GeoGuild: Location-Based Framework for Mobile Games

Georgia Ionescu, Javier Martín de Valmaseda and Michel Deriaz
Institute of Services Science
University of Geneva
1227 Carouge, Switzerland
Email: {$georgia.ionescu, javier.martindevalmaseda, michel.deriaz$}@unige.ch

***Abstract*—Smartphones' performance is in sustained growth, and their geolocation capabilities bring opportunities for developers to explore new aspects of social gaming. We propose a multiplatform framework that can give a social side to a wide range of mobile games. The framework is independent of the game and provides different location-based tools, such as guilds, territories management and geolocated events. Our set of tools integrates user geo-position on real world maps, allowing the players to team up and conquer territories in their vicinity. The uniqueness of our framework is the fact that it can turn a simple game into a full social experience, whilst combining the real and the virtual world. In this paper we provide an overview of our platform and show how well-established one-on-one games can be rethought as social multiplayer games.**

***Index Terms*—location; mobile; games; social**

I. Introduction

The capabilities of smartphones are growing at a rapid pace and with them, opportunities for innovative applications arise. In September 2012 there were over 845000 active applications in App Store [1] out of which around 16% were games, being the most popular category in iOS. For Android, in the second quarter of 2011, 64% of the downloaded applications were games. Additionally, according to the same study, in the ranking of the most downloaded applications the first position was occupied by games, and the third position by social networking [2]. This shows a tendency of mobile users to prefer games and social apps.

Sheila A. Paul et al. [3] describe some of the key characteristics that contribute to a game's success. In their paper they explain how *teamwork*, *competition* and *communication* enrich the user's experience and how these factors determine the players to stay longer in a game, that otherwise would become rather boring after a while. Another study [4] shows that a high percentage of the massively multiplayer online role-playing gamers (MMORPGs) would make friends with teammates. Additionally, more than 80% of the subjects were playing multiplayer games with their family and friends.

Cahier et al. [5] state that a serious game (games whose primary purpose is not entertainment) can be used for engaging people in sustainability issues. They propose a serious game solution to make the space of the game massively "participative", at the scale of a city or bigger areas. Local partners of a given city are easily able to add scenes, elements of scenes and micro-games transposing appropriate sustainability situations for their city. This reinforces the idea that a geolocated territory management can make users interact physically and socially in a game.

Most of the mobile games are single player with little or no social interaction. In this paper we present GeoGuild, a framework that integrates geolocation in mobile games, which can enrich one-on-one games through social interaction.

This paper is organized as follows. Section II presents several location-based applications that are relevant to our work, and introduces the problem statement. In Section III we describe several social scenarios, and the games that can use our tools. Section IV presents the GeoGuild architecture and functionality. Finally, Section V concludes this article and presents several directions for future work.

II. Related work

As defined by Joao T. P. N. J. and Antonio Fernando Coelho [6], a location-based game (LBG) is a game that uses player's physical location as input, and generates location-based information. The idea of location-based applications has been around for several years, and has evolved along with smartphones' capabilities. The improvement of precision for Global Positioning System (GPS) made the development of LBGs possible. The games can offer players different challenges such as finding items on world map, building empires, or even physical exercise. However, we could not find a generic solution that can be integrated in one-on-one games. Our objective is to take advantage of the location-based features in order to achieve a more challenging and socially engaging gaming experience.

There are several types of location-based games, which we further present.

Geocaching is one of the most popular geolocated treasure hunt games, having more than one million registered users [7]. The game consists of a real-world outdoor treasure hunt which uses GPS-enabled devices. The players can stash a

cache and share its approximate location with the other players, who can try to discover it by solving riddles and by exploring the area where the cache was hidden. Although it is a popular geolocated application it only provides services to find treasures previously hidden by other users. Our goal is to provide a complete territory management system with complex challenges and more social features.

