FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Towards a collaborative tourist system using serious games

Rui Fernandes

Mestrado Integrado em Engenharia Informática e Computação

Supervisor: Rosaldo J. F. Rossetti, PhD (Assistant Professor)

Co-supervisor: João Emílio S. C. Almeida, MSc

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Approved in oral examination by the committee:

Chair: Professor Eugénio da Costa Oliveira
External Examiner: Dr. Fernando Augusto Cruz e Silva Mouta
Supervisor: Dr. Rosaldo José Fernandes Rossetti

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Abstract

Nowadays, traveling is becoming increasingly easier. New and cheaper means of communication make tourism available for a larger number of people. Withal, smartphones are trending and they are replacing the common cellphone at a fast rate. It's safe to assume that, in a near future, every single person will be able to afford a mobile device of this kind, including tourists.

Many applications exist for mobile devices, specifically for smartphones, in order to help tourists in their journeys. There are applications to help the tourist before he gets to a destination, and while he is exploring a new place. All the applications available share the same problem, though: as they are created and maintained by third-party entities, content may not be complete or updated and, at the same time, they lack user feedback in order to fight these problems.

The best information about which points are interesting in a city is usually held by locals, or by people that visited that city recently. As locals tend to know even the most remote places inside their homeland, and recent tourists have the most updated information about the current state of the places they pass, these groups of people appear to be the best sources of information for a tourism application.

An application fed and maintained by its users, seems like the solution for the poor state of the information contained in mobile applications for tourists, but, motivating travelers to share their knowledge, in a long-term basis, poses a problem. This dissertation tackles that problem through the use of Serious Games. Being so, this project studies the impact of Serious Games in this area, accessing if they are a good method to achieve users collaboration in the building and maintenance of a tourism database, in a long term basis.

A prototype of a Serious Game for Android was developed, in order to enable the study of the effects on tourists of an application of this kind. This prototype was deployed, which allowed the validation by user testing. A group 20 individuals was selected as test group, and tested the application in the terrain. Data was collected from their experience and, after the testing period, users were submitted to a survey in order to realize which were their feelings towards this new experience.

Results showed that Serious Games are a viable approach to achieve several objectives. Users from the test group showed to be interested in the gaming environment, enabling them to share their knowledge, possibly in a long term basis. At the same time, this approach proved to be valuable in the areas of teaching and training.

Resumo

Viajar é, hoje em dia, cada vez mais fácil. Novos e mais baratos meios de comunicação fazem com que o turismo seja uma actividade ao alcance de um maior número de pessoas. Ao mesmo tempo, os smarthphones estão a ficar na moda, e estes estão a substituir os telemóveis comuns a um ritmo rápido. É seguro supor que, num futuro próximo, todas as pessoas poderão ser capazes de obter um dispositivo deste tipo, incluindo turistas.

Existem muitas aplicações para os dispositivos móveis, e mais especificamente para smartphones, cujo intuito é ajudar os turistas nas suas viagens. Há aplicações para auxiliar o turista antes de ele proceder à sua viagem, e também para quando ele se encontra a explorar um novo sítio. No entanto, todas as aplicações disponíveis partilham o mesmo problema: como estas são criadas e mantidas por terceiros, o conteúdo das mesmas poderá não estar completo ou actualizado e, ao mesmo tempo,

A melhor informação acerca de quais os pontos interessantes numa cidade é geralmente sabida, quer por habitantes locais, quer por turistas que tenham visitado aquela cidade recentemente. Os habitantes locais tendem a saber até dos locais mais remotos e, numa outra perspectiva, estão os turistas que visitaram a cidade recentemente, que têm informação actualizada acerca do estado actual dos sítios por onde passaram. Estes dois grupos de pessoas parecem ser as melhores fontes de informação para uma aplicação direccionada ao turismo.

Uma aplicação, alimentada e mantida, pelos seus próprios utilizadores, parece ser a solução para o mau estado das informações contidas nas aplicações móveis para turistas mas, motivar os viajantes a partilhar os seus conhecimentos, a longo prazo, representa um problema. Esta dissertação aborda o problema através do uso de Serious Games - Jogos Sérios. Sendo assim, este projecto estuda o impacto dos Jogos Sérios nesta área, avaliando se eles são um bom método para conseguir a colaboração dos utilizadores na construção e manutenção de uma base de dados para turismo, a longo prazo.

Um protótipo de um Jogo Sério foi desenvolvido para a plataforma Android, de modo a permitir estudar os efeitos de uma aplicação deste género em turistas. Este protótipo foi divulgado para testes, o que permitiu a validação por testes com utilizadores. Um grupo de 20 indivíduos foi escolhidos como grupo de testes, tendo testado a aplicação no terreno. Os dados relativos às suas experiências foram recolhidos e, depois do período de testes, os utilizadores foram submetidos a um inquérito, com o fim de perceber quais foram as suas opiniões em relação a esta nova experiência.

Os resultados obtidos mostram que os Jogos Sérios são uma abordagem viável para atingir vários objectivos. Os utilizadores do grupo de teste mostraram estar interessados no ambiente de jogo, permitindo que estes partilhassem o seu conhecimento, possivelmente a longo prazo. Ao mesmo tempo, esta abordagem provou o seu valor noutras áreas, como o ensino e a formação.

Acknowledgements

I would like to thank, first of all, to my family, that helped me to overcome all the problems that I encountered while doing this dissertation. If I am finishing my masters now, I owe much of my strength to them. Thank you mom, thank you dad, thank you Enikő.

Secondly, a special thanks you to my supervisor, Rosaldo Rossetti, and to my co-supervisor, João Almeida, for always being there to support me, and for being the guiding lights throughout this project. Their support during the rough times was crucial.

The people that made themselves available to test the prototype also deserve a big share of appreciation, without them it wouldn't be possible to obtain the results necessary to achieve the required conclusions.

To end this section, I would like to thank all my friends and the rest of my family, that in one way or the other helped even if just by socializing with me and making me laugh.

Thank you to all of you, without all the support I got I wouldn't be ending my studies now. Thank you very much.

Rui Pedro Araújo Fernandes

"A goal is a dream with a deadline"

Napoleon Hill

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Abbreviations

3D	Three-Dimensional
AR	Augmented Reality
JSON	JavaScript Object Notation
HTML	HyperText Markup Language
PoI	Point of Interest
REST	Representational state transfer
RPG	Role-playing game
SOAP	Simple Object Access Protocol
XML	Extensible Markup Language

Chapter 1

Introduction

This chapter briefly presents this dissertation's context and scope. It covers the motivation behind this study and it describes the problem to be tackled. Accordingly, the methodological approach that was used is summarized and the expected contributions of this research work are discussed. The structure of the document is also defined and explained so that a more comfortable navigation throughout the document is possible.

1.1 Motivation

Globalization opened the world's doors and people wish, more and more, to travel through them so that they can meet, experience and learn other cultures. As traveling through the sky gets easier and easier, as a consequence of low cost flying companies, and as land and sea's means of transportation widen, thanks to technological evolution, tourism is, unquestionably, one of the areas that most benefits from these changes. Therefore, nowadays, tourism is a reality for the majority of the people that have interest on it.

At the time of arrival to a new city, a tourist that wants to make a pedestrian trip around it faces some problems. Where to go and what to see with the time available are some examples. In order to mitigate them, the tourist must search previously about the city's points of interest and chose those which fall into his range of interests. The main techniques to execute these searches are questioning people who have been there already, which causes the problem of finding such people between one's contacts, or by searching online, which rises the problem of the overwhelming amount of information available. Reducing the points available to the interest ones and further planning where it is actually possible to go with the time available can be a time consuming task. Unless the visitor knows someone that lives on the place to where he is traveling, locals, the ones that hold the knowledge with the most quality and precision aren't even consulted.

In parallel, mobile devices are spreading to the point of vulgarity. Smartphones are a trend in these kind of devices and with it's growth, and consequent price drop, it is possible to imagine that

in a near future the majority of tourists will be accompanied by one of these devices. Therefore, to allow these devices to be used as their owner's personal city guide is an interesting way to explore its potential, saving time and money - factors that are so important for any tourist.

Many mobile applications exist in order to help and guide tourists around a city. Typically, when one is interested in visiting a certain city he should find the best application for that local, considering that these applications are normally created and maintained by some authority that is specialized in that place. User input is reduced to opinions or classifications about each of the points of interest that they have visited or routes that one should take. Consequently, the tourists' involvement in the feeding and maintenance of these applications is very low and, therefore, this market is lacking an application that creates on the users the need to help others who wish to visit the same places where they have been or to visit their own city.

Summarizing, the amount of travelers that wish to walk around a city and see places of their interest is massive. These walkers are required to spend a considerable amount of time researching for those places and planning the route afterwards. Even though that travelers are typically equipped with their smartphone, it does not exist an application that helps them in that process at the same time that entails them to actively contribute to share their experiences and interests in a way that is useful for future visitors. Simultaneously, locals, the ones that know the core of their home place, do not see the benefit in sharing their knowledge about the places that they find interesting.

1.2 Problem statement

As described in the previous section, tourists, nowadays, typically or research what they would like to see before they travel, or use a mobile application to find places when they arrive to the planned location. Both methods are not optimal, because several problems arrive from each of them. While with the prior research users tend to get overwhelmed with the quantity of information available, by using an application the risk of incomplete or outdated data exists, since those applications are populated and maintained by a third party.

The best sources of information are the users themselves, both when they are living as outsiders and when they are in their own home place. When they are traveling they can visit the points of their interest around them and, at the same time, they are able to confirm, update or deny the information available for that place, considering that they are exactly there at a determined moment. While exploring they might even find a place which is not included and add it. In the other perspective are the local inhabitants. These know the core of the cities they live in, e.g., the best places to eat, that hidden pub that isn't listed anywhere, the shops with the best prices.

Nevertheless, the users of an application aren't willing to freely give away their knowledge or, at least, not on a regular basis. Therefore, the best sources of information for an application of this kind, are merely using that same information and not providing or maintaining it.

Considering this, the two problems addressed by this dissertation are stated hereafter.

- How to motivate people to generate and maintain collaboratively an information system for tourism?
- How to make users that use a tourism application for the first time become loyal and hence long-term users?

A possible solution for these questions is provided with this project. Hopefully it will tackle these problems and be a valid solution for other systems that intend to obtain the same kind of behavior from their users. Commitment on the part of users is a hard to achieve but extremely valuable resource.

1.3 Aim and goals

This dissertation aims to assess how, and to which extension, the integration of Serious Games, with location based games, can be used to turn tourists into long-term sources of quality information. This study provides one more step into the understanding of what an application should have in order to keep its users loyal, concurrently allowing to evaluate the success of using Serious Games in an area in which they haven't been much explored. Studying this can enable future applications in the area of location-based games and Serious Games.

Secondarily, it aims to produce an application for tourism, that can help tourists to explore the places that they travel to, in a fun and didactic way. Although the creation of this application is not the primary target, its creation allows to fulfill the main objective which is the study about the effects of the integration of Serious Games in tourism applications.

Specifically, the application should be a smartphone one, for tourists, that has the following functions.

- Generate routes according to the users' current location, interests and their time restrictions. Besides generating the route, the application should guide the tourists along the way, providing information about what's around them, as requested;
- Emerge tourists in a game environment, providing joy while using the application. Through the games that will compose the game environment, the following objectives should be achieved.
  - Incentive the users to share their knowledge with the application and, consequently, with all the users of it;
  - Incentive the users to be the supervisors of the information inserted by other users;
  - Train users to be better explorers of unknown places;
  - Teach users facts about the points of interest of the location in which they find themselves;
  - Create competition between users in order to create a long-term relationship with the application;

  - Entertain the users so that they prefer to use this application over another.
  - Advertise business in the local area without using aggressive and spam techniques.

Through the application, the primary aim of this project should be achieved, enabling the study of the advantages and possible problems in the integration of Serious Games with tourism applications. Therefore, this study has the following goals.

- Assess the success of Serious Games in creating loyalty of the users to an application;
- Evaluate if a game environment enables the will of users in sharing their knowledge;
- Measure if and with which rate of success users can work collaboratively in the growth and maintenance of a tourism information system;
- Test if competition leads users to do tasks that they wouldn't originally do unless it is the way of surpassing another user in the rankings.

1.4 Methodological approach

In order to solve the problems that this dissertation focuses into, an application consisting in a serious game working together with a robust information system are implemented. To allow this system to accompany users at all times, it is set up as a mobile application, more specifically for android.

The two problems risen basically consist in user motivation, both as how to create it and as how to maintain it over time. Games are known for being entertainment methods and for rising the competitiveness levels of its players. As long as a game is a source of entertainment for the person who is playing, it is very likely the person will play it again, having the opportunity to do so. In parallel, if a game stays competitive, if there are other users to beat and it remains being challenging, a user that enjoys playing it will continue to try to increase his level in that game. Gamers are motivated to play the games that they enjoy and find challenging.

Since the effects that players experience when they play games, are the effects that appear to be one solution to the problem that this dissertation tackles, it seems a valid approach to create a serious game for tourism, in order to try to replicate the motivation felt by gamers whilst they play. If this game about tourism successfully entertains and keeps the users' competitiveness in high levels, it is expected that they will be motivated to keep playing it and, consequently, that they will contribute to the information system's completeness and accuracy.

As stated above, a serious game will be implemented. This game, along with surveys to the users that tested the application, are the proof of concept for this project. This subsection describes the steps taken on the creation of these elements.

In order to create all the elements necessary, several concepts had to be studied in advance. The areas of Serious Games, location based games, tourism, client server communications, databases and mobile technologies were carefully studied so that implementation decisions could be made.

The studying of games, followed by a brain storm of possible ways of engaging the players into the application, was carried out with the objective of defining the games that served the intended purpose - entertaining the users, while keeping them challenged.

The application should run in the users' mobile phones and have access to a server which should contain all the information available. In order to do so, the user must possess To do so, a client-server architecture is used, in which a server is remotely accessible by all the devices. For several reasons discussed in depth in this document, web services are used to enable the communication between the server and users' devices.

As a starting point for an application of this kind, points of interest are necessary in order to enable users to have something to work on. These points of interest could be either manually added, or collected online from one of the many open data bases available. To automatize the process and to collect a large amount of points, a crawler was created to automatically search and add these points of interest to the database. Thus, when the application was released, users had already a large collection available of places to visit and work on.

1.5 Scope

This project treads several areas. In a high level overview, the work developed can be classified as a spacial-temporal problem, with social components.

It is a spacial-temporal problem because the developed application helps tourists depending on their location and on the time that they have available. The application should be a support for users in the spacial context in which they are inserted, at the same time that should let them contribute with input that is referent to that same space. The social component comes from the fact that users collaborate with each other in the maintenance of the application's health. What some users add, will be used in the future by others and, at the same time, these future users will be the supervisors of the data inserted previously. Additionally, social networks, which are a trend nowadays, can also be used to potentiate the interaction between users increasing the social component of the project. Facebook, the most famous social-network worldwide, provides tools to allow the integration of other applications with it.

In order to solve this kind of problem, another area is explored - Serious Games. This type of games is used to create competition between users, at the same type that it allows them to have fun while using the application. The three main areas of Serious Games tackled with the application are education, training and advertisement.

Considering that we have a spacial-temporal problem, solved through the use of Serious Games, the area of location-based games is inherent to this project as well. Therefore, this project enriches this area, taking into account that location based games are being used, almost entirely, with entertainment purposes only.

Summing up, this project aims to solve a spacial-temporal problem with a social component through the use of Serious Games. Being so, it implicitly approaches the area of location-based games.

1.6 Expected contributions

Hopefully the application developed should allow users to have a whole new experience when they travel somewhere where they haven't been before. Besides having help in their pocket, allowing them to visit points of interest in a simple and focused way, the game component of the application should incentive users to contribute to its completeness. Being so, it's expected that tourists take a new approach in the way that they use applications for their activities, by being sources of information and not only users of the provided data. On the same way, this dissertation should show that Serious Games are a valuable approach to create a long-term relationship based on collaboration for an utility application - in this case a tourism application.

Considering that the application developed is fully location-based, it represents a step forward in this area as well, since Serious Games are not associated with location-based applications often. The program developed is a serious location-based game, leading the way to further developments of applications of this kind

Finally, this dissertation also contributes to the field of social applications, by using social competition as an incentive to keep improving in the game. It should measure to which level the social interactions between players of a game makes them strive for a better performance

1.7 Organisation of the document

The following parts of this document are organized as follows.

Chapters 2 and 3 focus on exploring the areas that hold interest to the execution of this work.

Chapter 2 focuses on the subject of gaming. Serious Games are defined, as well as the main areas in which they are being used. The benefits of this concept and its evolution is also studied. The definition and the way location-based games are developing is also covered. The main technologies used in these games are also addressed. In chapter 3 it is possible to find a study about tourists - their interests and habits. It focuses as well in tourism in general, and the available places to gather information in this area. Important applications for tourists that are being used today are also enumerated, and the reasons that distinguish them from this project are explained

Chapter gives a thorough explanation of the steps taken in the execution of all the study. The way the problem is going to be tackled is explained as well as the methods used towards its resolution. All the technological decisions are addressed in this chapter and the test-bed used to validate the proposed approach as well. The proof of concept implemented and its functionalities are carefully enumerated and described.

Chapter provides a detailed vision on the system architecture. The architectural options taken, and the way the application's several independent parts are connected so that the game is created are indicated.

The collected data and its analysis are focused in chapter 6. Conclusions based on this data as well as the difficulties encountered in the testing phases are also described.

Lastly, chapter 7 summarizes all data and conclusions of this project. The actual results and expected contributions are assessed, followed by the problems and lessons learned during all the development. What could be done to improve this application, along with the results of those actions can be found in the end of this chapter.

