine cattle; Plant legumes in the Spring; Plant legumes in Autumn)

- **F.1** - How do you think of the game?  
  (Answers: 1 - Very boring, . . . , 6 - Very Interesting)

- **F.2** - Is the game easy to understand and play?  
  (Answers: 1 - Very hard, . . . , 6 - Very easy)

- **F.3** - Did you fulfill the objectives given to you by the survey responsible?  
  (Answers: Yes, No, Don’t know)

- **F.4** - would you like to play it again?  
  (Answers: Yes, No, Don’t know)

- **F.5** - Please give the game a suggestion or critic.  
  (Open question)

---

1 correct answer
The first six questions of the final survey are used to compare with the corresponding ones of the first survey (questions three to eight), and see if the user's opinion and knowledge on agriculture and steppe birds has improved. The remaining questions serve to evaluate the game, and get more feedback from users.

4.3 Results

This evaluation was made with twenty persons whom filled the questionnaires and played the game. Figures 4.18 and 4.19 summarize results of those questionnaires, which are described in Section 4.2:

![Table 1](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAIQAAAdCAYAAAB...)

Figure 4.18: Answers to Questionnaire 1

4.4 Results Discussion

In this section is the discussion of the results presented in the previous section.

The first question of the first survey (Q1) show the sample of inquiries has a great number of casual gamers, some hard core gamers and some people that do not play videogames. The second question shows that the majority of them (sixty five percent) had never had worked in agriculture.

Figure 4.20 compares the related results of both surveys. By analyzing it can be concluded if the objectives described in section 4.1 were accomplished.
4.4.1 Perspective on agriculture

User thoughts on agriculture:

- By comparing A.1i and A.1ii (Q: What is the probability of you making career in agriculture in the future?), a slight increase in the probability of following a career in agriculture is noticed (zero point one), after playing the game. However since the sample is only twenty people long, this result is not significant enough.

- By relating A.2i and A.2ii (Q: Do you think agriculture is profitable?), is concluded that after playing the game, gamers thought that agriculture is less profitable than before.

- While analyzing A.3i and A.3ii (Q: Do you think agricultural subsidies are important to farmers?), it is concluded that after playing the game, users thought subsidies are much more important to farmers than before.

In conclusion the game changed the view of the gamers over agriculture. After playing, players understood better the difficulty of being a farmer in Castro Verde, where the soil is not very fertile, the climate is aggressive and subsidies are indispensable to gain some money.

Thought there was a slight increase in the appeal of working in the future in agriculture, this result can be ignored since the sample of inquiries is too little, and it could be an answer made to please the inquirer. Better results for this answer could be obtained if the game showed agriculture as more profitable and modern activity with lots of technological advanced resources.
4.4.2 Knowledge on How Agriculture Affects the Steppe Birds

- By comparing A.4i with A.4ii, an increase on the correct answers is observed. After playing the game a larger number of persons thought that agriculture is indispensable for humans and some others species.

- After analyzing the results of the comparison between A.5i and A.5ii, it is noticed that the number of correct answers increased from fifty seven point sixty nine percent to seventy six point eighty eight percent correct answers. This means that after playing the game, user could identify better the steppe birds from other kinds of birds. Also after playing the game, there were not people answering "Don't Know", while before were seven. This means that after the game, even thought there was an increase of the number of persons trying to guess the birds, there were nineteen percent more correct answers, which showing that the game was effective in teaching the birds to gamers.

- The comparison between A.6i and A.6ii, shows that after the game, player could identify
better which measures benefit the birds. This is supported by an increase from sixty two point five percent to eighty eight point seventy five correct answers.

In conclusion the objective of teaching about steppe birds and the way agriculture affects them was accomplished. After the game, players could identify better the steppe birds and indicate which agriculture measures were the best for them.

### 4.4.3 Game Likability

By analyzing the rest of the answers from Q2 questionnaire it is possible to know some of player’s thoughts on the game. F.1 and F.4 show that gamers liked the game, considering it more interesting than boring, and the majority of them (sixty percent) would like to play it again.