Another popular LBG is Turf Wars [8]. This is a massively multiplayer online game where players can claim places on the world map and defend them. They can also build turfs or capture them from their opponents. The game also has a "pay for safety" system, where weaker turfs can pay (using the game's currency) stronger turfs to offer them protection against their enemies. The players have access to several types of virtual weapons which help them in their fights. The aim of the game is to build an empire as big as possible. Similar to Turf Wars, Geo Wars [9] is based on building geolocated towers and defending them. The game integrates the real time local weather which plays an important part in the combats. The weather can boost or attenuate a tower's defense capabilities.

Ingress [10] is an augmented reality MMORPG created by NianticLabs@Google. Players can join one of the two teams *Enlightened* or *Resistance* and try to conquer as many territories as possible in their surroundings. The game consists of finding check points (such as portals or resonators) on the world map and conquer territories by interacting with the check points.

Smart Rabbit [11] is a location-based exergame for Android, designed to give a more interesting side to exercising. It aims at encouraging people to become more physically active and exercise more by enjoying the game. The entire game is based on running competitions between the players. The one that is able to run a certain distance in the shortest time wins the challenge. Smart Rabbit has three different modes : Training Mode (no interaction with other users), Duel Mode (two players compete against each other) or Circuit Mode (more players run the same distance in the same city, but possibly a different path). Although social interaction exists in Smart Rabbit, there is no collaboration between the players.

Geolocation services occur in social applications as well. For instance the one designed by A. Ellertson and Patrick Seeling [12]. In their paper they propose an application which combines mobile social games technologies with location-based services in order to build learning communities.

In this Section we presented several location-based games which offer different challenges to the players. Geolocated games combine these challenges with the physical movement on the map. The ratio between the amount of physical movement and the other challenges varies from game to game. Although they are all engaging, the ways of using geolocation is very simple. Most of the times, the main activity is focused on wandering around on the map and checking into a certain location. Additionally, in most cases the social interaction is little, even though we have seen that location-based applications can be community oriented.

We propose a solution that combines different elements from the applications presented in this Section and brings several new ones. Our system aims at making games more interesting, challenging and collaborative. We are creating GeoGuild, a framework that can be added to a wide range of games, and turn them into challenging location-based games with a strong social side. This platform manages the territories on a virtual map, allows players to team up and form guilds, make decision through collaborative voting, and dispute their battles by playing the games they like. Our solution lead to well balanced location based games where the physical movement on the map is not the main challenge of the game. Board and card games can integrate our solution in order to offer the players new goals to achieve and new opportunities to socialize and cooperate.

III. Applications

A. Target Games

The games we are targeting with this framework are mainly one-on-one games. These games have in general very little social interaction, most of which is outside the game itself. We further present two games that could be the perfect candidates for using our framework.

Let us consider a very well known game, which is popular in the entire world: *chess*. Chess is a two-player game, which can be played physically or virtually. There are many chess applications that allow the players to engage in a chess match against people from around the world. However, the players are normally isolated from one another. The final goal of a chess match is merely to defeat the opponent. By integrating geolocated features into a chess game, the purpose of the match can dramatically change. A new game can be designed by combining chess and location based features (territories, or being part of a guild). This new game can have a new goal, for instance building an empire and conquer territories in the area where the players and their team mates are located. The battles between the guilds and the way of disputing territories would be chess matches. Players that live geographically close to one another, could team up and build their own guild. They can conquer territories and fight against other guilds, simply by playing on-line chess tournaments.

Let us present a very concrete example of how a chess game application can integrate our framework and how such a game could function. A chess player *A* wants to team up with her/his friends and play together for a common goal. Using the GeoGuild features, player *A* can create a guild and invite all her/his friends to join it. Once created, the guild can conquer territories on the virtual map in the area

where the guild members are located. The guild decides what territories to conquer through democratic vote, using the voting system provided by our platform. The voting system is very simple. One or more players suggest an area in the players' surroundings, and the guild members can vote whether they agree or not to conquer them.

If the territories they choose are already occupied by another guild, the two teams will have to dispute a battle. This battle consists in a chess tournament between the members of the two guilds. This territory conflict gives a whole new meaning to the chess match. The goal of the match is not merely winning it, but to conquer or defend your territories.