Chapter 2

Serious Games

Humans have been playing games for thousands of years [oW10]. Multiple types exist, ranging from games played with dices, darts, boards and tables, just to state some. Nowadays, the trending industry is the one of digital games, a multi-billion dollar industry with millions of players worldwide. In the United States of America, it represented 24.75 billion dollars in sales in 2011 [Ass12].Playing games is known for being addictive, sometimes leading people to reach beyond their limits [Ran12]. This chapter focuses, primarily, on explaining the concept of serious games, and on studying several applications of this kinds of games known up to date. The second part of this chapter represents the state of the art of location-based games, an industry which is growing furiously with the massive spread of mobile devices.

2.1 Overview

After analyzing several authors' descriptions of what a game is, Hays concluded the following

> "A game is an artificially constructed, competitive activity with a specific goal, a set of rules and constraints that is located in a specific context. " [Hay05, chap. Working definition of a game]

In its origins, this constructed activity that fosters competition in the achievement of a set goal was created with pure entertainment in mind. Nowadays, video games are also used for other purposes other than just the joy of its player. These games, which have the primary objective of supporting some area, and not the entertainment of the player, are called serious games and are used to improve players abilities in several areas, e.g., education, military, health, social change, academic [RCV09].

Although that, at a glance, Serious Games appear to be a recent phenomenon, the term as we know today was first presented long before the computer's and electronic devices' introduction to entertainment. In 1970, Clarck C. Abt [Abt70] introduced serious games with a very close

definition to the one that what we use today. His games, specially based in board or sports forms, focused in students' education, military training and social and personal development. Due to technological evolution, nowadays, video-games play the major role in serious gaming.

A market study by J. Alvarez [ADM10] estimates that the serious game worldwide market is worth 1.5 billion Euro and it is expected that the value of sales will rise almost seven times until 2015. This study also predicts that the business world's interest in serious games will rise around 2013, especially in the small and medium enterprises, whose awareness of these tools is rather limited.

Quantifying, Figure 2.1, shows clearly that the number of serious games per year grew over time, having a substantial increase at the end of the year 2000. Another interesting fact is that the areas in which serious games are focused also vary during the years. In Figure 2.2 it is visible that the large chunk (65.8%) of the games were created focusing education. Ecology and advertisement were the other areas with the largest focus. On the other hand, after 2002, the distribution of serious games by the several areas is quite more balanced, having advertisement the lead in market share, closely followed by education, as seen in Figure 2.3. Clearly companies understood the power of serious games in the advertising of their products.

2.2 Why use serious games?

To understand why should serious games be used, it is important to first realize how games engage players. Prensky [Pre01], proposes that six structural elements characterize games and makes them motivating. Those elements, and their consequences, are the following.

- Rules, that organize the game;
- Goals and objectives, that players strive to achieve;
- Outcome and feedback, which measures progress against the goals;
- Conflict, competition, challenge and opposition, leading to player's excitement;
- interaction, the social aspect in the game;
- The representation or story exaggerating interesting aspects of reality.

These elements need to be carefully planned in order to create a fun and engaging game. If players are having fun, they will stay motivated and will strive to achieve harder and longer objectives.

Specifying, games have rules which restrain the players actions but, at the same time, they allow the users to have multiple choices at each time, giving them control over the features of the game [ML87].

Complying with the rules of the game, a player should have a clear set of objectives at each point of the game [FF02]. These objectives should also be preceded of some kind of "briefing" that describes the current task and suggest the tasks that players might find ahead [PKW+02].

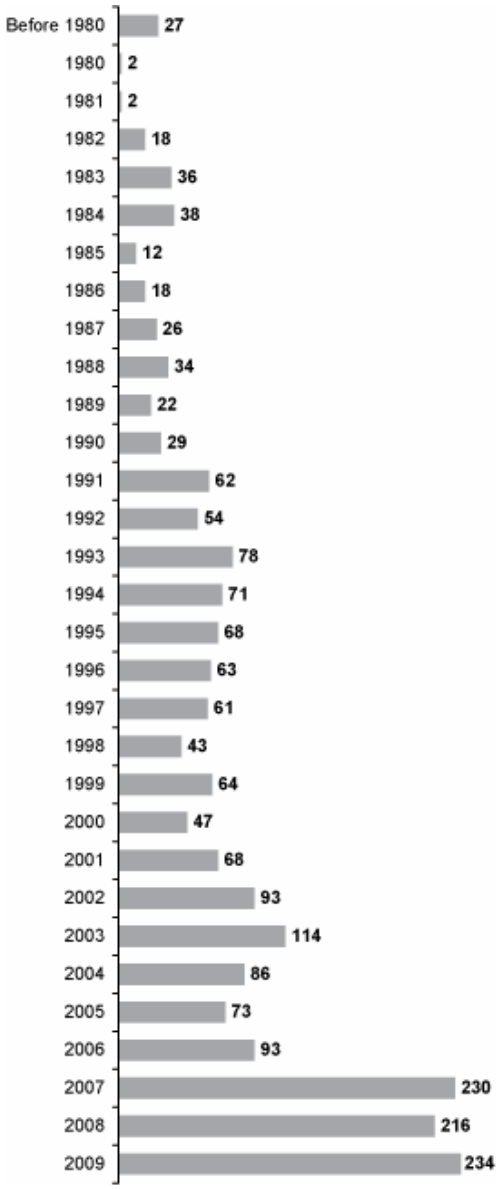

Figure 2.1: Number of serious games released each year [2218 games] (from [DAJR11])

The progress through the objectives of the game should be clearly identified with feedback at appropriate times. Users should get indication when they lose, and directions on the correct direction afterwards [Gee04], as well as rewarded with feedback on progress or success [Laz04]. The feedback's timing is of major importance, because people are quite poor at understanding and remembering information they have received out of context or too long before they can make use of it [Bar99], therefore, feedback at the exact time when it is necessary is crucial.

In order to keep the game exciting, the player should be presented with several and distinct challenging situations [Smi99]. These challenges should always be preceded of others with similar tasks, because players tend to adapt in light of experience [Voc04]. This wish to be challenged, even with one's own previous achievements, is probably the most important motive for interac-

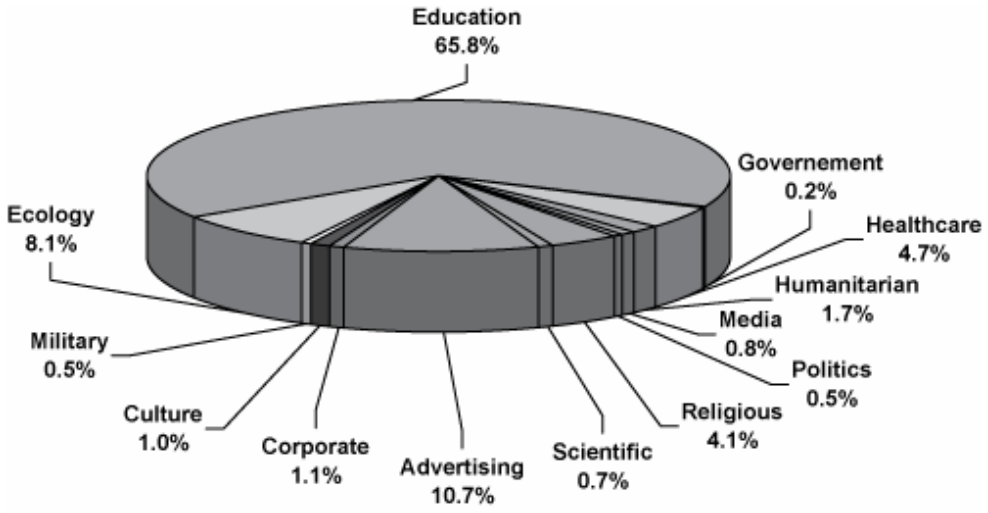

Figure 2.2: Market repartition of serious games released before 2002 [953 games] (from [DAJR11])

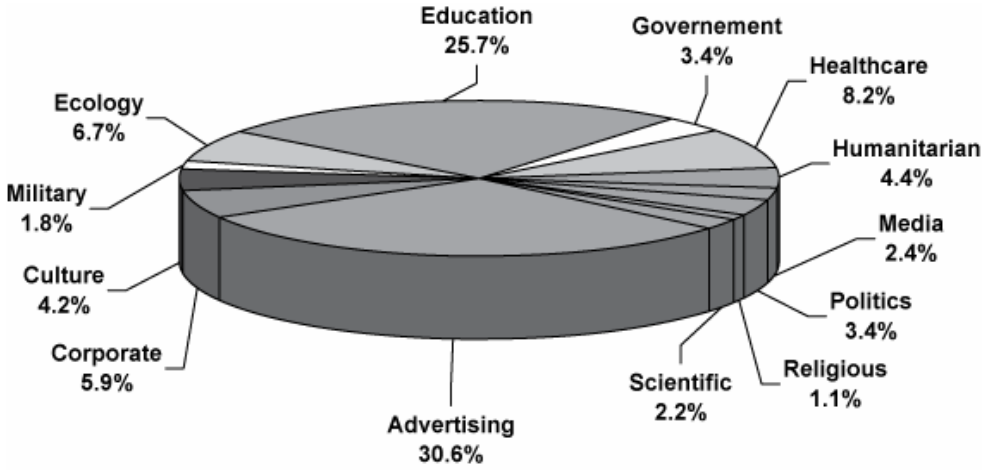

Figure 2.3: Market repartition of serious games released after 2002 [1265 games] (from [DAJR11])

tively entertaining [VHK03]. Players feel rewarded just for accomplishing progress, therefore most of the times, an explicit reward is not even necessary, as progress is its own reward [LK04]

Social interactions play a major role as well. Even though this kind of interactions can interrupt immersion in games, as real people represent a link to the real world, and this fact can knock players out of their fantasy game worlds [SW05], social interactions get people to play games even if they don't enjoy playing at all or don't enjoy that particular game [Laz04]. People enjoy talking about a game, gloating when beating a friend, feeling proud on themselves when they win [Laz04, SJSW03]. A lot of players spend hours participating in the virtual community of a game, chatting, forming clubs and associations and consider it a large part of the attraction of an online game [Cor04].

The story in which a player is contextualized, while he plays, is defended by advocates of narrative in game design as a mean of creating a more immersive and engaging gameplay [Ada01, Bri01]. This narrative is even a medium for contextualizing learning in meaningful ways, as it creates a rich and engaging experience [MRLL08]. Typically a narrative arc includes the beginning of a story, a medium arc of conflict climaxing before the denouement [Dic05]. The narrative can be linear but the acceptance of player input interferes with and alters the nature of a linear narrative [Ped03]. One of the strategies to infuse plot into gameplay includes branching stories, in which the player's choice influences the storyline and the outcome [RO05]. Another is to keep the narrative intact but to allow players choice in the order in which they access the various components of the story [RO05].

Summarizing, these game elements, when carefully taken into account, allow the production of a game that enrolls the players in a fun, addictive and motivating activity. Considering that motivation is the key factor to learning [Fri97] and is crucial, as well, iin the assimilation of skills, during training, for example, it's safe to assume that games are good tools to be used with different purposes than just entertainment.

The following chapter shows some of these applications, across several areas, at the same time that analyses the efficiency of this approach.

2.3 Applications of serious games

Serious games have been applied to a whole range of areas. In this section, several applications of this kind of games will be discussed, enlightening in the reasons for using serious games, the approach used and its outcomes. Note that only the main areas were investigated thoroughly, since the concept of serious games is being applied to a large number of sectors.

2.3.1 Education

Being living in the information age, nowadays' children spend, in their majority, a large part of their childhood playing video games. The time they spend playing is often questioned as if it wouldn't be better applied into playing outside or in doing schoolwork. As kids feel bored to study, but motivated to play games, teachers, researchers and designers of learning resources, are studying how this powerful medium can be applied to education. Kirriemuir [KM04] refers two key points in associating these two activities.

- The desire to harness the motivational power of games in order to 'making learning fun';
- A belief that 'learning through doing' in games such as simulations offers a powerful learning tool.

This association from games and education, is called *edutainment* [FSSA06]. Even though the exact benefits of using games to boost the learning process haven't been successfully measured

yet, educational games are known to, at least, be able to improve reasoning skills and higher order thinking [MAY90, WS87] and to increase the retention of subject material [D+94, JD93].

Taking this into account is not surprising that video-games have been successfully implemented as educational processes, and not only for children.Tactical Language Training System was a project used to help learners acquire basic communicative skills through a combination of interactive lessons and serious games [JMM+04]. In the first evaluations conducted, learners found the system to be more effective than the instruction that they had in a classroom, and that they would be happy to take the system home and play in their free time. On the other hand, the system presented some problems with the pronunciation system, being it too strict. Figure **??** shows a screenshot of the game.

Figure 2.4: Screenshot of the game Tactical Language Training System

Savannah is a mobile game designed to encourage the development of children's conceptual understanding of animal behavior [FJS+04]. In this game students role-played as lions, having to simulate their behaviors in the savannah. Students showed interest in the fact that they were learning by interacting and not by reading, and they realized how risky the life of a lion was. Figure 2.5 shows an example of the use of the game.

Freitas *et al.* [dFL04] refers Max Trax, a driving game created to engage new adult learners for developing numeracy skills. In the game players had to answer to mathematical questions in order to advance in the track and in the process of comparing cars in terms of costs. The game achieved a completion rate of 68% in its first 7288 users.

Figure 2.5: Savannah game in the handheld devices. Players in these situations are receiving a "sight" (left) or a "smell" (right)

Pierre-Majorique [LM06] Leger proposed a turn-based game to teach ERP concepts to students, using. In this game students have to run a business with a real life ERP(SAP R/3). This approach was successfully tested with both undergraduate and graduate business administration students. Those students who participated in the business game appeared to have better assimilated the concepts of the subject, comparing to those who didn't use it. They also seemed better prepared for some following subjects about the matter. In addition, 93

Rania Hodhod *et al.* [HKC09] combined narrative techniques with intelligent tutoring techniques in a single model, creating adaptive educational interactive narrative system (AEINS). This AEINS, is an inquiry based game, to support teaching ethics to students in the ages between 8 and 11. The game presents and involves students in different moral dilemmas at the same time that tracks the students performance and evolution. This study was still to be tested with a large number of students, but the results it obtained at the time of the paper showed promising results.

As shown, serious games have been used with success in a multitude of teaching domains. Although results are hard to be quantified to obtain a exact success rate, all the experiences show improvements in relation with traditional methods. A mid-point between the traditional methods, and the full use of games, should be attained, in order to obtain the maximum potential from this kind of digital adventures. Too often educators and designers try to make things "easy" for learners, thinking that the easiness of tasks attracts people to them [Res04] but, as shown by

Mihaly Csikszentmihályi *et al.* [CKB04] this is not true, as people become most deeply engaged in activities that they find challenging as long as not overwhelming.

2.3.2 Training

In order to master a task that requires skill, one has to spend a considerable amount of time training it. The larger the quantity of times that a task is repeated, the larger the amount of time spent on training it, the better results are expected. Nevertheless, some activities are just too expensive, dangerous or time-consuming to repeat the desired times to achieve the desired rate of success.

Computer-based training has already been applied to several areas, such as military training, aviation, medical training or even business training. In some companies and institutions, this kind of training is even part of the standard method, being applied, usually, in parallel with training in real environments. Although developing a game with high fidelity and quality is not cheap, it is still cheaper than practicing the real methods in a large number of cases, such as military training, and allows for a large number of repetitions that would be hard to simulate in real-case scenarios, such like emergency landings or reaction in catastrophe scenarios.

The military was the main driving force in this area, trying to apply computer games to train its soldiers. Although many earlier programs were developed and used, the first game to reach massification and popularity was the game America's Army, which was used both to attract and train new recruits to the American army [ZMW+03, FSSA06]. After just six months of being released, it already counted with over one million registered users. This game was so successful because it was extremely realistic in terms of visual, audio, weapons and physics representations (crucial factor to its end), but it dealt as well with setting specific tasks for each player in a mission and implemented a simulation of a military career. All these facts allowed the game to be successful, proving to be a worthy investment. A screenshot of the gameplay is visible in figure 2.6.

Figure 2.6: Screenshot of the game America's Army

In the health area, Knight *et al.* identified benefits in using Serious Games to train medical staff in the process of triaging victims on their arrival at a hospital. People trained through this method performed better than a test group trained with the classic card-sort exercises, achieving better results on the accuracy with which they tagged the victims regarding the gravity of their condition, and performing better as well in the decision of which methods to be applied to the patient. Similar outputs regarding the time taken to choose the correct methods were verifiable in the 2 groups though.

Sidh is a game based firefighter training simulation [BEH+07] used, as the title states, to train firefighters through the use of a game. In this game, players are immersed in a virtual world, where their actions in the physical world correspond to interactions with the game, using sensors, and, due to this fact, some game tasks requires heavy physical effort. Figure 2.7 shows a user playing the game, as well as an in-game screenshot. This game achieved the required results, proving to be fun and having the trainees showed improvements through the use of it. The implementation of a platform of this kind in firefighters headquarters would allow, for example, for firefighters to train voluntarily in their idle hours, since they affirm having fun with it.

Figure 2.7: Sidh game. On the left, a real user playing it. On the right, an in-game screenshot

Serious Games are also being used to train common people in the evacuation of buildings in fire [CR09, RAR+]. 3D games are used to simulate a fire scenario, and users control an avatar with the objective of exiting the building. Although actual results of improvements couldn't be achieved, these works prove their importance in the attainment of behavioral data in fire-situations, allowing a study for further developments in the actual training.

Summarizing, Serious Games are proving to be worthy tools in training in the most varied situations. Their game component allows players to stay motivated, thereby performing tasks that would be considered dull in real training. These voluntary training achieved leads to eventual positive results.