F.2 presents a near average value; this means that gamers did not find the game neither easy nor difficult to understand. However F.3 indicates that the great majority of the players (seventy five percent) did not accomplished the proposed initial objectives. This can be explained by the initial try and fail learning approach from the players. Only a few read all the information on agriculture and birds, the majority started playing the game and learned with their mistakes, reading the information only to understand why they failed.

From the suggestions left on F.5, was concluded that users would like to have better graphics, sound, more useful information, seasonal reports, bigger letters on the buttons, a better tutorial and a cooperative multiplayer component.

Though most of the players did not accomplish the proposed objectives, they did find the game interesting, and would like to play it again. Also, the game was not as simple to understand as intended. A better tutorial system is needed to make the player learn the mechanics and the rules of the game faster at the beginning. A good choice could be a walkthrough a year tutorial, with several objectives to accomplish each season, which would teach the primary actions and the most important measures to make through the game. Some suggestions from F.5 should be also considered to improve the fun and entertainment of the game, like adding sound, better graphics, more useful information, seasonal reports and the a cooperative multiplayer system.
Chapter 5

Conclusions

5.1 Summary

Agriculture is indispensable for the survival of the humankind and some other animal species. However, this ancient activity is being abandoned since it requires physical hard work and it is not as profitable as other activities found in the urban areas.

Ecofarmer is a serious game which was developed considering the Castro Verde region, where agriculture is not profitable because of the soil and weather, but it is essential for the survival of the steppe birds. Its’ purpose is of changing the view on agriculture, teaching that agriculture is not only important to humans but also to other species, and which measures are the best to benefit both humans and steppe birds.

The game succeeds teaching about the agricultural reality of Castro Verde. After playing the game, users understand better the adversities that farmers face, and how important subsidies are to make a living. The results also showed that the game also succeeds in teaching about steppe birds and the agricultural measures that can damage or benefit them.

As a video game it had good results, most of the testers found the game more interesting than boring, and would like to play it again. Nevertheless few users accomplished the proposed testing objectives, and the game was not found simple to understand and play. A better tutorial system must be implemented in order to better teach about the game mechanics and rules. With this tutorial not only the game experience could be improved, since the players would not fell so lost, but it would also teach better about the agriculture and the measures that affect the steppe birds.

However, the game didn’t have a great success in making agriculture look more appealing as a future career prospect. The increase in the will to proceed a career in agriculture was marginal
(zero point one). This can be explained by the fact that the game represents the reality of Castro Verde, and farming is not profitable there. If agriculture is shown as a good source of income, it could look more appealing as a career option. Another option could be by showing the technological advance tools that can be used to work in the farm, showing that farming can be a modern and not as hard task as thought.

In the overall the game accomplished its objectives, since it can be used as a tool to teach about Castro Verde’s agriculture and the way it affects the steppe birds, while keeping the user entertained and amused.

5.2 Future Work

To improve the current work the following measures should be implemented:

- Use better and more appealing graphics. This will make the game look more pleasant and attractive to the general public.

- Put it in a server with a DNS, in order to integrate into Facebook. This way the game will be accessible to a larger public.

- Develop the multiplayer mode. An agricultural collective, could be used to generate multiplayer gameplay. The collective could be a farmers’ alliance that could increase the income, decrease expenses and give access to some collectables. This feature could be very effective if the was integrated on a social network.

- Develop a tutorial that teaches more about the gameplay, agriculture and biodiversity. This tutorial must be a visual exploring walkthrough with seasonal objectives, in order to make user explore the game without reading much.

- Add seasonal reports to give more information about what is happening in the game. These reports should include numbers of animals lost, animals born, how rainy was that season and financial information. However these reports shouldn’t pop-up, they could appear in a mail-inbox that the player could consult as he pleased. The player must not be bored with unwanted information.

- Add game missions and more collectibles.

- Add some special events.

- Integrate a more developed financial system, where the player can ask a bank for loans, pay debts and deposit money.
• Add a story to the game, with a beginning and end of the game.

• Make possible for the player to chose and personalize an avatar.
Bibliography


**Websites**


