Using Location Based Game MapSigns to motivate VGI data collection related to traffic signs

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Abstract

Geo-data created by numerous VGI applications are widely used today. Although VGI data bring numerous benefits, they also have some limitations primarily because the users are not motivated to collect all kinds of geo-data but only those that are of great importance for them. Therefore, there are types of geo-data like traffic signs, park benches, trash cans, pedestrian crossings etc. that are in most cases not covered by the existing VGI applications. Our aim is to address the problem of volunteers’ motivation by creating location-based game (LBG) whose by-product of playing would be such data. In this paper we present the prototype of the MapSigns LBG that is used for mapping traffic signs. The proposed game has the data quality check implemented in the game plot. Also, in this paper we address the possibilities of consuming geo-data created this way by officials and wider set of users.

Keywords: Location based games, VGI, traffic signs.

1 Introduction

Lately, the geo-data collection process based on the concept of Volunteered Geo Information (VGI)[4] is massively exploited by all relevant stakeholders in the field of GIScience including private companies, Non-Government and even Government sector. It can be said that the current development in the field of Web and mobile technologies is driving such progress and it is evident that the volumes of voluntarily collected geo-data is getting bigger each day [2]. Also it is evident that the quality of VGI data is improving in time both in terms of positional accuracy and the qualitative and quantitative attributes. This trend makes such data possible replacement for traditional geo-data, collected by official agencies, in many possible use case scenarios.

The fact that VGI is based on cheap technologies which are available to almost every Internet and smartphone user is what makes it even more valuable. Such wide availability of VGI applications is making this phenomenon global since the most popular applications based on this concept are used in different countries, both high and low developed, across the continents. This global nature of VGI has led to the fact that more and more different geo-data are collected this way everywhere.

But the VGI concept has its limitations both in the range of data for which users are motivated enough to collect and also by the fact that such data are collected predominantly in urban areas [5]. The lower amount of data collected in rural areas is due to the low population density and therefore low number of volunteers. In addition the more number of people that are interested for some type of geo-data the more chances such data will be collected sooner. But with time and with spread of the new technologies and better communication capabilities in rural areas, the amount of collected data is rising and coverage is improving.

The same cannot be said for data which are not of the primary concern for mainstream users of such applications. Although it is evident that different geo-data including streets, addresses, touristic locations, economy related geo-data etc. are well mapped in popular VGI based applications, there can be found a large amount of data which location characteristic isn't of such high importance for users, but could be valuable in some specific situations.

Geo-data related to things like traffic signs, park benches, trash cans, pedestrian crossings etc. are rarely found in such applications or can be found only in those areas where the volunteers participation rate is very high. One cannot say that some subsets of such data are not available in different GIS application, for instance, stop signs, parking signs and street directions could be found in GPS navigation software or even on Google Maps or OpenStreetMap. In many countries the collection of such data can be considered to fall within the jurisdiction of the national or local municipality agencies and therefore it is expected to be collected like traditional geo-data with traditional methods and tools. Nevertheless, the process of mapping such data can be considered expensive especially for small and underdeveloped local municipalities that cannot afford having professional GIS software and surveyor mobile devices. Therefore, it could be convenient if the power of volunteers could be used in such cases.

But the problem of motivating volunteers to collect this kind of data arises. It cannot be expected that majority of volunteers will be interested in collecting locations and descriptions of traffic signs. Also, it is hard to expect that, due to a number of such data, minority of devoted users that are in pursuit for reputation on popular VGI applications will able to collect them. Therefore, we think that using location-based games (LBG), whose side-effect would be collecting such “unpopular” data, could improve users’ motivation. Additionally, data collected in such way could be used as a
starting point for creating geo-data of official agencies in the future.

In this paper we present the prototype of the MapSigns LBG that is used for mapping traffic signs. The game is currently in its initial development stage. It is played by the two teams, consisting of at least one player, that compete by collecting traffic signs locations, types and descriptions. The collected data quality check is implemented in the game plot, and the quality of collected data directly influences who will be the winner of the game. In the paper we also present how traffic signs related data could be used by official local municipality agencies and how obtained data can be additionally edited and integrated with other official data on the city level.

The rest of the paper is organized in the following way. The second chapter describes the current research in the area of LBG that are used in order to collect geo-data and existing quality assessment of the collected data approaches. The third chapter presents the proposed game plot, roles in the game and how data validity checks are incorporated in the game plot in order to assure collected data future usefulness. The fourth chapter describes the system architecture with special accent on the proposed mobile application. In the fifth chapter possible examples of use of such data both in desktop and Web GIS applications that are used in the city of Niš are presented. The last chapter gives concluding remarks and states directions for future development.