2.3.3 Advertising

Games, have also been used for advertising a product or company. These serious games are often called advergames, and are showed a considerable evolution in terms of quantity in the recent past. Advergames create a relationship between the user and the company, through the interaction

obtained by using the game, becoming persuasive since the user feels the freedom that he gets from choosing the narrative actions[FC12].

At the same time, as a game has multi-platform capabilities, and if it is enjoyable, it will pass from person to person, creating advertisement, passing the advertising company's message in a viral way[Oli]. Wise [WBK+08] studied the relationship between attitude toward the game and attitude toward the brand, and states that the change in brand attitude attributable to game enjoyment is stronger for product-relevant advergames than for product-irrelevant advergames.

One of the earliest games of this kind was Tooth Protectors[Ada98], released in 1993, used to advertise the American pharmaceutical and consumer goods manufacturer Johnson & Johnson. In this game players had to protect the teeth, using dental floss from the candy that keeps falling from the top of the screen.

In a more up to date point of view, there is the example of the BBC Top Gear game [KoK12]. This game is designed for Facebook, where its users can test their driving skills with a driving simulator. This shows the interest in developing these kinds of games for several platforms, to reach the largest number of users possible. Examples of the 2 games mentioned previously can be seen in figure 2.8

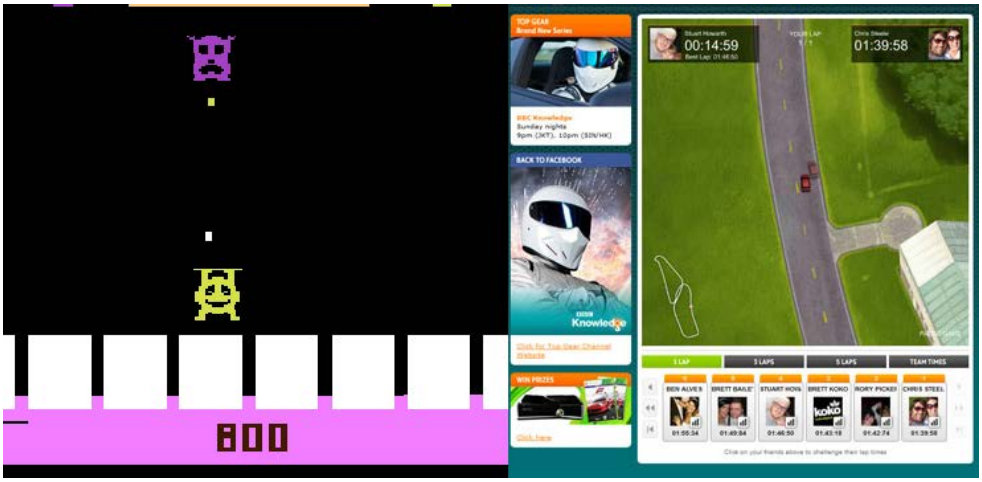

Figure 2.8: Screenshots of advergames. On the left a screenshot of "Tooth Protectors" game. On the right a screenshot of "BBC Top Gear" game

2.4 Guidelines to create a serious game

As Serious Games have a non-entertainment goal as a main objective, means to achieve it must be studied and compared.

Yusoff *et al.* [YCGW09] propose a framework to be used as a reference when designing a Serious Game. The authors focus their attention on nine aspects that the developers should take into account:

- **Capability** - cognitive, psychomotor and affective skills that the user is intended to develop;

- **Instructional Content** - the subject that the user is intended to learn;
- **Intended Learning Outcomes** - combination of capability and content that the user is expected to acquire;
- **Game Attributes** - game characteristics that must be present to create an engaging and meaningful experience;
- **Learning Activity** - tasks and methods that the player must perform, along with learning materials and feedback;
- **Reflection** - activities created for the user to weigh in what he learned and think how to tackle the next challenge;
- **Games Genre** - game category based on its gameplay and challenges;
- **Game Mechanics** - set of constraints that determine the players' interaction and how the game is played, based on its genre;
- **Game Achievement** - measurable value on how much was accomplished that can be used to adapt further activities to the players' levels.

However, this presented model does not consider interactions between players. Wendel *et al.* explore this possibility in [WHGS10] and set a clear distinction between "cooperation" (simply splitting tasks among players) and "collaboration" (weighed effort to tackle a challenge as a group which leads to a greater outcome than the sum of the individuals' effort). The authors recognise that collaborative behaviour must be encouraged by setting common goals for group members and distributing knowledge, tools, roles or possible actions to the users in such a way that all of them are considered necessary. They also mention that, for the experience to be repeatable, a certain amount of randomness must be present so the challenges vary over time. Still, this can not be exaggerated, as too many unexpected events can cause instability within the group.

2.5 Summary

As discussed in this chapter, the concept of serious gaming is not a recent one but, over the last few years, it has deserved a large amount of attention from the scientific community and even from the industry.

This software has been giving proofs of its potential as a method of educating, training, advertising, and others, at the same time that keeps the player with high motivation levels. With the nowadays *technology-focused society*, these "utility games" represent an opportunity to reach individuals that feel bored and, consequently, uninterested with traditional methods. In some areas these games even correspond to a cheaper alternative relatively to the preceding approaches.

Chapter 3

Tourism

3.1 PoI Gathering

In this chapter the problematic of PoI gathering will be focused. The final application to be developed during this thesis should be able to gather PoIs from multiple sources and this chapter will focus on the state of the art of those sources and how data can be collected from them.

Different agents should focus in gathering data from different sources, maintaining an high abstraction level. This means that the data sources should be studied so that the agents may collect interesting data from them.

Mainly, three sources of information will be studied: public databases, social networks and the users of the application themselves. Those sources will be studied in detail in the following sub-sections.

3.1.1 Public Databases

Public databases are a huge source of information. These databases are available to the average user and provide some way to freely download the information contained in them. Besides the easiness to obtain information, these databases are also valuable because they are usually built by the users. Since the users posted the contents, it's expected that these contents may have interest to other users looking for data in the same context.

3.1.1.1 OpenStreetMap

OpenStreetMap is a free editable map of the whole world. It is made by any user interested in participating in the project.

This website allows to view, edit and use geographical data in a collaborative way from anywhere on Earth. It was created to allow people to have a completely free map which they could use in any way that they wished, without any legal restrictions [Ope11]

Through the use of Xapi[1], a read-only OpenStreetMap Extended API that provides enhanced search and querying capabilities, it is possible to easily access the data contained in the OpenStreetMap's database. To obtain PoIs, the API can be used as described below.

```
http://open.mapquestapi.com/xapi/api/0.6/node[key=value][bbox=LEFT,BOTTOM,RIGHT,TOP
    ]
```

Listing 3.1: Query format using the XAPI API

The arguments on the query should be modified according to the data to be obtained. This data will be returned in XML format. The pairs *[key=value]* define the type of PoI to be researched, while the argument *[bbox=LEFT,BOTTOM,RIGHT,TOP]* define the geographical area to be searched. The following query is an example of how to obtain historical monuments in the Porto area.

```
http://open.mapquestapi.com/xapi/api/0.6/node[historic=monument][bbox
    =-8.751,41.116,-8.441,41.244]
```

Listing 3.2: Query to obtain historical monuments in Porto

Should be noted that the query above returned nine results. An example of one of the monuments listed can be seen below.

```
<node id="411630292" version="3" timestamp="2011-05-10T07:18:14Z" uid="132740" user
    ="Creando" changeset="8099601" lat="41.1456706" lon="-8.6145526">
  <tag k="name" v="Torre dos Clerigos"/>
  <tag k="tourism" v="attraction"/>
  <tag k="historic" v="monument"/>
</node>
```

Listing 3.3: Example of monument returned by the query 3.2

Considering that this database only provides the name and location of the PoIs, it should be used as a starting point to make an initial list of PoIs in the area. This list should be then improved with information about each of the PoIs.

3.1.2 Google places

Google places is a database for PoI that is populated either by common users that just share a site, or by business owners, that use the platform to advertise their enterprise. All the users may rate and review the places, thereby enriching the database. In the picture 3.1 is presented an example of a PoI in Google places.

[1] http://open.mapquestapi.com/xapi/

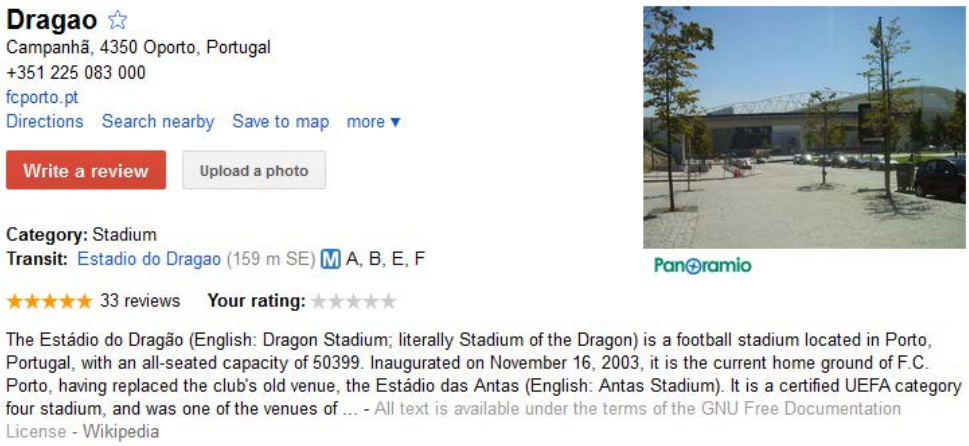

Figure 3.1: Example of a PoI in Google Places

The Google places API is a service that returns information about Places — defined within this API as establishments, geographic locations, or prominent points of interest — using HTTP requests. Place requests specify locations as latitude/longitude coordinates. The four basic Place requests available are listed below.

- **Place Searches** — return a list of Places around a specified location;
- **Place Details** — return more detailed information about a specific Place;
- **Place Check-ins** — report that a user has checked in to a Place;
- **Place Reports** — allow to add new Places to the Place service, and to delete Places that were previously added.

All the requests to the API return JSON or XML results.

Considering the available requests, it's possible to gather data about PoIs in the desired locations using the *Place Searches* request. For each of the individual results gathered, detailed information about it can be easily obtained using the *Place Details* request. From this detailed information it's possible to extract, among others, the name, type, address, GPS coordinates, average rating and the url to the page showed in picture 3.1 of each PoI. Note that the user's reviews are still not available through the API so, if necessary in the future, they should be obtained through the parsing of the html contained in the url referred above.

Place Check-ins and **Place Reports** aren't useful in the point of view of data gathering, but they can be utilized to allow the user to collaborate to this open database. These functionalities won't be discussed here since they don't represent a priority.

3.2 Social Networks

Social Networks are definable as a web-based service that allows users to create a somehow public profile within a bounded system, create a network of connections to other users and scroll and explore other's connections network [mBE07].

According to the definition above, the first recognizable social network site was launched in 1997. SixDegrees.com allowed users to create profiles, list their Friends and, beginning in 1998, surf the Friends lists.

Since those days, social networks grew to an impressive dimension, being used by millions of users all over the world. The most used social network nowadays - Facebook - has over five hundred million users[2].

According to a study, this growth is due to two main factors [fCG08]. Firstly, the networking factor itself - the ability to connect with people that have something in common (location, interests, hobbies, etc.). Secondly, the supposition that internet users want to share their own content, without having to care about creating and maintaining their own website.

Thus, these networks represent a place where millions of users freely share their knowledge and interests. So, it's possible to affirm that these networks represent a huge data base of information where, a part of it, is related to places in the world and people's opinion about them. In the following sections, PoI data extraction from these networks will be discussed, so that it is possible to understand where and how the agents to be created in this dissertation should gather information.

3.2.1 Facebook

Facebook, due to its user base, has an enormous amount of data with possible interest to many parties. Aware of this fact, Facebook's creators have tight privacy rules that forbid automated data collection without their written permission.[3] Even though an authorization is needed for automated data collection, several methods to obtain that data were studied.

Even though crawling through users profiles, connections, photos and so on, would generate a large amount of information, it wasn't found a way of giving value to that data in the context of our problem. For example, if a user updated his status saying that he was in the PoI "X" or posted a picture of some PoI, that would possibly generate feedback from his friends and, therefore, this data could be useful for the system to implement. The problem is that extracting this information would require techniques to analyse text and image, without the certainty that the extracted data could be well characterized and classified in order to be usable.

Taking this into account, useful Facebook data can be extracted, for sure, from their new application: Facebook Places. This application allows users to create places that will be stored as Facebook profiles. To access these profiles, it is necessary to use the Facebook Graph API.

[2] http://www.digitalbuzzblog.com/facebook-statistics-stats-facts-2011/
[3] http://www.facebook.com/apps/site_scraping_tos_terms.php

Graph API allows to access every object in Facebook's social graph by a series of HTTP request, which return results in JSON. These requests have the following format.

```
https://graph.facebook.com/ID
```

Listing 3.4: Query format in Facebook's Graph API

Replacing the *ID* by one existing ID in the database, it is possible to access the public information on that profile. An example of a response to a query which is a Place can be seen below.


```
{
   "id": "153817204635459",
   "name": "Empire State Building",
   "picture": "http://profile.ak.fbcdn.net/hprofile-ak-snc4/277044
       _153817204635459_6128836_s.jpg",
   "link": "http://www.facebook.com/empirestatebuilding",
   "likes": 63748,
   "category": "Landmark",
   "website": "http://www.esbnyc.com/",
   "username": "empirestatebuilding",
   "description": "Exciting Exhibits Now Open!  The new exhibit Completion by May
       1, 1931 on the 80th floor chronicles the construction of the global icon
       with breathtaking photos and construction transcripts. Visit the interactive
        Sustainability Exhibit on the 2nd floor and learn about the Empire State
       Building\u2019s energy efficiency initiatives.  You can see them both free
       with paid admission to the Observatories.  Join us today! ",
   "location": {
      "street": "350 Fifth Avenue",
      "city": "New York",
      "state": "NY",
      "country": "United States",
      "zip": "10118",
      "latitude": 40.74845310716,
      "longitude": -73.985568859921
   },
   "public_transit": "34th St-6th Ave (B, D, F, V, N, Q, R, W)\n33rd St-Park Ave
       (6)\n33rd Street (PATH)\n",
   "hours": {
      "mon_1_open": 403200,
      "mon_1_close": 468000,
      "tue_1_open": 489600,
      "tue_1_close": 554400,
      "wed_1_open": 576000,
      "wed_1_close": 36000,
      "thu_1_open": 57600,
      "thu_1_close": 122400,
      "fri_1_open": 144000,
```

```
31        "fri_1_close": 208800,
32        "sat_1_open": 230400,
33        "sat_1_close": 295200,
34        "sun_1_open": 316800,
35        "sun_1_close": 381600
36     },
37     "phone": "212-736-3100",
38     "checkins": 36013
39  }
```

Listing 3.5: Result to the query with ID = 153817204635459

From a Place profile, it is possible to retrieve, if available, the following information.

- likes;
- category;
- description;
- city;
- country;
- GPS coordinates;
- checkins;
- website;
- location (street, number);
- photos.S

This information is, assuredly, useful for a database of PoIs. The main problem resides in finding the profiles which are Places, since Facebook doesn't provide any way of searching only for them.

A way to overcome this obstacle is crawling all the profiles available, identifying those which are Places. But, the 64-bit range ID adopted by Facebook poses a hard to overcome temporal barrier, since it would take years for a single computer to scroll through all the IDs. Therefore, to capture useful data, would be necessary either, too much time, or a large number of machines. Neither of those will be available during the implementation of this dissertation, fact that leads to let the Facebook option aside.

3.3 User's contribution

The PoI data bases described in the previous sections are mainly user fed. Users of those applications take the initiative of adding their own PoI, making these databases increasingly complete, at the same time that they comment and rate others additions.

So, following the same line of thought, it's acceptable to think that the users of the application to be developed in this dissertation will want to participate by adding their own PoI. These PoI will be an addiction to those already existent, - collected elsewhere - and they should also be interested in rating and commenting the PoI already available. Therefore, users might be classified as another source of information, as viable as the information collected automatically by the application's agents.

3.4 Route Generation

Route generation consists in generating a route, from a given set of PoI. Considering that we are generating routes for tourists, each PoI should have a score to the tourist to whom the route is being generated for. Finally, the goal is to find the optimum route, i.e. the route which satisfies the tourist the most (the set of PoI in which it passes sums up the highest score possible).In this particular context, it is also necessary to take into account that the distance between PoIs can't be elevated because we want to generate walking routes.

As route generation has been explored by multiple times over the last years this chapter will focus in the related work that already exists about this subject.

3.4.1 Related Work

Dynamic Tour Guide [Kra07] generated and recalculated routes in real-time (less than five seconds), the routing algorithm was very simple and it had important restrictions: it could only create proper solutions for one day routes and a small number of POIs.

A PET called P-Tour [Mar04] applied a genetic algorithm to calculate routes. Nevertheless, tourists had to manually enter the POIs they wanted to visit with their details (visiting time, duration and tourist score). Moreover, the system needed nearly ten seconds to obtain a route for just twelve POIs.

Zenker et al. [Zen09] presented ROSE, a mobile application assisting pedestrians to find preferred events and comfortable public transport connections composed by three main services: recommendation, route generation and navigation. They identified the route planning problem to solve and they described it as a multiple destination recommendation with public transportation and time windows. This is the same problem we propose. However, they did not find any algorithm able to solve it.

In another paper [AGS09] this problem is treated as a Time Dependent Team Orienteering Problem with Time Window and was solved with an heuristic based on the Operational Research's algorithm Iterated Local Search. It was able to be solved in real time, taking 5 seconds to find the routes in 50 PoI. This system included bus and it calculated the routes with help of a matrix with pre-calculated times of travels between all of the PoI.