Considering the fact that the events are geolocated, all the players who want to participate in the tournament will have to be positioned in the area that is "under attack". This rule applies to both teams involved in the battle. Thus, the battles give the chess players the opportunity to and to socialize with their teammates, and meet their opponents in real life.

Another popular game type is card games. There is a wide range of card games, each having their own particularities, but the gameplay is very simple. Each of the two players owns a deck of several cards (with different powers, capacities, etc) and strategically play the cards against the opponent's ones. The aim of the match is in general to defeat the opponent's cards by using the different capacities they have.

All the gameplay possibilities previously illustrated for chess, apply to card games as well. The card game could be used as the way of disputing territories and influence areas on the map. Additionally, for this type of game, the members of a guild could build a common deck by donating their best cards to the guild. The players could also rent cards to other team members.

B. Case Study

We are working closely with *EverdreamSoft*, a game company that produces a successful worldwide card game - *Moonga* [13]. They have showed interest in GeoGuild and they plan to integrate this framework in their next main release.

Moonga runs on both Android and iOS and consists of two-player matches. Each player owns a deck of five cards and they take turns when playing them. Each round, both players choose a card that they play against the other one's card. Depending on the cards' parameters and affinities, each of them produces a certain damage to the opponent. At the beginning of the match, both players have 20 HP (health points). The game ends when one player looses all her/his HP or when the entire deck is played. The player who owns the most HP at the end of the match wins the game.

By integrating the GeoGuild framework, Moonga will allow players to form geolocated guilds. They will be able to share

Fig. 1. Moonga Battle

Fig. 2. Moonga Territories

cards with the guild members and to play tournaments against other guilds.

C. Social Scenarios

A very important characteristic of our framework is the fact that it is geolocated. This means that in the game certain features are activated only if the players are geo-positioned in a certain location/area. For instance, if a team's territory is attacked, they will have to gather in the attacked location, and play the game, against the other team. This gives the players the opportunity to meet and socialize with their team mates, and with their opponents as well.

The geolocated management of our framework facilitates the organization of located events. The game designers could take advantage of this and offer bonuses in the game for players that participate at certain events in a particular location. This gives the players the opportunity to meet in real life with people from around the world with whom they share the passion for the same game.

IV. Solution overview

In this chapter, we present GeoGuild, a social framework that integrates a world map and manages the map's territorial configuration. GeoGuild offers features regarding the guilds, territories on the world map, collaborative voting, etc.

A guild is represented by a group of players which are the guild's members. The guild can own virtual lands on the world map.

A. Challenges

One of the most important characteristic of our framework is its *generality*. Designing a framework for a vast variety of games, is a challenge. GeoGuild provides various generic features like for instance creating/joining a guild, conquering a territory, or voting for a certain decision inside the guild.

At the same time, our system is quite *flexible*. The parameters which define the restrictions applied to guilds or calculations of the territories can be tuned. Additionally, new features can be easily integrated in our framework. GeoGuild can be adapted and configured for the specific needs different games have.