2 Related Work

Location based games that are used on mobile phones are not new and have been popular since mobile phones equipped with GPS sensors came to market. Lately, we are the witnesses of the great expansion of LBGs on the mobile phones’ applications market that are built to serve different purposes. For instance in [6] authors have extensively researched 63 papers which covered some 15 different LBGs. They proposed the classification of LBGs into three separate categories according to their main objective: ludic, pedagogic and hybrid. It is evident that the most important objective for users is fun and it should be the implicit objective of any game. Therefore ludic LBGs are only meant to offer fun for their users and income for their developers like most of the LBGs that can be found on the market [3].

Other game objectives can be explicitly embedded into the game by its developers. For instance, the example of pedagogic games is Frequency 1550, the one of the earliest LBGs for learning historic facts [8]. The game is meant to motivate pupils between 12 and 14 to acquire specific historical knowledge about the city of Amsterdam. Its gameplay is based on extensive back-story that consists of answering key questions, completing learning tasks, doing different activities, reading narratives and interacting with other players.

Lately LBGs that belong to the group termed hybrid are gaining focus of the research community. Those are the LBGs that, besides offering amusement, require from users to complete some specific tasks that are embedded into the game storyboard. Motivation for using such tasks could be data collection, data validation, users tracing etc. In the GIScience domain, the most important are LBGs which purpose is to produce geospatial data that is useful for non-gaming applications. Geo-data produced as side-effect of playing LBGs could be later used in various GIS-related software. Such LBGs could be regarded as special types of VGI applications. The only difference compared to the popular VGI applications is in the users’ motivation to collect data.

Similar to VGI based applications, LBGs which by-product are collected geo-data suffer from problems with validity, verifiability and mistrust for such data. The main research activity in this field should be creating ways to improve the quality of geo-data collected this way. For instance, group of authors led by Sebastian Matyas [7] proposes Web based solution that provides the ability for users to assess geo-data collected in their CityExplorer LBG during playing sessions. Main game objective is collecting markers on various locations in the city which is divided into non-overlapping segments. The player who has entered the majority of markers in such a segment gets points. Between game sessions, players are able to confirm or deny the correctness of all other players’ markers anonymously using dedicated Web platform.

Another example of LBG for collecting geo-data with embedded quality control is Urbanopoly [1]. It is based on the well-known board game Monopoly transferred to the real world. Initially, game has been filled with geo-data from sources like OpenStreetMap, Open Data Portal of “Regione Lombardia” and others. Starting from an initial dataset of geo-data, players complete missions and challenges in order to create new or to review existing geo-data. Urbanopoly is the game without distinct game-sessions and geo-data could be continuously improved. Nevertheless, this LBG as a primary focus has POIs in the city which are in most cases already available from different public geo-data sources.

As a difference to previously mentioned LBGs, we propose the solution of the game with distinct game sessions and the expected output of each session should be geo-data regarding some specific real-world features that are rarely mapped by existing VGI or LBG applications. Each game session is based on collecting redundant geo-data that are checked at the end of the game by players that were involved in that particular session. We think that such approach where data validity check is embedded into the game plot of each session will improve the quality of the collected geo-data.

Regarding technologies used for development of such applications, initial LBGs were in most cases developed using JavaME technology, known for its cross-platform nature which provided the possibility for using such games on wide variety of mobile phones. On the other hand, contemporary smartphones are dominantly equipped with one of the three most popular mobile operating systems (mobile OSs): Android, iOS and Windows Phone (including WP7, Mango and WP8). In addition, each of popular mobile OSs have their designated maps that can be used in applications like Google Maps and Bing Maps which are almost always used in LBGs. Therefore one cannot expect that location based game developed for one platform can be used on others although there are some third party Integrated Development Environments (IDE) like Unity 3D [9] or Xamarin.iOS and Xamarin.Android (former Monotouch and Monodroid) [10] that provide possibilities for compiling one code for different platforms. Nevertheless, we have decided to develop our prototype game for Android because the fact that, according to the market researches, this is the predominant mobile OS,
especially on the Serbian market thus the game, once when completed will be available to wider audience. The prototype is developed using Eclipse IDE and Java programming language.

3 MapSigns game plot

The location based game Map Signs is a chase game where the objective of the two teams is to as quickly as possible get from starting location to the randomly selected destination within the radius of approximately 1-2 km. The teams are divided into thieves and policemen. Each group can consist of minimum one person with restriction that the number of team members may differ by a maximum of 1.

Game starts when one player creates the game on his current location. Other players can see pending games and their respective starting locations and join accordingly by selecting their teams. After all the players join the game, the player that created the game starts it. Thieves get the destination location first and their time starts counting. The team starts with their quest. They need to choose the route to destination along which they need to collect traffic signs. For Thieves, each collected traffic sign is regarded as heist. Traffic signs are collected by acquiring their exact location using available location providers (preferably from GPS provider), choosing traffic sign's type by selecting proper sign image from the set of predefined images, and optionally by capturing image of the sign and adding additional descriptions if appropriate.