3.4.2 Distance between two Points

To be able to generate any route, the distance between the PoIs must be known. In order to calculate that, it is possible to use The Google Distance Matrix API. This API can be used as follows.

```
1 http://maps.googleapis.com/maps/api/distancematrix/output?parameters
```

Listing 3.6: Query format using The Google Distance Matrix API

- The element *distancematrix* contains the matrix of points between which the distances should be calculated.
- In the *parameters* it is possible to select parameters like walking distances or the units in which the result will be given

Chapter 4

Methodological Approach

4.1 Problem Statement

Nowadays, tourism is an activity accessible to a large part of the world's population, due to the constant expansion of the means of transportation. For those who have interest in it, and the resources to do it, many tasks have to be performed in the time prior to the traveling itself. Tourists need to research what they would like to see in their travel destination, whether using books, online resources or friends. After this research period, they are still required to create a route that allows them to visit the places they are interested in, taking into account the time that they have available. All these tasks are very time consuming, and they are just impossible without the required free time.

At the same time, smartphones are evolving, getting cheaper, becoming an alternative to the regular, simple, cellphone. Due to this, many of today's tourists have a smartphone and the tendency is that most of them will have one in a near future. With this in mind, there are several applications in the market to support tourism activities (chapter 3). A whole range of these applications exist, but they typically share the same problems, considering that they are created and maintained by third-party entities. Those problems are the following.

- Contents are incomplete or outdated;
- An application focuses in a specific area;
- Contributions from the users themselves are reduced to classifications and comments.

A solution to these problems could be having the users be the sources and the maintainers of the information available in an application of this kind. But, in order to have that happening, users would need to be motivated in contributing with their knowledge and, to reach a good quality standard in the information, in spending their time confirming the data of other users. This motivation would have to be kept, as well, for a large period of time, so that users could feel part

of a community and reach long term collaboration. Therefore, this dissertation tackles two main questions, that are:

- How to motivate people to generate and maintain collaboratively an information system for tourism?
- How to make users that use a tourism application for the first time become loyal and hence long-term users?

The approach followed in this project, to answer both of this questions, was the merging of serious games with a tourism application, thus creating a serious game for tourists. Therefore, it's intended that, through games, tourists will be eager to contribute to the application in order to progress further in the game. At the same time, through games, they should feel joy in using the application so as they keep using it.

Ultimately, the main research question of this dissertation is: **Are serious games a viable option to motivate people to collaboratively create and maintain a tourism system in a long-term basis?**

4.2 Project Description

Serious games can be a choice to consider in order to address the aforementioned issues. Their potential to make tedious tasks become enjoyable is considerable and have been used in a wide range of areas (can be consulted in chapter 2.3).

This project intends to access whether Serious Games are a good mean to achieve long-term collaboration from tourists in the creation and maintenance of a tourism database. To evaluate if Serious Games are a good solution, a test-bed was created, which consisted in an Android application, followed by a testing period with real test-subjects, concluded with a survey executed by the same test-subjects, in order to access the effects of the application in them, as well as their opinion towards it.

The android application focuses in creating a gaming environment for its users. This application rewards users for exploring a new place, as well as for contributing with their knowledge about their new discoveries or about their hometown. The application communicates with a remote server, through an internet connection, in order to obtain data. All the communications are done through Web Services, so that the server's data can be used by a multitude of platforms without any costs.

After developing the application, a test group was selected and the application was tested, by the users belonging to the test group, in order to obtain real results from its use. All the data gathered from the user's interaction was stored. When the test-period was over, the testers were submitted to a survey, in order to evaluate the application's effects on the users, as well as the player's opinion. The data recorded while the players were using the application, plus the answers to the survey, were the basis of the results analysis, accessible in chapter 6, and the conclusions taken about the effectiveness of the approach used in this project can be consulted in chapter 7

4.3 Expected Contributions

This project intends to contribute to the community both practically and scientifically. Practically, it should contribute to create a better experience for tourists, helping them in their trips at the same time. The practical contributions of the project are an application that:

- Allows users to take routes in a city according to their available time, interests and current location;
- Involves users in a gaming environment, so that they have fun using the application, at the same time that creates a long term-relationship;
- Allows its users to contribute with their knowledge about PoIs;
- Uses the users as controllers of the contained information;
- Trains users to be better explorers of cities;
- Teaches users interesting facts about the places they visit;
- Is easy to expand to other platforms, so that in the future all kinds of users can be reached.

In a scientific point of view this dissertation contributes in several areas.

The area to which it contributes the most is the one of Serious Games, to which it represents an important step forward. This concept is being applied to several areas, but the applications for tourists using it are almost unexistant. Considering this, this project opens the door to further investigation in the association of Serious Games and tourism applications.

Parallelely, it contributes to the area of location-based games, bringing a new application to it. This application encloses games, surrounded with a gaming environment, that are strictly location based. Therefore, it represents a step forward to the area of location-based serious gaming.

Lastly, the completion of this project allows to address a really important issue nowadays, which is the user's motivation towards the use of an application. The use of Serious Games to achieve motivation is an approach frequently used, but in this case it focuses in creating motivation for collaboration and long-term use of an application, not only motivation for learning or practicing some skill, as it is commonly used.

4.4 The Game Concept

A serious game is a game which involves the players around a real purpose. In this thesis, the purpose is to create the largest database of PoIs possible, being the users/players the providers of the information. With this in mind, it is important to identify what challenges the players will look for in a game of this genre. Players should be pushed to share their knowledge about the cities that they know and, at the same time, get rewards for sharing that knowledge. These rewards can vary since the "simple" public recognition, to some tangible rewards. Summarizing it is important to

identify which actions will increase the players score and what can be done with this accumulated score obtained through actions that increase the quality of the community.

This section focuses in explaning the game environment thought for this system, while the games themselves are explained thoroughly in chapter 5.

4.4.1 Point System

In order to create the desired competitive gaming environment, a point system was created, so that users would be rewarded for their actions in the game. Table 4.1 contains all the actions that are considered rewardable, and the corresponding points awarded for completing them.

Table 4.1: Rewarded actions and corresponding points

#	Action	Points
1	Addition of a new PoI	90
2	Addition of missing information about an existing PoI	30
3	Adding pictures about a PoI	25
4	Checking-In in a PoI	15
5	Completing a Circuit	50+n*10 (n = hours spent)
6	Completing a Quest	50+n*10 (n = consecutive quests)
7	Failing a Quest	10
8	Using the "Questions/Answers" game	10
9	Answering correctly to "Questions/Answers" question	20
10	Kilometers covered	5/km
13	Confirmation that the reported information is incorrect	15
11	Wrong or invalid addition of a new PoI	-100
12	Addition of wrong information about an existing PoI	-80
13	Adding faulty pictures	-30

As it can be seen in table 4.1 the addition of new information into the system is highly rewarded. This happens so that users are encouraged to contribute with their knowledge. In the opposite direction, inserting faulty information into the system is highly punished, in order to discourage this type of behavior. Users shouldn't feel like they can abuse the system just to climb the rankings.

The action referred in number "4" is when a user declares that he is at some place. The truthfulness of this statement is achieved by verifying the GPS position. It is important to refer, though, that passing a point in the "Circuit" game or finding the point in the "Quest" game is considered a check-in and, therefore, the Checking-In points are rewarded. This enables a user that didn't complete the "Circuit" game which he started to still get some points from the progress until the place where he finished.

The kilometers covered using the application are also rewarded, even if the user isn't playing any game at the moment. This is used in order to encourage the use of the application, although

the user isn't interested in playing in that exact moment, since having the application turned on boosts the chances of using it for a valuable action.

The referred point system is used in order to create a players' rankings, so that users are emerged into a competitive environment. As the actions of the users make them gain or lose points, users are encouraged to play the games and contribute with their knowledge, allowing them to go upper in the rankings and be able to compare themselves with other users. Even if a user is using the application only for its touristic capabilities, that user will be gaining points. With these points, that same user will be awarded a rank in the game, and it might sparkle the competitive side inside of him.

4.4.2 Rewards

Players are rewarded for actions on the game. These rewards build the player's score. Now, it's important to analyze which advantages the player should get for achieving high scores in the game. Since a game should engage its players both in short and in long-term, these two kinds of rewards were implemented.

Short-Term Rewards

In order to keep the player motivated, and give regular rewards, the badge system was created. This badge system rewards the users for achieving an increasingly quantity of each of the rewardable actions in the game, existing levels for each kind of badge. The table 4.2 shows the badges available and the quantity of actions necessary to obtain them.

Table 4.2: Badges achievable and corresponding actions

Badge	Action	Quantity Necessary
Beginner/Good/Pro/TOP Hunter	Complete Quests	3 / 25 / 75 / the most
Beginner/Good/Pro/TOP Tourist	Checking in	10 / 50 / 125 / the most
Beginner/Good/Pro/TOP Buster	Identifying wrong Information	3/ 15 / 50 / the most
Beginner/Good/Pro/TOP Pilgrim	Using the application	10 / 50 / 125 / the most
Beginner/Good/Pro/TOP Book-Eater	Answering questions correctly	10 / 50 / 150 / the most
Beginner/Good/Pro/TOP Explorer	Completing Circuits >2h	3 / 25 / 75
Beginner/Good/Pro/TOP Gastronome	Checking in restaurants	5 / 25 / 75
Beginner/Good/Pro/TOP Party-Animal	Checking in bars/clubs	5 / 25 / 75
Contributor of the day/month	Achieving most points	most of the day/month
King Tourist	Achieving most points	Most points in general

As it can be seen in table 4.2, most of the badges reward specific actions in the game, evolving with the quantity performed. But, to create even shorter incentives, "Contributor of the day" badge exists, to boost the player's motivation through a journey using the application. Hopefully the badge system is a good incentive to achieve contribution and activity from players.

Long-Term Rewards

To achieve a longer use from its users, a long-term relationship should be achieved. Besides being careful about creating an appealing and useful application, other techniques were used to try to gather users' interest. The point-system referred in 4.4.1 is used to classify actions, and the points gathered are used to create a players ranking. So, users can check where they stand in the overall picture, and strive to get better, by comparing themselves with others.

Besides this, when users earn points, their character in the game gains levels. This pushes users to try a bit harder as they progress in the application, because more experience is necessary to level-up as each level passes. The formulas used for this level system are the following:

- **Points to next level** : 250 * currentLevel * (currentLevellevel + 1);
- **Current level** - FLOOR [(1+SQRT(currentPoints/31,25+1))/2].

These formulas allow to calculate in which level the user is and how many points does he need to get to the next level.

Hopefully, the global rankings, paired with the leveling-up system, create in users a constant need to achieve better results. In affirmative case, a long-term relationship might be accomplished.

Physical rewards

People are known to be extra motivated when some action is rewarded with money or equivalent, a prize which has value for them.

It can't be tested in this dissertation, but if an application of this kind get launched in the market, and starts having real users as players, some real world, physical rewards, could be used to incentive use. For example, brands could use the application to advertise their products or shops, and users could get bonuses for going to the place at a determined time or for being the best contributor in a city in the day where a determined product is being advertised. At the same time, if the application would be sponsored or generating revenue, prizes could be awarded for achieving certain objectives in the game, e.g., "the first user to reach level 25" or "the contibutor of the month" badge.

4.5 System's Architecture

The system's architecture is client-server based. An high-level representation of the architecture is presented on Figure 4.1.

In this representation is visible that the system is composed by three main parts. The "Server" is composed by three elements: the "Crawler", the "System Database" and the "Web Services". The "Crawler" is responsible for making use of the open databases' APIs in order to request, parse and subsequently add PoIs to the "System Database". API requests are represented by red arrows and the storage of information in the database is represented by the blue arrow. The "System

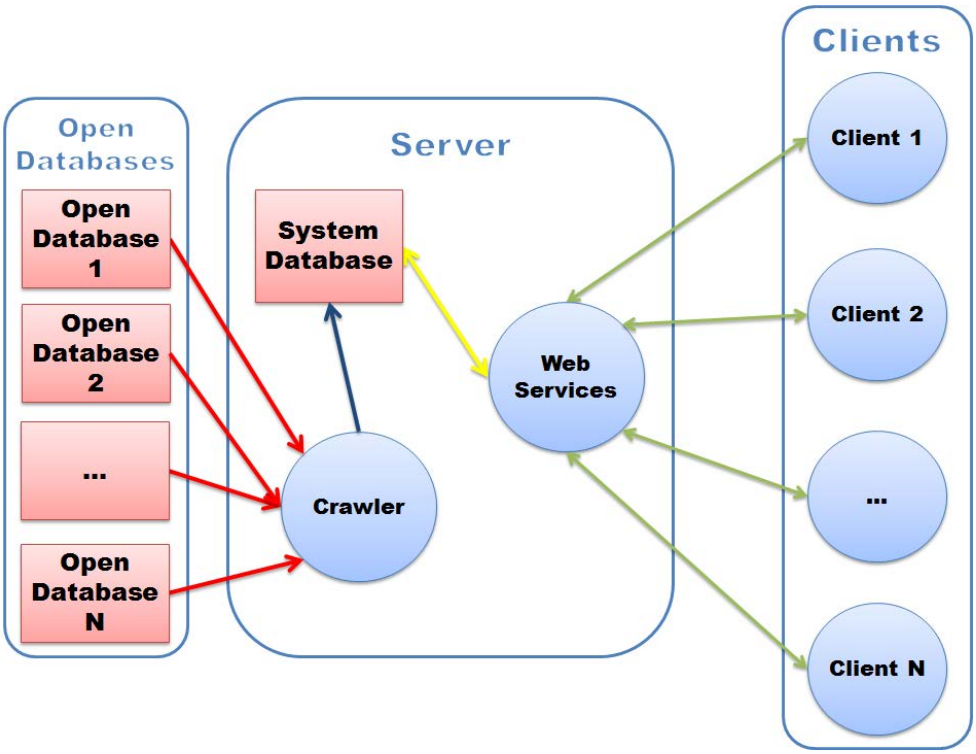

Figure 4.1: High level system architecture diagram

Database" is the database that contains all the information regarding the project built in this dissertation, from users to PoIs. "Web Services" are all the web services that were built in order to allow the communication between the "System Database" and the "Clients". These gather information from the "System Database" in order to provide it to the "Clients" but do the opposite process as well, being these transferences of information represented by the yellow arrow. "Open Databases" are all the databases from where the system collects PoIs for, in a first phase, the beginning of the project, so that users have something to start with and, in a second phase, for a synchronization in which the "Crawler" should check which new PoIs from these databases can be added to the system. Red arrows represent the data flow from those databases to the "Crawler". "Clients" are all the smartphones using the application, being the system's interface with its users . The green arrows represent requests from these devices to the "Web Services" and consequent responses. To note that these requests are made to a remote server, therefore they require a wireless or 3G internet connection. The tools used to build this system, as well as the decisions behind technological choices are discussed in the following section.

4.6 Tools and technological decisions

Several tools were used to develop the application and to collect and analyze the results obtained throughout the tests performed. These tools and the decisions behind them are discussed hereinafter. This project consists mainly in three implementation areas and, therefore, mainly three

tools were used to it's completion. These areas are the server, the clients and the web services that allow the communication between them. The tools used, along with the reasons to justify the decision of using each one of them are explained hereinafter.

Android vs Other platforms

The Android platform was chosen over others for several reasons.

First of all, it is the mobile operative system which is being sold at a faster rate at the moment. Figure 4.2 shows that Android and iOS together represent 90% of the sales in that period of time, being android the leader. This allows to potentially reach a larger number of people by developing the application using this technology.

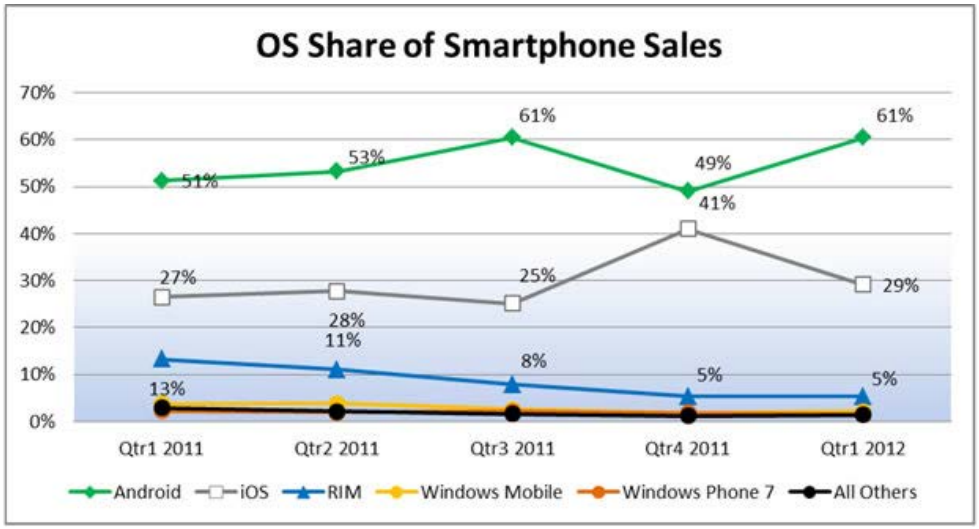

Figure 4.2: Share of mobile operating systems sales in the United States (from [Whi12])

On the other hand, this technology is already dominated by the developer. This is, as well, a crucial factor, considering that the need to learn a new language to implement a system of this extent would be a risk. In terms of functionalities, both technologies (Android and iOS) provide a similar range of possibilities.

JSON vs XML

All the web services and API calls done in this project are implemented in JSON. Although both languages are quite similar in features, JSON was chosen because it is just simpler in its structure. Therefore, JSON messages are smaller in size, making the sending and recipiency of data faster, which plays a major roll when this data is to be exchanged between a server and mobile devices, causing the data transmissions to be cheaper (in the case that the user pays for the data exchanged in his Internet connection).