B. GeoGuild Architecture

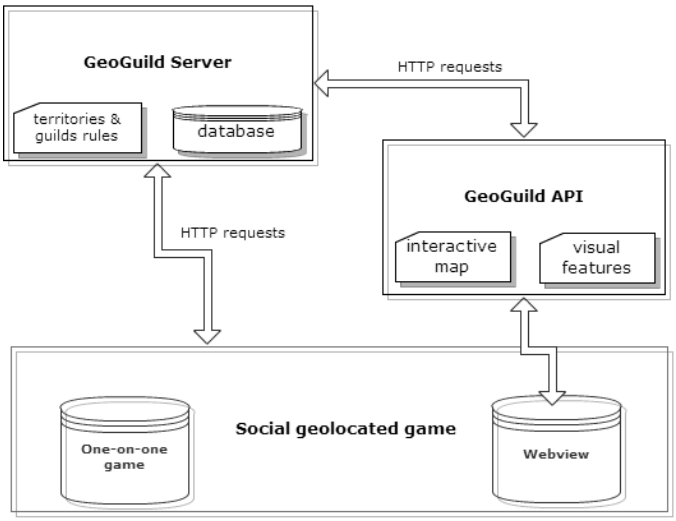

Fig. 3. GeoGuild Architecture

As shown in Figure 3, the framework consists of two main modules: *GeoGuild Server* and a set of libraries called *GeoGuild API*. Both are independent components, and can be easily integrated in a multitude of mobile platforms.

GeoGuild Server incorporates all the guild rules and territories management, along with a database. The server provides the mathematical formulas and constraints applied to the territories and the rules an restrictions specific to guilds. Additionally, the server implements a collaborative voting system which offers the team members the possibility of democratic vote for all the major decisions needed to be taken inside their group. The database contains all the guilds' information, the map configuration and specific parameters. The server is completely independent of the game, and can be called through HTTP requests by either the game itself or the GeoGuild API.

GeoGuild API is a set of Javascript/HTML5 libraries which offers the visual features regarding the guilds and the management of territories. One of the most important one is the interactive world map, which can have a certain configuration. The maps configuration changes with each action taken by the players such as conquering a territory, or creating a new guild, etc. The API offers all the features needed to display territories in different colors or patterns, guilds, items etc. A very important characteristic of the API is that most of the player's actions are directly linked to her/his geo-position on the map. This means that some actions are available in a certain location, where a certain point of interest or item is located, while others have a certain range of interaction distance. The players located very far from that particular point of interest have very few possible actions towards it, and in most cases it concern only information display.

As previously stated, the GeoGuild API consists of a set of Javascript/HTML5 libraries, which makes it platform independent. It can be easily integrated in other applications, using components that can display web pages. The communication between the server and the API is possible through HTTP requests to which the server responds with a JSON formatted answer.

C. Territory management

We propose a flexible organization of the territories on the map. As opposed to having check-points that players need to check into, our world map is organized as a grid with cells of different sizes. The size of the cells automatically adjust to the map's configuration. The more crowded an area is, the smaller the cells are. The advantages of using a dynamic cell system are numerous.

The territories can be acquired in exchange for the game currency. If the price for a cell is for instance fixed, smaller cells will cost as much as bigger cells. Although the price calculation remains very simple, it adjust automatically to the market. The motivation behind it is to imitate a simplified real estate market where the prices are directly influenced by the interest shown by the buyers, and the density of population.

For the areas where the players are sparse and thus the guild density is low, the cells will clearly be bigger compared to the areas with high densities of guilds. This will give the opportunity to the guilds to buy bigger areas without having their players move a lot. This way the game remains interesting and not very difficult to play for the isolated players.

In crowded areas, aside of the fact that the prices are higher for a small cell, the dynamics of the map can change a lot, and there are enough cells in order to give the chance

of expanding. Since the unit of measurement of the land is represented by the cell, adjusting the cell size means that the territories available for conquering are constantly expanding. The territories are measured in number of cells achieved, and not the area itself.

D. Main features

GeoGuild framework offers a voting system, that allows the guild members to vote for certain events inside the guild. This way every member can take part in the decisions made inside the group, and not only the guild master. All the members can vote whether to accept a new guild member, to attack a certain territory, etc.

Additionally the framework provides a complete set of features designed for creating and managing a guilds, conquering territories and disputing battles between guilds.

V. Conclusion and Future Work

We presented GeoGuild, a unique framework that can enrich one-on-one mobile games by giving them a social side. By integrating geolocated features in mobile games, we give the players new opportunities to meet and socialize.

We showed that well-established games can be adapted to the current trends. Through location based features, they become more socially engaging.

We are currently in the process of integrating our framework in Moonga, a successful card game running on iOS and Android. A geolocated event is planned for the near future which will give us feedback on how their players perceive the new features brought by GeoGuild into the card game.

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