All the advantages that XML provides, such as better describing data or providing the ability to order the data being exchanged are just unnecessary for the application being implemented.

REST vs SOAP

In order to implement the web services, a choice had to be made regarding the technology to use. Between the 2 main technologies available - REST and SOAP - some differences exist, although the objective is the same.

The main advantages of SOAP over REST are that it allows secure transfers and it allows as well the transfer of binaries, therefore being able to transmit attachments. This is done at bandwidth cost, and a SOAP call could require 10 times more bytes than a REST call for the same data. Considering that for the project implemented there isn't the need of transferring neither secure data, neither attachments, REST was chosen for its lightweight feature. In mobile connections, that factor alone plays a major role, and without any disadvantages in the use of REST that single factor was decisive.

MySQL vs other Databases

The choice in this matter was really bound to economical limitations. The server available for this project allowed two kinds of databases: MySQL and PostgreSQL. Considering that between these two the differences aren't decisive in any kind, both are relational open-source databases, MySQL was chosen because of having worked with this kind of databases before.

4.7 Summary

A correct definition of a problem is essential to achieve good results without an excessive economical and temporal cost. This chapter does exactly that, defining the project itself and identifying the choices made. Also, the concepts behind the use of Serious Games that were used are explained, considering that the generation of the required gaming environment plays a crucial role in the success of this dissertation

Chapter 5

Implementation

This chapter describes the features implemented in the prototype developed in order to validate the hypothesis of this dissertation. All the features of the application are described, as well as some auxiliary tools that were developed.

Special focus is given to the games and gaming environment developed in order to boost players motivation and, consequently, gather their knowledge.

5.1 Overview

The implemented system is composed basically by four distinguishable parts. These parts are the following.

- **The android application** - Prototype where the Serious Games are implemented, that works as the interface with the users;
- **The database** - MySQL database, located in a remote server, that stores all the data that composes the system;
- **The crawler** - Web Crawler used to gather PoIs from open databases, in order to have some data to start the system with;
- **The web services** - Mean of communication between the android application and the server's database.

This chapter focuses in detailing specially the android application, as it is the main component that is used to validate the hypothesis of the dissertation. This prototype for the android platform implements a series of games, involved in a point system, to emerge the user in a competitive gaming environment. The main menu of the application can be seen in figure 5.1, and it provides an excellent overview of the constituting parts of the application. As the implemented prototype

is a location based Serious Game, all the functionalities available in the application work based on the signal received through the GPS hardware available in the device, therefore, GPS has to be enabled in the user's device in order to allow the functioning of the application.

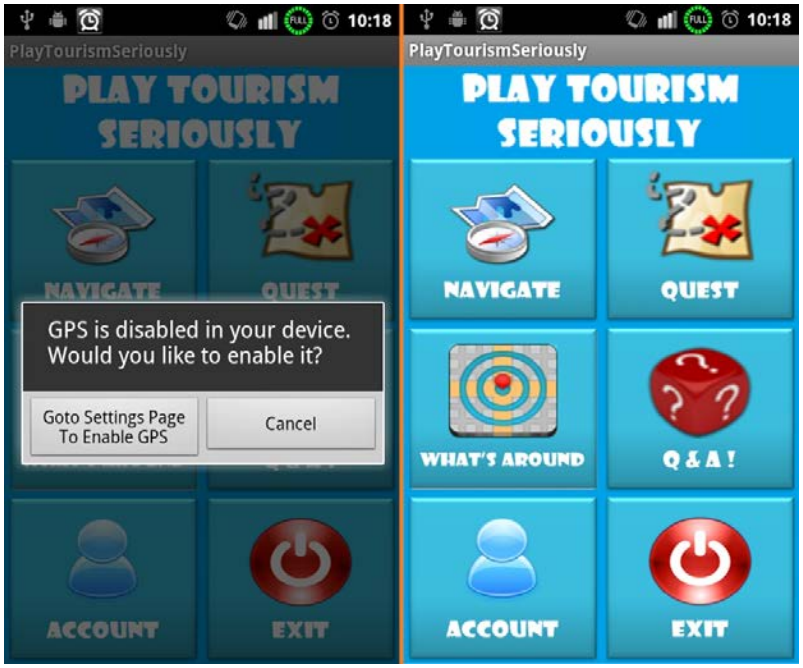

Figure 5.1: Screenshot of the application's main menu. On the left is shown the behavior when the GPS is turned off.

As showed in figure 5.1, the application has 5 main components. These components are the following.

- **Navigate** - Allows the user to navigate through a set of PoIs according to the time available. This component integrates the "Circuit" game;
- **Quest** - This component refers to the "Quest" game, in which a user is challenged to find a PoI in the city;
- **What's Around** - Utility functionality, used only to find PoIs around the user that fulfill a set of criteria;
- **Q & A** - This component has the "Questions/Answers" game, which inquiries the user in order to evaluate his knowledge about the place where he is;
- **Account** -Shows the user profile. Integrates the user's preferences and progress in the game.

The following sections describe thoroughly the components referred above, as well as other implemented functions considered important.

5.2 PoI

Usually, the PoIs are the center data of any tourism application. The application developed in this project is no different, and its main objective is to motivate users, through the Serious Games concept, in order to obtain their knowledge, namely, their knowledge about a city's PoIs. This section details how were the PoIs treated in the application. Figure 5.2 shows how PoIs are displayed in the developed prototype.

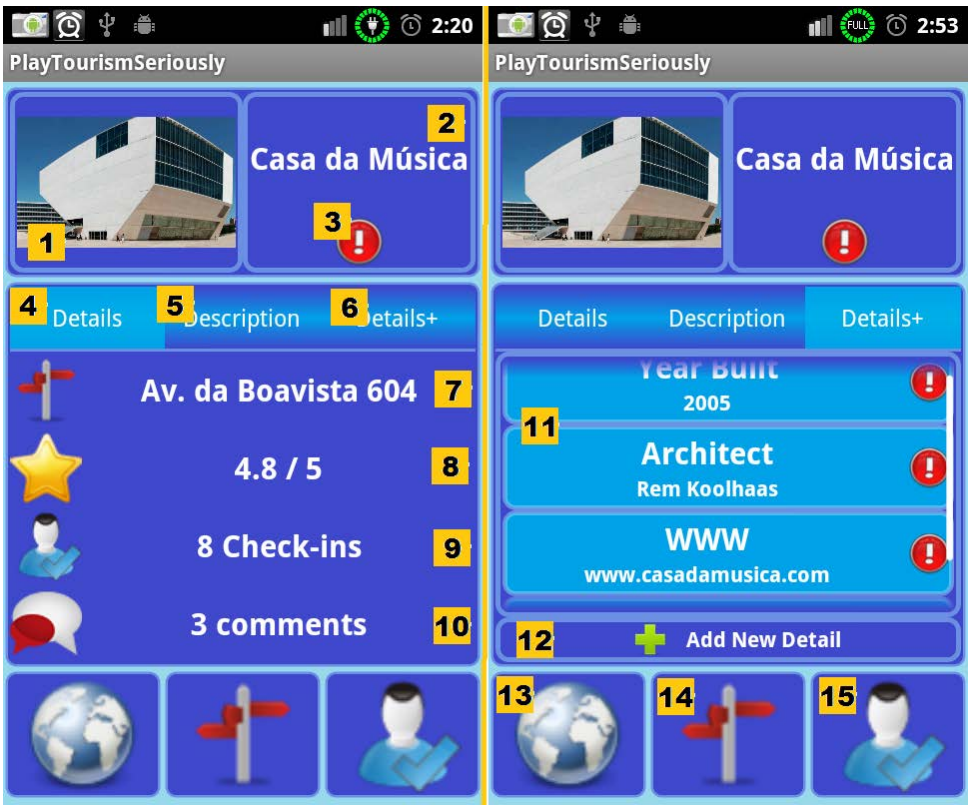

Figure 5.2: Interface of a PoI. On the left, the "Details" tab is selected. On the right, the "Details+" tab is selected

As shown in figure 5.2, when showing a PoI 3 main areas can be identified. Those areas, and their components (identified by numbers in figure 5.2), are explained below.

Face Area

- **1 - Pictures** - This area contains the PoI picture. With a tap, users can check all the pictures available about the place, or add their own.
- **2 - Title** - PoI name. This area also contains the report button described in number 3;
- **3 - Report PoI** - By tapping in this button, one can report the PoI. This reporting system, explained in section 5.2.2, is used to control the content available in the database. In this area, users can report the following problems:

  - Incorrect Name: the name of the PoI is incorrect or incomplete;
  - Incorrect Location: the address or coordinates of the coordinate are incorrect;
  - Unexisting PoI (Spam): completely unxisting PoI added, possibly, just to cheat the system and gain points.

Details Area

- **4 - Details** - This tab shows the mandatory details of the PoI. All the PoIs have, at least, these details and a name;
- **5 - Description** - Tab that contains the description of the PoI, when available;
- **6 - Dynamic Details** - Tab containing the dynamic details of a PoI. These details are further explained in section 5.2.1;
- **7 - Address** - Shows the address of the PoI;
- **8 - Classification** - Shows the average classification of the PoI. Taping this area shows the average classification of the PoI overtime;
- **9 - Check-ins** - Shows how many people have checked in into this PoI;
- **10 - Comments** - Shows how many comments exist for the PoI. By tapping in this area one can read the comments available;
- **11 - Dynamic details** - Here all the dynamic details available for the PoI are shown.
- **12 - Add a dynamic detail** - By tapping this button, users can add dynamic details to this PoI.

Actions Area

- **13 - See in map** - Taping this button shows the localization of the PoI in a map;
- **14 - Dynamic details** - Taping this button a user can obtain the directions to the PoI.
- **15 - Add a dynamic detail** - By tapping this button a user tries to check-in into the PoI. If the proximity validation succeeds, the user checks-in. By checking-in a user is able to comment and rate a PoI.

5.2.1 Dynamic Details

Every PoI has a determined set of details and, for each category of PoIs, only some kinds of details make sense. In other applications, as usually the data is not inserted by the application's users, the person who does the input can control what to show for each PoI. As in this application data is added by its own users, they have to be able to insert any kind of data that increases the

knowledge available for each PoI. For this reason, this concept of dynamic details was created and implemented. Examples of these details can be seen on the right of the figure 5.2.

To support this feature, these dynamic details are in meta-data form. The database tables used to support this feature can be seen in figure 5.3.

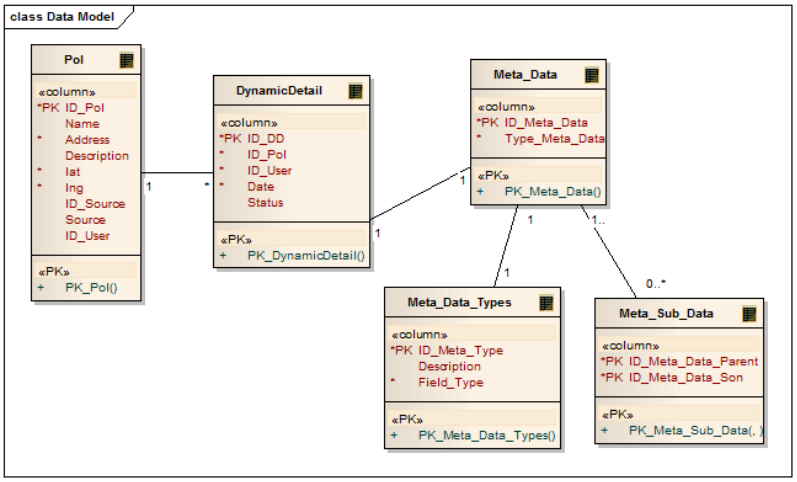

Figure 5.3: Database representation of the tables used for the Dynamic Details

When a user wants to add a detail for a determined PoI, all the meta-data types available are shown to him. If the user finds the kind of data he wants to add, he just has to choose it and fill the form. In the negative case, he can suggest a new type of data that will later be evaluated by someone who is keeping the application.

As it can be seen in figure 5.3, one PoI can have many Dynamic Details. Each of these dynamic details is composed by a meta-data, that has a meta-type and it can have other sub meta-data. This table "Meta_Sub_Data" is used to support meta data that is not atomic, but yes composed by other meta-data.

5.2.2 Report System

When the data of an application is inserted by its users and, specially, when a reward is given for it, it's important to keep track of the added data and control it. In the application developed, it's intended that the own users of the application turn into the controllers of the content added by others. These controlling actions can be done by tapping in the exclamation mark icons that can be seen in figure 5.2.

Those exclamation marks referred above can be used to report two types of information: the PoI itself, or one of the dynamic details available. The database tables used to support this feature can be seen in figure 5.4.

PoI_Reports get stored in "PoI_Report" table, as dynamic details reports are stored in "Dynamic_Detail_Report" table. When reporting a PoI, the user only has to specify a reason for doing it. When a determined number of reports is achieved, compared with the confirmations of the

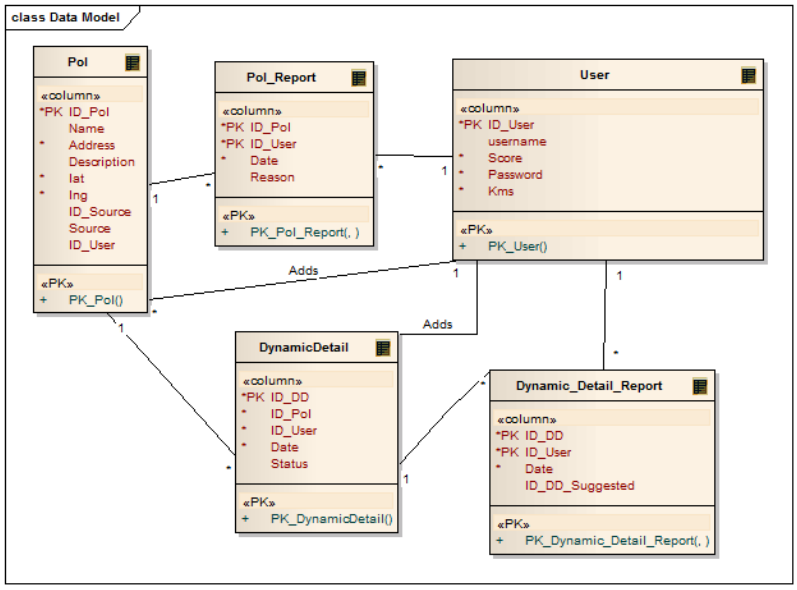

Figure 5.4: Database representation of the tables used for the report system

point (by check-ins), the point is deleted. In this state of the application, a PoI is deleted after 10 negative reports.

When reporting a dynamic detail, the process is slightly different. At the time of the report, the user is invited to suggest a correction for it. These corrections are stored as another dynamic detail, but with the "Status" field set to "pending", instead of "main". This is used so that when a user is reporting a mistake, he can check what others suggested, and suggest the same as someone previously suggested. In the case of not agreeing with any of the suggestions, the player can add his own. In this version of the application, a dynamic detail "Status" field would change from "main" to "incorrect", representing the bad state of the data, when one of the suggested details would reach 5 suggestions. This detail that reached 5 suggestions would then take the place of the one that was stated as incorrect, and be shown in the page of the PoI.

Users are awarded points when an information that they reported is considered to be faulty by the system. All the users that reported the same get points, and the users that suggested the same alteration, in the case of the dynamic details, get the bonus for adding a dynamic detail as well.

5.3 Navigate

"Navigate" is a functionality that allows the users to make a trip around a city, taking into account their current location and available time. This trip is calculated according to the user's defined interests, and it is possible to customize the trip. The functionality "Navigate" is the holder for the game "Circuit". In this game users are challenged to complete the circuit that "Navigate" generates for them. An example of a "Circuit" can be seen in figure 5.5

Figure 5.5: Interface of the game "Circuit", with an 1h trip starting at "Camara do Porto" and finishing at "Ribeira"

As it can be seen in figure 5.5 the user is going to the second point of the trip. This is a trip started at "Camara do Porto" and the user set the finishing point to be "Ribeira", as well as the time of the trip for 1h. The user gets points for each PoI that he visits during the trip (a Check-in is made) and bonus points if he finishes the full circuit. The activity flow of the choice of a "Circuit" game is visible in figure 5.6.

As shown in figure 5.6, the user is able to set the trip's maximum time and a finishing point if necessary. After that process, a route is given to the user, which he can modify by rejecting the PoIs in which he is not interested. After identifying all the PoIs to remove, a new route is generated. This process can be repeated until the route pleases the user, and then the game can be started. Adding PoIs to a route is a functionality which is not implemented.

Route generation

The routes generated to the "Circuit" game try to maximize the players' pleasure, by showing him the most possible PoIs that fall in his categories of interest. The pseudo-code for the logic behind

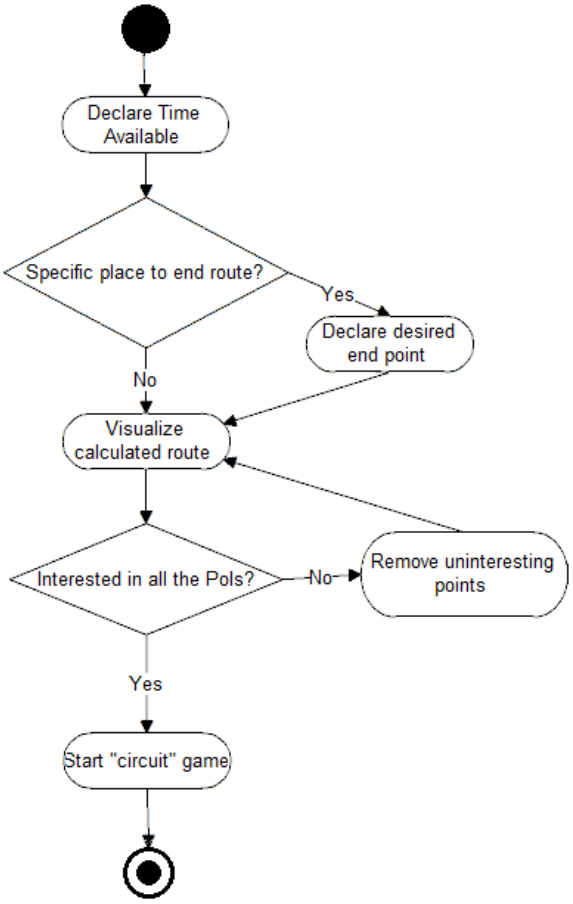

Figure 5.6: Activity Diagram of the selection phase in the game "Circuit"

the route generation can be seen in figure 5.7.

```
Get currentLocation;
Get maximumTripTime;
Get endPoint;
Get userInterests;
If (timeNecessary(currentLocation to endPoint) > maximumTripTime){
    Error;Exit;}
Points = Calculate all the points reachable from current location with the available time;
Get time/distance matrix between Points;
Route = generate best route(Points,userInterests,endPoint);
While (user not satisfied){
    Route Generate best route ((Points - PointsToEliminate),userInterests,endPoint);}
Start Game (Route);
```

Figure 5.7: Pseudo-Code for the route generation algorithm

The application starts by requesting for the trip's maximum time and for the ending point of the route, if available. These values, together with the user's interests (previously defined) and the current location, are the basis variables. After, all the PoIs from the database, that belong to the categories discussed in section are gathered. All the distances, and corresponding times, between

those points are calculated using *The Google Distance Matrix API* [Dev12c] and the values are stored in the table "Distances" in the server's Database. To refer that the *The Google Distance Matrix API* is used only to calculate the values which the database doesn't contain already, due to the request limit implemented by Google.

With all the time necessary to travel between each point, a Branch&Bound algorithm is applied, being the nodes the score of the PoI (calculated through the formula Score = Interest * Classification (if classification is not defined it is assumed as maximum)) and the branches the time necessary to travel from the parent PoI to the son PoI.

Taking into account that the server's computational power is usually higher than a mobile device's one, and in order to minimize data transfers between the device and the server, the route generation is done server-side. The device simply asks, via Web Services, for a route, sending the initial variables (current position, time available, interests and end point), and receives the directions of the calculated route as a result.

5.4 Quest

"Quest" is a game that intends to boost the inner explorer inside of any tourist. In this game, players are challenged to explore a certain area, in order to find a PoI that can be anywhere inside the region with the radius defined by the user. The radius can be set between 100 and 400 meters. In the figure 5.8 it is possible to visualize the interface of this game.

In this case the player is searching for "Casa da Música", and he is close to it. The several areas of interest that constitute the interface are shown in detail in the figures 5.9 and 5.10 .

Figure 5.9 shows the bottom menu of the application. The area "1" shows the name of the PoI which the user is looking for. When tapped, this area shows information about the place, like pictures and other details, but hiding the address. Buttons "3" and "5" let the user zoom in and out the map. Button "4" enables the user to start a new quest, if he is not playing, or try to finish the current quest, by giving up or successfully concluding it. Button "6" lets the user play the "Questions/Answers" game, talked further in 5.6, while he is playing the "Quest" game.

Button "2" enables/disables the help for this game, which can be seen in detail in figure 5.10. This helping system works like the "hot and cold" game [Tra12], providing imediate feedback when the user changes position. The closer the user gets to the point he is trying to find, the closer the bar moves to the fire symbol, and the opposite is also verifiable.

This game's activity diagram can be seen in figure 5.11. As stated, the first part of this game is to assign the player a PoI to search for. This PoI is chosen at random, from the points where the user has never been. If the user tries to finish the quest, a proximity validation is performed in order to evaluate if the user is close enough to the PoI to actually have found it. In positive case, the user can choose to play again (and earn extra points from consecutive games) or to finish. If the answer is negative, the user has to keep looking for the point, until he finds it or gives up. Upon successful conclusion of the "Quest game", points are awarded. In the case of forfeit, compensation points are awarded as well.

Figure 5.8: Interface of the game "Quest"

Figure 5.9: Menu of the game "Quest"

Figure 5.10: Help on the game "Quest"

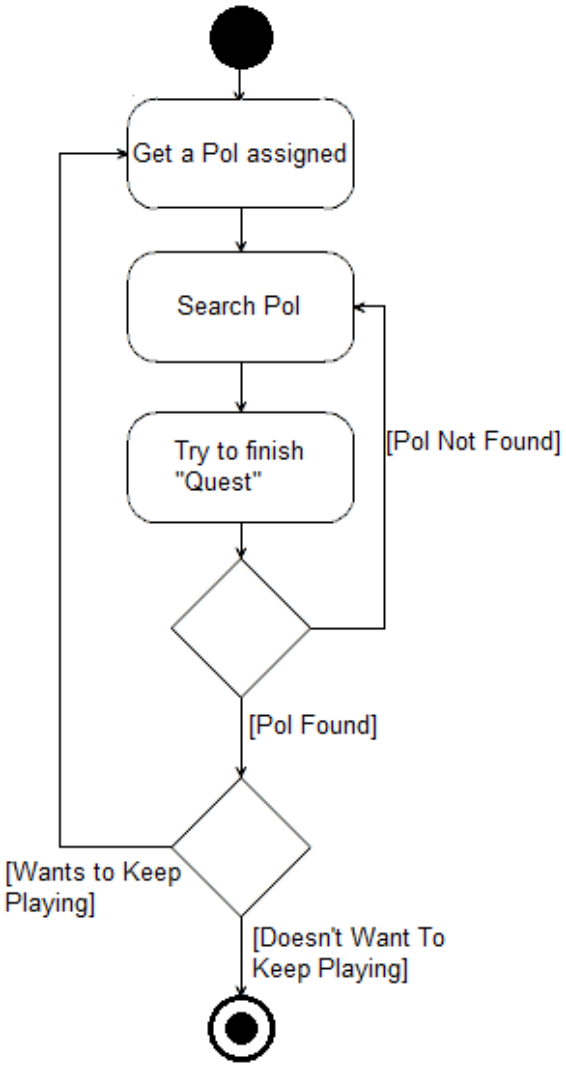

Figure 5.11: Activity Diagram of the game "Quest"

5.5 What's Around

"What's around" is a functionality that allows users to search for nearby PoIs, that meet the criteria defined by them. Users can search for name and/or category and the places are presented by order of distance to the current location. The categories available can be consulted in appendix A. An example of a search can be seen in figure 5.12

After selecting the search parameters, a request is sent to the server, returning all the PoIs that meet the criteria, in a 15km radius. When the results are presented, users can either view the information about a place, or ask a route to it. Both this functionalities are accessible through a menu that pops-up after a long press in the desired PoI, while a single tap will show the name of the place. If the user chooses to see the information about the PoI, a page like the one shown in figure 5.2, discussed in the section 5.2, is shown.

Figure 5.12: Example of the result of a "What's around" search

If a route to a determined place is asked, a request is made to *The Google Directions API* [Dev12b], with the following request parameters.

- **origin** - User's current location's coordinates;
- **destination** - Destination PoI coordinates;
- **sensor** - Indicates if the request is being made by a device with a GPS sensor. Set to "true";
- **mode** - Specifies the mode of transport to use when calculating directions. Set to "walking" considering that this is a pedestrian application;

The JSON response received is then parsed and the directions are shown on the map.

Besides the interaction available by simple tapping in the selected place, users can also interact through the bottom menu shown in detail in the figure 5.13. In this menu, buttons "1" and "4" allow the user to zoom the map in and out, button "2" is used to perform a new search, while button "3" can be used to play the "Questions/Answers" game, discussed in detail in section 5.6.

Figure 5.13: Menu of the functionality "What's Around"

5.6 Questions/Answers

"Questions/Answers" is a game that intends to test the players' general culture. It poses questions to the players about the PoIs of the city in which they encounter themselves. An example of these questions can be seen in figure 5.14.

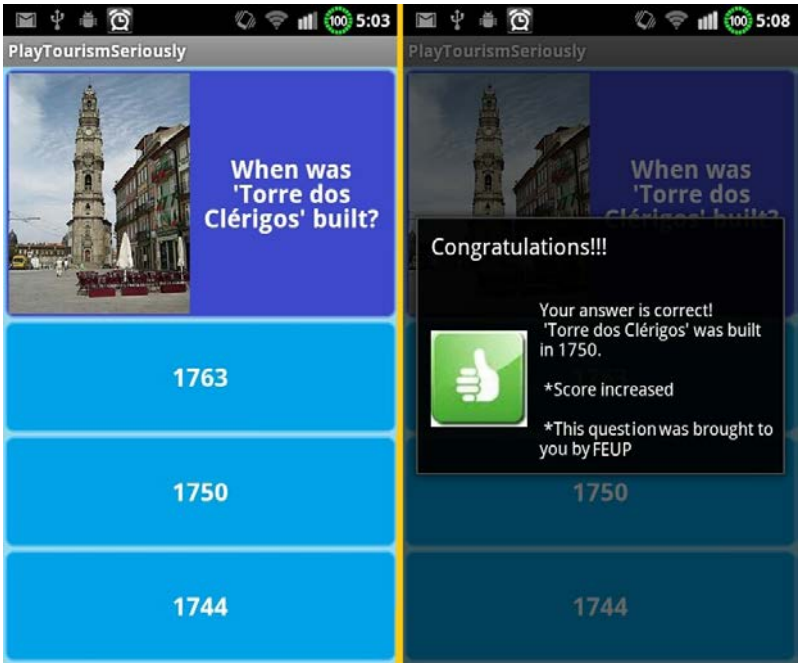

Figure 5.14: Example of a question in the "Questions/Answers" game. On the right image the feedback to a correct answers is shown.

This game is intended to be played in almost every situation, as it is of low time consumption. The situations in which this game can be played are the following:

- From the main menu of the application;
- While playing "Circuit";
- While playing "Quest";
- While using the functionality "What's around".

The questions that support this game are automatically generated from the data about the PoIs available in the database. Being so, when a user adds a dynamic detail to a PoI, a question about a PoI can be automatically generated. The meta-data that forms the dynamic PoIs, thoroughly discussed in section 5.2.1, enables these automatic questions to be created.

Each meta-data type has a question syntax defined for it. For example, the meta-data type "year1" stands for "Year built". When a user adds a detail of this kind about a PoI to the database, this game automatically gained a new question, by placing "When was" + name of the PoI + "built?" as the question. The incorrect answers are automatically generated depending on the meta-type which is being treated. For example, the type "year1" has a random number from 2 to 10

5.7 User's Profile

From the main menu, the user can tap into the "Account" button in order to access his profile. In this part of the application, users can check their progress in the game, as well as change their personal informations and preferences. The interface of the user's profile can be seen in figure 5.15.

Figure 5.15: User's Profile Interface

As observable in figure 5.15, a first look in this area provides a summarized view of the user's information and progress in the game. All the areas that form this interface are detailed next.

- **1 - Personal Information** - By taping in this area, the user is able to change is personal information, e.g. password, profile picture, username;
- **2 - PoIs Visited** - Taping in this button shows the user activity in the places that he checked in. His comments, ratings, classifications are shown, for each PoI, when available.;
- **3 - Journey Log** - A tap in this button takes the user to the area where he can visualize his personal journey log. All the locations of where he as been (not only PoIs, but streets as well) with the application turned on are recorded; A list of all the coordinates, ordered by date is shown, with the possibility of visualizing where that coordinate corresponds to, in a map.
- **4 - Badges** - All the prizes for progress (discussed in section 4.4.2) that the player has achieved can be seen by taping in this button. Badges won, and correspondent titles are shown;
- **5 - Experience** - This area shows the current level of the player, as well as the experience gained so far. Through the progress bar available, the user can see how much experience he has, and how much is required to achieve the next level. By tapping in this area the user is able to check his position in the rankings, and compare his performance with the other users'.
- **4 - Personal Preferences** - In this area the user is able to set his preferences relatively to the categories of PoIs. By sliding the bars of each section, one can define the level of interest existing towards each category, comparing to the others. These preferences are used when the program generates a traveling route for the tourist and, therefore, a set of PoIs isn't worth to classify, e.g. hospitals, public bathrooms, transportation. Thus, the categories available to classify are:
  - Buildings and Monuments;
  - Religious Buildings;
  - Museums and Galleries;
  - Statues and Fountains;
  - Scenic Viewpoints;
  - Parks and Zoos.

5.8 PoI Crawler

In order to gather PoIs from the available public databases, a data crawler was developed. This crawler is currently working with the data available through *The Google Places API* [Dev12d]. This API is discussed in detail in section 3.1.2.

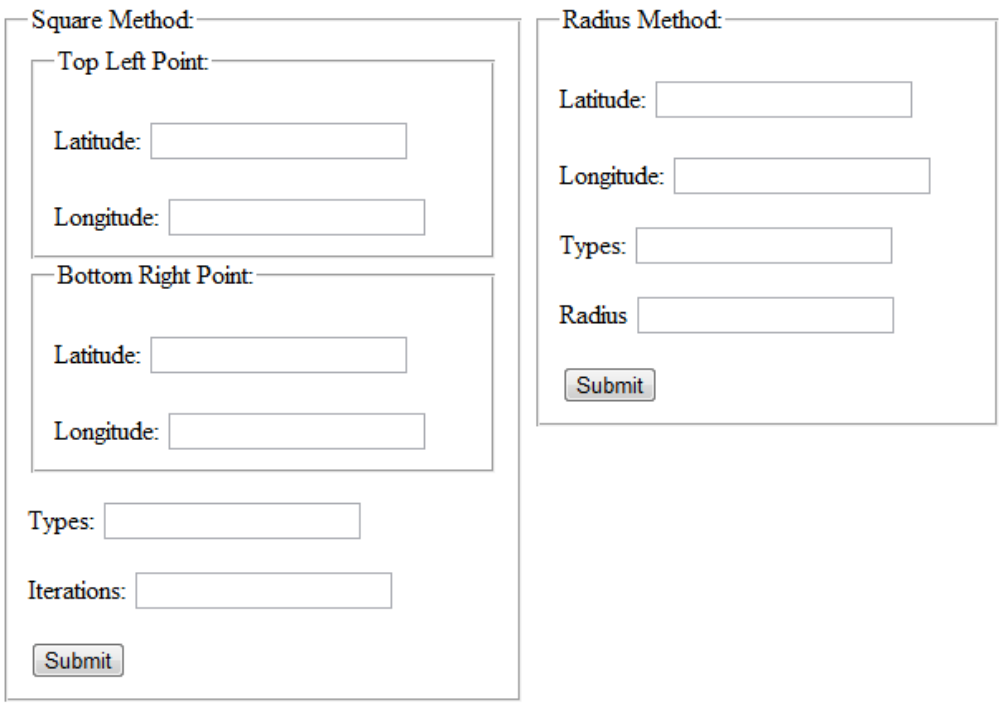

Figure 5.16: PoI Crawler's Interface

So that the interaction with this crawler could be facilitated, an HTML interface was implemented. This interface can be seen in the figure 5.16.

Although the interface is in HTML, the crawler was implemented in PHP. As it can be seen in figure 5.16, 2 crawling methods were implemented. The methods are the **Radius Method** and the **Square Method**.

The **Radius Method** simply makes a call to *The Google Places API* with the given parameters. The **Square Method** extends those capabilities and makes a grid search over the square area designated by the coordinates of a top left point, and the coordinates of a bottom right point. This square is divided vertically and horizontally, as many times as defined by the user in the "Iterations" field, forming a grid, and a Google Places API call is performed in each of the points contained by that grid. Both methods work based on the algorithm defined in 5.17

```
1  Gather all the parameters passed by the interface;
2  Make calls to the Google Places API;
3  Parse JSON data to PHP data;
4  For each Point "P" in the PHP data;
5      If "P" exists in the database Ignore, Else add "P" to the database;
```

Figure 5.17: PoI Crawler's pseudo-code

5.9 Summary

Correctly defining the problem was essential for identifying the steps to develop this Serious Game, that is built through several mini-games enclosed in a point system to create a competitive environment. Therefore, the work done to elaborate the methodological approach (chapter 4) revealed to be crucial to the good pace of the implementation phase.

However, defining the problem doesn't necessarily define the means with each the problem will be tackled. In the implementation phase, the technological decisions became final and it was important to have studied all the tools used, since the code developed had a considerable complexity level, specially in the android part.

More time to implement and test more routing algorithms would be desirable, but the presented solution already produces acceptable results. Anyway, better results could probably be achieved with a different algorithm or a more optimized heuristic.

Finally, the implemented application and all the accessory services were implemented with success. The application fulfills the targeted objectives and the games implemented work as foreseen.

Chapter 6

Results and discussion

In order to validate that Serious Games are a good approach to achieve collaboration and loyalty from the users of a tourism mobile application, a prototype was developed and later tested with real users. This chapter focuses in discussing the results obtained, and analyzing whether this approach is valid.

The present chapter describes the population sample, the data collected, and the important effects that could be noticed from the serious gaming experience. The opinion of the users towards the application is also presented, obtained trough a survey realized after the testing period.

6.1 Evaluation Methodology

In order to obtain data related to the use of the application, real users were invited to test it in a real scenario. Therefore, users installed the application in their Android mobile phones, and used it for the period of a week, without any supervision.

Utilization data was collected by the server, in order to obtain quantitative data about the application's usage and, when the testing period was over, a survey was conducted on the users, in order to obtain qualitative data. This survey focused in their opinion about the application, but it also covered the effects from it that might have yielded on the users.

6.1.1 Test Setup

The test group was educated in the purpose of the application that they were testing, and were encouraged to use it in the city where they live in, for a period of 5 days (a working week). The features of the application were explained, and the game concept was also indicated. Users knew that they were not playing alone, and that a ranking would be created. Although no physical reward was promised to them, when users inquired about the possible existence of one, it was neither confirmed nor denied.

During the testing week users could report bugs or contact in case of any need for help, but they were left to use the application unattended. Hence it was possible to collect results that were more similar to a real case scenario and all their movements were automatically tracked as long as the application was running.

The testers also knew that they would be subject to a survey after the testing period was over, so that they would be alert about not forgetting their feelings towards the application. On the other hand, they didn't know anything about the content of the future survey, so that they wouldn't be biased during the test.

The servers of the application were loaded with informations about two cities: Porto and Póvoa de Varzim. This information represented the only information available in the application in the beginning of the testing period but, as expected, that amount rose overtime.

The survey was conducted through e-mail, sent 5 days after the testing period was over, having all the answers been received in the three days following the dispatch of it.

6.1.2 Population Sample

A total of 20 individuals were selected as a sample to test the developed prototype. All these testers were previous android users and, therefore, no adaptation period to the hardware was required.

Taking this into account, and considering that tourists exist in all ages and genders, these factors were ignored for this analysis. Instead, users were classified according to the following parameters.

- **City where the user tested the application** - *Porto* or *Póvoa de Varzim*;
- **User is inhabitant of the city where he tested the application** - *Inhabitant* or *Non-inhabitant*.

Although an attempt to equalize the quantity of people belonging to each group was made, due to difficulties in finding test subjects these numbers were, finally, not balanced. The distribution is shown in table 6.1

Table 6.1: Sample Distribution.

City Tested	Inhabitant	Non-Inhabitant
Porto	12	3
Póvoa de Varzim	5	0

As it is shown in table 6.1, from the 20 testers, 17 tested the application in the city where they live, and only 3 tested it in a city in which they were not locals. In order to facilitate references, from here on, during this document, testers will be called according to the following terminology.

- **PORTOs** - inhabitants of Porto that tested the application in Porto;
- **PVZs** - inhabitants of Póvoa de Varzim that tested the application in Póvoa de Varzim ;

- **FOREIGNERs** - foreigners that tested the application in Porto.

6.2 Results and Discussion

The next subcategories focus in showing the results obtained in the several areas which this prototype intended to test, and presents a discussion in each of them. Through the graphics of the data obtained and the analysis executed, it should be possible to assess the efficacy of the application.

6.2.1 User's Contributions

The main objective of this dissertation is to investigate whether Serious Games are a good approach to make users collaboratively generate a touristic database. This subsection provides data that allows to check the value of this approach.

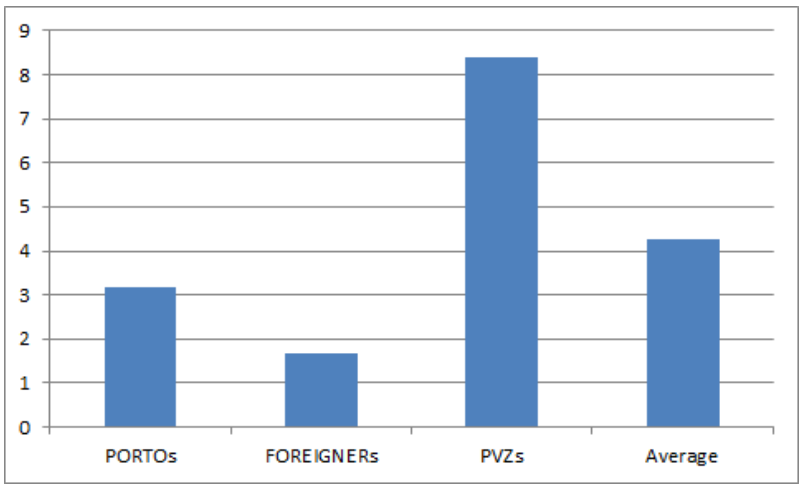

Figure 6.1: Average PoIs added, by test group

Figure 6.1 shows the average of PoIs added by each test group. Not surprisingly, in average, FOREIGNERs contributed with less PoIs than the other groups, since they were visiting a new city. Still, they added some that were not on the database, as they were passing by them. The fact that PVZs added more PoIs than PORTOs is probably due to the fact that most of the PoIs contained in the beginning of the testing period were in the city of Porto. With more room for improvement, it was easier to add information.

Interesting to refer that, on top of the 353 PoIs that were contained in the database in the beginning of the test week, 85 more were added by users. This represents an increase of almost 25%, showing that the competition created by the point system motivates users to contribute with their own knowledge.

To refer, as well, that users produced a total of 181 check-ins in 88 different PoIs. These are used to validate the existence of a point, besides allowing users interactions with the PoI. A group

of 20 users, in just a period of a week of non-continuous usage, confirmed the existence of almost a quarter of the total PoIs available.

6.2.2 Learning

As the serious game being tested presents information about PoIs in a city, by using it, a user might be absorbing information about the place which they are exploring. Furthermore, this application contains the game "Questions/Answers", which specifically intends to test the user's knowledge about some place and, hopefully, teach him in case of ignorance about the correct answer. While testing the application, users played the "Questions/Answers" game and, after the testing period was over, users were asked the same questions again. Figure 6.2 shows the data relative to their answers.

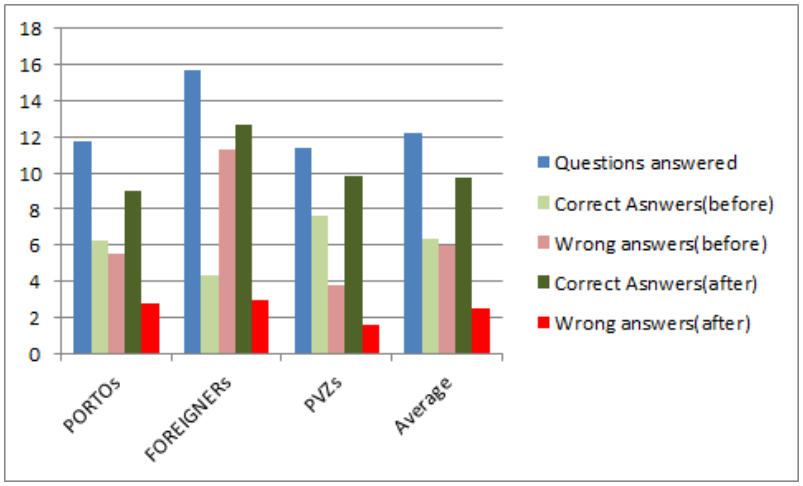

Figure 6.2: "Questions/Answers" game average results, by test group

First of all, all the groups answered to a similar amount of questions, with a slight advantage to FOREIGNERs, probably because they were more interested in acquiring knowledge, considering that they were not in their home-place. Not surprisingly, this group is the one that has the lowest average of correct answers, being the only group that answered more questions incorrectly than correctly. It was expected that locals would know more about their own city than visitors.

As it is also observable, users from all groups answered correctly more times when they were requestioned on the subjects. This increase in performance can be analised on Figure 6.3

As it is shown in the graphic above, all groups improved the number of correct answers after they had answered the questions a previous time. On average, the performance was 95.16% better, having the group that answered most poorly during the testing period registered an improvement of 208,33%.

These results demonstrate that the "Questions/Answers" games induces learning in the users of the application. Players assimilated the information that they were shown during the game, at least for the minimum period of 5 days, being impossible, with the current tests, to determine if

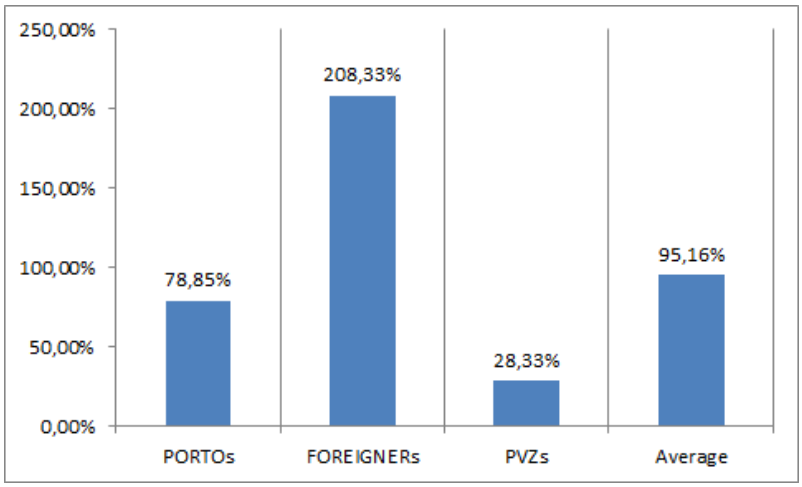

Figure 6.3: "Questions/Answers" game performance difference, by test group

this learning is permanent or just temporary. Either way, clearly, users knew more about the PoIs of the city in which they used the application after playing the "Questions/Answers" game, than they knew before.

6.2.3 Training

Another point that this application tries to achieve is the training of users in their orientation in a city. In the game "Quest", which is further discussed in section 5.4, users are drawn to find a PoI which is located around them. The test group played this game several times, and the data is available in the Figures 6.4 and 6.5.

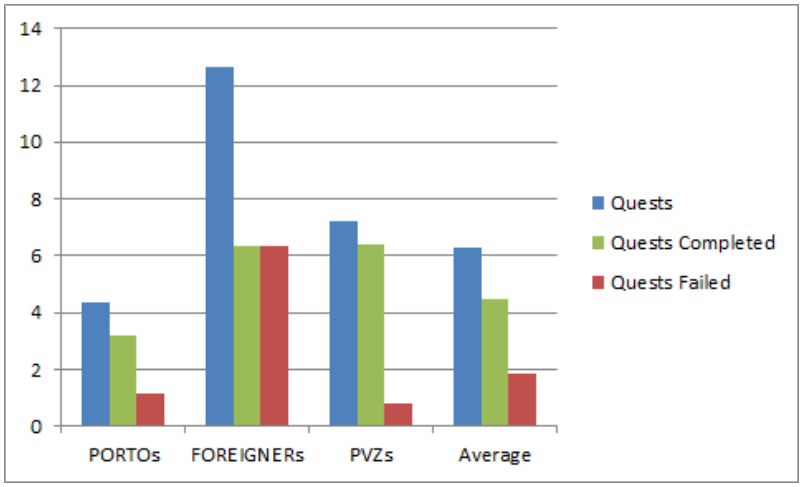

Figure 6.4: "Quest" game average results, by test group

In Figure 6.4 the averages for each group are shown. The FOREIGNERs group was more attracted to the game, and when asked for the reason to this attraction, they said that it was making

them explore the city and, therefore, they like it. Although it is not shown on the graph, since it only shows average, none of the test subjects failed all the quests they tried. The people who tried the game less did 2 quests.

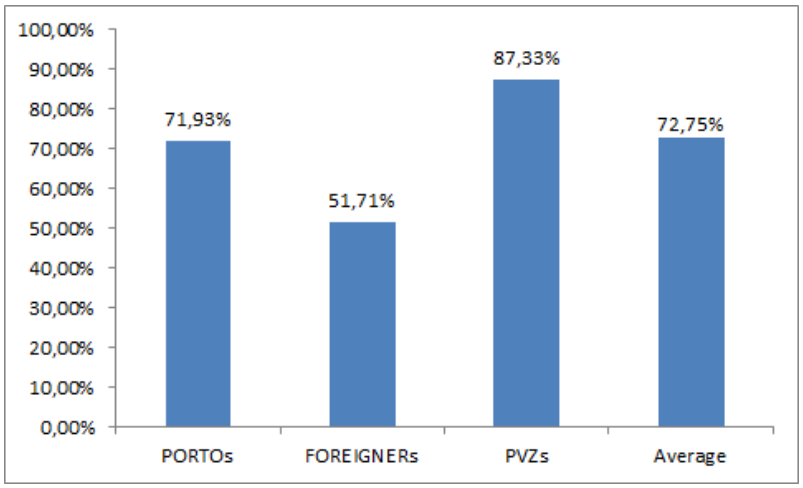

Figure 6.5: "Quest" success rate, by test group

Although FOREIGNERs played this game with more frequency, probably because they didn't know the city as well as the other test subjects, accumulated with the fact they they didn't speak the Portuguese language, they were the ones that performed more poorly in this game, as shown in Figure 6.5. Still they completed around 52% of the quests, while others had an success rate over 70%.

In Figure 6.6 the answers to two of the survey's questions are summarized. The questions were the following.

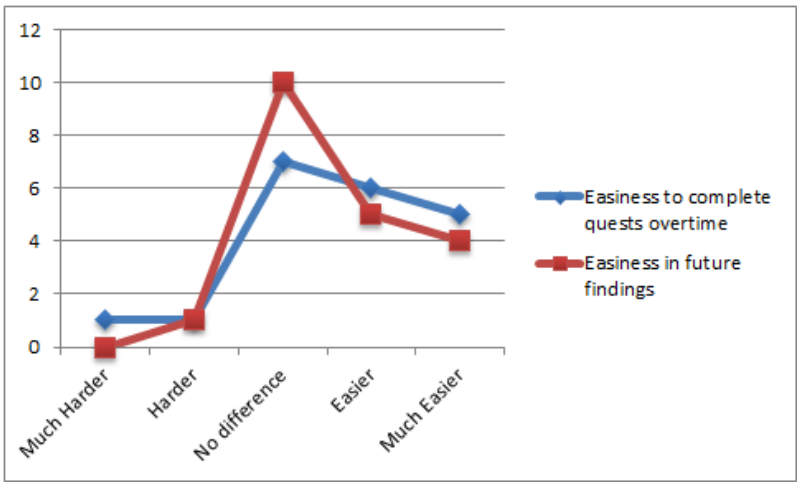

Figure 6.6: Number of answers to each of the 2 questions of the survey

- **1** - Did you find easier to complete quests overtime? (Were the last quests played easier than the first ones?)

- **2** - Do you think that playing this game will help you in the future situations, where you have to locate some point in a city, but you don't know its exact location?

Both the questions intend to assess whether the game helps people in localizing and orientating themselves better in a city. As it is shown in Figure 6.6, around half of the people think that the game didn't get easier over time and that they don't think that it will help them in future situations. Nevertheless, 50% of the test subjects indicated that the game got easier overtime and 45% state that they think this game will help them in future situations where they have to find a determined place.

When asked for the reasons to explain the fact that the game was getting easier overtime, most of the subjects indicated that they were just searching better, since they were adapting their searching tactics. These players indicated that at first they were just going randomly until they found the place or eventually gave up but, after some games, they were applying other techniques, such as searching street by street in order, and planning before they started the best route to pass all the streets in the gaming area.

Relatively to finding places in the future, for example, when they encounter themselves in a situation where they have to meet with someone in a determined place, where they don't know the exact location, users stated that the game was a good training, since the techniques applied to complete the "Quest" game could be applied in those situations. They said the game increased their orientation skills, given that they were capable of knowing were they have been before and where a determined street would lead if they would follow it.

These results and opinions show that the "Quest" game has some training features attached to it. Users that felt improvements state that they feel that they can orientate themselves better after some games, and that they learn how to search better for an unknown place. They stated that this is important to succeed in the following quests they would make but, furthermore, and more importantly, that it provides a good training for future situations where they have to search for an unknown location.

6.2.4 Advertising

During the utilization of the application, subtle advertisement was used, in order to assess whether users would recognize it or not and, at the same time, to study if users would feel bothered by it. Examples of that advertisement can be seen in Figure 6.7. The names of the companies advertised were "FEUP", "LIACC" and "PTS". Users were asked two questions, and the answers to those questions can be seen in Figures 6.8 and 6.9.

In the graph seeable in figure 6.8, it's visible that 80% of the players noticed the advertisement. To those who noticed, it is important to investigate if they could remember what was being advertised. From the users' answers, it's noticeable that, most of them, did indeed remember the

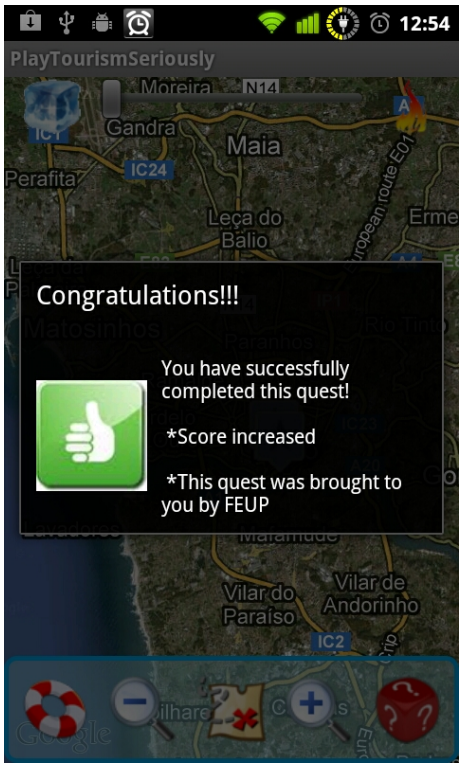

Figure 6.7: Example of a message in the game with advertising

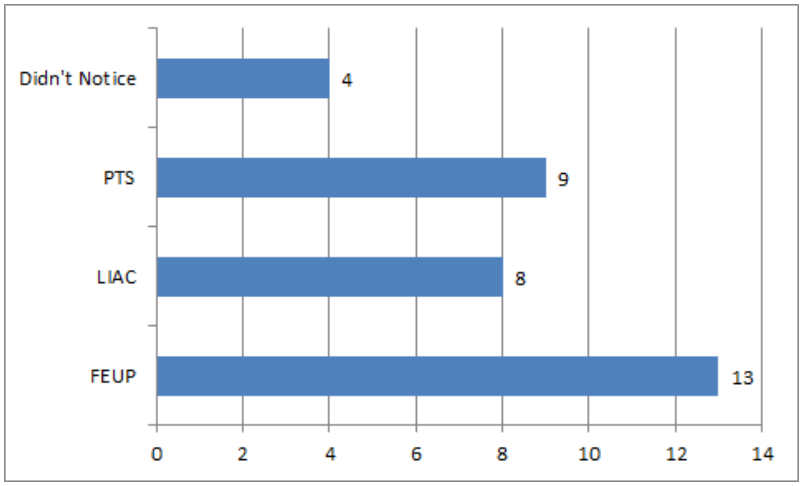

Figure 6.8: User's that noticed the advertisement, per company

companies advertised. This shows that, messages in the application can be used to pass marketing information.

Figure 6.9 shows data relative to how bothered were users by the advertisement used. Half of the players said that they were not bothered at all by this advertisement and, even, that they were expecting some, since most of the android's free applications contain advertisement in them. Just one user showed to be extremely bothered by the advertisement, having said that any form of

advertisement is extremely annoying to him. The others who noticed the advertisement were just slightly bothered, as they prefer applications without any form of marketing.

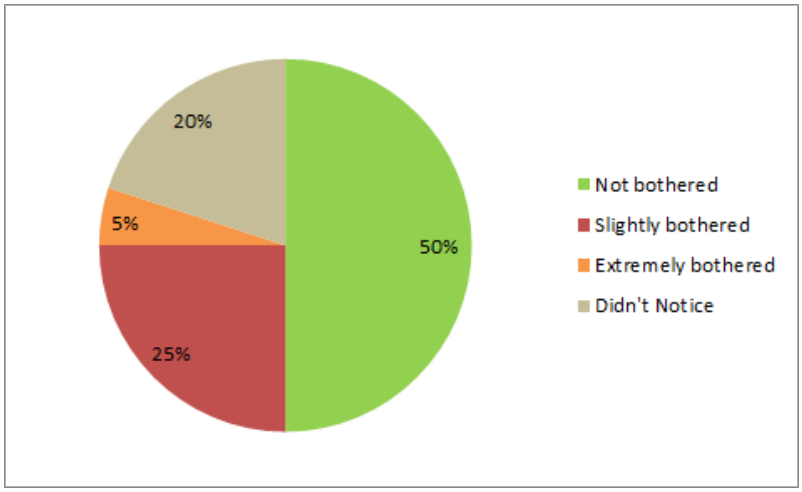

Figure 6.9: How bothered were users with the advertisement used

6.2.5 User's Opinion

This section summarizes the answers from the testers to the survey's questions that are not referred in the above subsections. These questions focus on the feelings of the users towards the application, and what they think of it's utilization in the future.

From the user's that contributed as testers during the testing period, all of them found the application interesting to use. Some stated that the games made them perform actions that they wouldn't normally do, being the most used example the searching for a random point located in the area (the "Quest" game).

Most of the users said that they felt fun in the games and that they would feel even more if they could do, somehow, some of the tasks in a group environment. Still, they felt motivated by the ranking system, and said that they were doing tasks, sometimes, only to go up in the rankings chart. They wanted to finish the week as the winners.

Some of the users were happy to realize, as well, that they learned some general culture from playing the "Questions/Answers" game. They didn't realize that they had learned until they were asked to answer the same questions again. As they performed considerably better, they felt achievement.

The game "Circuit" was basically used only by the FOREIGNERs, since the other users level of interest in a tour around the city in which they live in, was low. FOREIGNERs stated that this game was a good experience, and that they were shown the key points of the city in the time that they had available, without too much stress. This group of users also stated to feel joy to know that they were receiving extra points from the completing of a circuit, and that this had striven them to not stop until it was finished. The other two groups only tested the "Circuit" game, but they

stated that would definitely make use of it if they were exploring a new city, which is actually its intended function.

Users in the test group, that had friends testing the application as well, said that this fact was pushing them further to gain points so that they could rise above their friends in the ranking. They stated that if they would have the opportunity to brag about their accomplishments, they would. This confirms the importance of the social aspect of the game, having social networks such an important role in this objective.

When asked about their likelihood to keep using the application after the testing period, the results were considerably positive. As shown in 6.10, 55% of the testers answered positively to this question, having 20% of them stated that they would use it for sure.

When asked for the reason of the positive answers, users stated that the games built in the application make using this touristic knowledge system a different experience from the ones available at the moment. These games motivate them to do different tasks and to contribute with their knowledge. Users state that feeling part of the content in the application, coupled with the fact that they were fighting to climb the rankings, would make them continue to use the application. Another fact that motivates them to the continuous collaboration is the belief that, since this application is maintained by users, it will contain PoIs that other applications probably won't, since locals know better their own cities than anyone else.

Users that answered negatively, stated mainly two reasons. First, that they don't like to feel like they have to work to build something, they prefer to use a final product, which is in its full potential right out of the box. The other reason is that the application contains too many unnecessary features for a tourism application. They prefer simple versions where they just have to install and use the guiding functionalities.

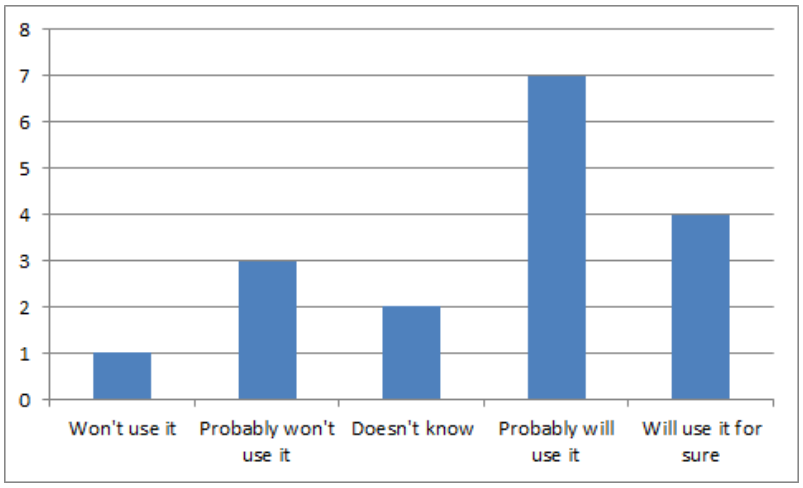

Figure 6.10: Likelihood of using the application in the future

6.3 Summary

As it was thoroughly discussed in this section, the results were fairly positive.

Users proved to be of considerable value as sources of information, and they would like to keep using the application, in their majority. The gaming component attracted users that feel motivated by challenge, and strived them to achieve better scores through the contributions to the game.

On top of this, the application showed good results in teaching and training its users. The users in the test group learned facts about the cities in which they tested the application, or its PoIs, and felt improvements in their orientation and searching capabilities.

On a negative side, some of the users showed aversion to the fact that the application is much more than a simple touristic application. Some users just prefer to go the simple way, and use an application which is a plain product and fulfills only the required functions, which are the ones of informing and guiding a user through a city.

Overall, results were positive, and show that Serious Games are a viable approach to achieve loyalty and collaboration from its users.

Chapter 7

Conclusions

This chapter concludes the document, stating and summarizing what were, effectively, the contributions of this dissertation. It focuses on the practical and scientific contributions, the conclusions arisen from the results obtained, as well as the lessons learned throughout all the phases of this project.

7.1 Final remarks

Smartphones are becoming popular devices, and the applications existing for this devices, that are focused on helping tourists, present a major flaw, by not involving the users themselves in the creation and maintenance of content. Typically, users are not willing to share their knowledge if there is no reward for it and, at the same time, it is hard to achieve long-term loyalty from them. As stated throughout this document, the project's main goal was to verify if serious games are a viable method to obtain collaboration and loyalty from tourists, in the generation and maintenance of a tourism database.

In order to achieve this objective, a tourism Android application was created, with several games linked to a point/reward system. In this application, users are immersed in a gaming environment, where they see their actions rewarded. A user is rewarded by using the application to know and learn about a new city, as well as when he contributes with his knowledge about the places that he knows. The effects of the application were accessed with a survey to a group of users that tested the application for a limited time, with the purpose of evaluating its success in the compliance of the objectives set in the definition of the project.

Overall, it was proven that serious games are a good approach in achieving the objective of creating collaboration in the generation of a tourism database. While having fun, and by having the ranking system creating competition, users were open to contribute with their knowledge, so as to achieve a better place in the rankings. At the same time, they said that they would be further encouraged to do it, if the rewards would be something more substantial than only social

recognition. In addition, users, in general, confirmed that they would like to continue to use the application in their travels, since it fulfilled the objective of aiding them in the exploration of a new place, and in teaching them facts about their whereabouts, at the same time that provided a fun approach in doing so. Summarizing, the test group utilized in this project contributed with their knowledge, and would like to continue using the application, showing that serious games are an effective way of engaging users in a collaborative environment, possibly in a long-term basis.

Scientifically, this master's dissertation adds one more chapter in the usage of games for purposes other than entertainment. Serious games, as discussed in chapter 2, are used in multiple areas, and this dissertation explores another possibility, the one of using serious games to improve collaboration in the creation of a tourism database.

Practically speaking, the realization of this project produced an application with serious market potential. Developing this program further can lead to an application which would be usable by the general population and, in consequence, help tourists around the world that would like to be involved in a new experience, as long as they own a smartphone.

7.2 Further developments

There are mainly two aspects of the association between serious games and tourism applications that couldn't be properly tested, and can be studied in the future.

First of all, using the users as controllers of the information added by others couldn't be tested, in a controlled test group. Although the functionality was available, it wasn't used by any of the users, and it was stated that they couldn't find any information wrong in the system. In the open market, the competition created by the game, specially if associated with better rewards, would eventually lead to users trying to abuse the system, by inserting dummy information in order to collect easy points. The viability of this collaboration form can only be tested if the application meets users outside this controlled group, that knew that they were testing a prototype and, therefore, didn't try to cheat the system.

The second aspect is the integration with social networks. Although some interactions with social networks are already implemented, a mass integration with those networks would extend the social aspect of the application, and help in the achieving of the objective of this dissertation with a higher rate of success. Facebook, Twitter, FourSquare, and others, are used by millions of people nowadays, and are a great place to advertise the application, allowing, at the same time, users to interact with each other. This interaction can motivate people to achieve even more in the game, so that they can brag about it to their friends. If the friends of an user know about the application, they might get interested in using it as well and this can ignite competition, taking into account that rankings exist. Either by collaboration, or competition, actions in the game help the application to grow and to fulfill its objective. The social aspect was, nevertheless, noticed, with users that knew each other in the test group commenting about their performance in the game, and confirming that this interaction made them become even more motivated to achieve higher results. Integrating the functionalities of the application with a wide range of social networks could lead

to a massification of this social interaction and, as a consequence, lead to more motivation to play the game.

7.3 Future work

Considering that this dissertation was a project of 20 weeks only, many of the ideas that appeared in the beginning of the project, as well as some that came up during the course of it, couldn't be implemented. Nevertheless, all these ideas represent improvements to the actual application, since the initial goals defined were fulfilled. The following subsections provide an overview of the improvements that can be implemented in the future.

Augmented reality

Augmented reality (AR) is being used nowadays with several purposes, specially within mobile platforms. This technology extends the interaction between the user and the world around him, through the device that one is using.

Taking this into account, it seems that this technology fits the gaming world as a glove, and could provide a much more immersive experience for the tourists in the exploration of a city. AR to find PoIs, friends, or any other possibility seem like an interesting upgrade. Possibly, besides the integration of the current games with augmented reality, this technology could lead the way to new, different, games. Examples of applications of AR in tourist applications for smartphones can be seen in 7.1

Offline Mode

Something that the users complained about during the testing of the application, was the fact that they had to use their 3G connection in order to receive and send data to the server. Considering that most of these users pay, depending on the amount of data that they consume, to their service providers, it can be a major set back to the use of the application in the real world. Even though that, in a near future, it is expected that internet would be widely available for a cheap price, possibly even for free [Tec10], it would be advisable to create an offline mode to the application. In this mode, the mobile application would need to have a local database, that would be previously filled with the data related to the area where the tourist would like to go. At the same time, any interactions of the user with the system would be saved in the user's device. Upon connecting to the internet, the application would automatically synchronize all the data with the servers.

Advertising

Serious games have been used as tools for advertising by several companies (as it can be consulted in chapter 2.3.3). This application has the potential of including advertising in it, to the places that tourists are usually interested in. Restaurants, hotels and other places, could be interested in

Figure 7.1: AR view in commercial smartphone applications: Annotation connected to sidebar, showing additional information about POI in mTrip (upper left), Several POIs in mobeedo's AR view (upper right), Augmented Reality UK, showing annotation about the zoo in Bournemouth (down left), and displaying YouTube video in AcrossAir (down right) [from [YBG12]]

advertising promotions or any other kind of information to the tourists that are actually visiting the town in a certain moment.

The possibility of creating a business account, besides the one of a normal user is a possibility, allowing an interface directed to business, presenting the owner with statistics of their own business and allowing the posting of promotions or any other kind of information related to that company.

A business model would have to be created to this purpose, in order to control the flow of this advertisement, so that users aren't disturbed by unwanted publicity. In any case, this association could be, undoubtedly, useful both for tourists, that can find unique opportunities, as well as for the companies, that get another mean of spreading their image.

Transportation

Even though that this application is designed to help pedestrian tourists in their visits to a city for a short period of time, transportation, specially public one, is something that tourists typically use. In order to please a greater amount of travelers, this information could be integrated in the application, even because means of transportation or some courses are, in some cases, tourist attractions themselves.

On the other hand, in medium/large sized city, it's virtually impossible to walk from one extreme to the other, in a realistic period of time. This can lead to situations where monuments that

fall into the user's preferences are left out of the suggestions, being replaced by other PoIs with less interest, because of the distance handicap. Calculating circuits taking into account transportation could help tourists achieve more pleasing exploration trips, but would probably require changing the routing algorithm.

Treasure Hunt Game

An extension to the "Quest" game implemented in this application could be made, adding the possibility of users finding "treasures" left by others in a determined place. This could be used, so that users would be able to explore, not only the city center in the search for landmarks in it, but also remote places, such as forests, mountains, or other places situated outside the man made landscape. This simple extension of the "Quest" game would attract people that like other kinds of tourism, besides the one of looking for the main points of interest that a town contains.

Design

Even though the users that tested the application didn't find its design a set back, it is known that appearance is a key component in defining product–person relationships and as such, it significantly affects commercial success [Blo95]. Therefore, in order to achieve a larger community playing the game, it would be important to revise the design of all the interfaces, improving the quality of it. Landscape mode, better icons, better colors are some examples of interface parts that could be improved in order to achieve a more satisfactory interaction with the user.

Multilingual Database

Considering that the application is to be used by tourists all over the world, its important that the contents are available in their own language. Therefore, a migration from the actual database, to a multilingual schema, would be necessary in order to release the application to the public. Although English is the universal language, if the application could reach its users in a more comfortable way for them, it would be one more step to achieve their loyalty. The application's interface could be easily changed to any other language, given that this feature is already supported by the Android [Dev12a].

Improved route generation

The implemented algorithm allows for a user to indicate how much time he has available, and get a route taking into account this factor. Although this implementation satisfies a lot of tourists, that arrive to a city and want to see what's important, without losing much time in preparations, and that have limited time to do it, other tourists know that they will be in a city for several days. An improvement to the routing algorithms could extend the possibility of using this knowledge of in how many days the trip will consist, so as to provide better routes, possibly dividing the city by

areas, in which the user would achieve a better result than if he would simply ask for a different route everyday.

Smart user interests

In the developed application, users define their tastes and interests for each category of landmarks. In the future, the application could use this as a starting point but, overtime, it could infer if the users' tastes have changed through their usage and classification of the points where they have been. This is often done in online shops, where items are recommended taking into account one's history. Implementing algorithms that would redefine the users' tastes overtime could lead to a better experience.

7.4 Lessons learned

Executing this dissertation showed that the users of an application are willing to be contributers, as long as the right motivation is created in them. This very valuable knowledge, considering that engaging users towards an objective is a hard mission to accomplish.

Furthermore, it helped in the understanding of how, careful planning, and evaluation of choices, is important before they are actually made. For example, a lot of time was lost trying to set up web services in a technology that wasn't compatible with the servers available. This proved to be a poor choice and, if the technological set up was carefully studied before starting to develop, this mistake could have been avoided.

Finally, developing a project of this dimension alone (excluding the guidance provided from my tutors), proved that careful planning, and resilience to keep up with that plan, are major values that one should have in order to succeed in the developing of a product (which, in this case, was a scientific study). This is knowledge that wasn't so bluntly displayed during the path in this Masters, was clearly absorbed during the final chapter of it - the execution of this Dissertation.

Appendix A

PoI Categories

This appendix presents a list of the available PoI categories in the application.

A.1 List of available Categories

- Sightseeing;
  - Buildings and Monuments;
  - Religious Buildings;
  - Museums and Galleries;
  - Statues and Fountains;
  - Scenic Viewpoints;
  - Parks and Zoos.
- Food and Drinks;
  - Restaurants;
  - Cafes;
  - Bars and pubs;
- Accommodation;
  - Hotels and Guesthouses;
  - Hostels;
  - Camping Parks;
- Entertainment;
  - Clubs and Discos;
  - Theaters and Concert Halls;

  - Casinos;
  - Cinemas;
- Shopping;
  - Shops;
  - Shopping Areas;
- Transportation;
  - Bus and Tram;
  - Airports;
  - Train;
  - Taxi;
  - Boat;
- Utilities;
  - Tourism Info Centers;
  - Embassies and Consulates;
  - Hospitals;
  - Pharmacies;
  - Police;
  - Post Offices.
  - Public Buildings and Institutions;
  - Public Toilets;
  - Saunas and Spas;
  - Sport Infrastructures;
  - Rent-a-Car;
  - Rent-a-Bike;
  - Car Parks;

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