Destination location is presented to Policemen 20 minutes after the Thieves started their quest after which time they start with the chase. Along their route, they also have to collect heist evidences by collecting traffic signs data.

Both teams meet at the destination place when the counting is finished. After that, the player that initiated the game, signs in as judge and traffic signs collected by both teams are presented on the judge's map. Other players can follow judge along the route backwards to the starting location and check the collected data. [The role of Judge is collective role and all players by consensus decide whether the specific collected traffic sign is valid or not (is not reasonably close to the real sign's location, the type of the sign is incorrect etc.). The most important case is when the same physical sign is mapped by both teams (this is the desired outcome of the game), then they collectively decide whose data is better by selecting them on the map. Traffic signs entered by Thieves team have red border line, Policemen' blue and sign accepted by Judge has yellow border line. Signs that are not accepted are deleted by the Judge. Each accepted sign reduces the 10 minutes from the total time of the team. The winner is the team which has shorter elapsed time. After the Judge finishes reviewing all collected signs, they are uploaded to the game server.

The game has lots of borderline cases. For instance one team can run to get to the destination as quick as possible without collecting any data along the way. To prevent such cases, teams without any accepted sign automatically loses regardless of the elapsed time (this forces that at least one sign is correctly collected). Additionally, in order to prevent such race issues each player has the radar that shows when the closest location of the opposing team member is within 200 meters. This provides the ability for team members to balance between the opposing requirements, their walking speed and quality and quantity of collected data.

To prevent multiple acquisitions of the same data, Judge rulings from previous game sessions are presented on the users’ maps. Only when users are sure that they can collect sign better than the existing one, Judge can later accept that new edit and delete the old one. This enables users to validate existing, previously collected data.

4 MapSigns architecture and implementation

The MapSigns project is a system assembled from multiple components. Since the main objective of the system is not only the LBG but also data that are harvested in the process and the use of such data. The whole system could be divided into two main parts (see Figure 1):

- Location-based game subsystem.
- Official geo-data subsystem.

VGI part of the system consists of one MapSigns Game Server, its database and multiple client mobile applications. That part of the system is used for playing game and collecting data. Each member of both teams uses its own smartphone with installed MapSigns mobile application. In order to synchronize the whole game, each device sends its updates to the server in 10 seconds time slots by sending its current location and possible newly entered or edited data. Members of the same team share all collected signs data but are not able to see data collected by opposing team.

After initial startup of the application, the user can setup hers profile by entering username, capturing picture with camera or selecting the picture from the file system. After setting the profile, user can choose whether she wants to create new game or choose the existing one that is pending for

Figure 1: MapSigns system architecture
Players. The main game screen is the MapActivity which uses Google Maps Fragment supported form the GoogleMaps API V2 for Android. The users can choose whether they want to use vector or satellite map. In many cases, satellite map can be more suitable because users can compare the real situation with the satellite image. When the game starts, users are presented with the destination location on the map. Users are able to lock the map according to their position or to pan it freely. In order to collect the map sign data, user is required to stand next to the traffic sign and select add sign from options menu. The user can enter traffic sign only on hers current location. On the sign insert Activity, user needs to select the sign type. Traffic signs are divided into three main groups according to the official regulation that is used in Serbia:

- Danger signs.
- Explicit order signs.
- Warning signs.

At the moment application supports total of 235 traffic signs. The user searches the appropriate sign on a TabView control with three tabs. The sign is selected by matching its image compared to the real sign. At this stage of development, the application only uses traffic sign codes but in the future, appropriate names will be mapped with each sign. But some signs are unique and only follow some specific pattern. For example signs to denote the names of places or objects (sign for the city, name of the bridge). When mapping such signs, the user selects the sign pattern but she also needs to take the picture of the real sign. User can also add the additional description of the sign. After the sign in entered, the proper marker with the sign symbol and appropriate border based on the user team is shown on the map. New sign description is sent to the game server in the next time slot.

The mobile client application is made of multiple Activities (Figure 2) and one Service. By starting/joining the game, the background game Service is started. The game Service is responsible for communicating with the game server and for acquiring the GPS location. Service communicates with the Map Activity using BroadcastReceivers. Whenever some important game parameter changes (either new data received from server or the location changed), Service updates the Map Activity and the map is updated accordingly. This approach provides the flexibility for players, because some asynchronous events like received phone call, received SMS or any other won’t affect the game status. Service maintains all important aspects of the game in the background regardless of the Activity that is presented to the user. After the player is able to return to the game, the Map Activity is presented to the user and updated according to the current game status (players’ location, new traffic signs etc.).

MapSigns game server is a simple multithreaded C# WCF application that communicates with mobile applications. MapSigns game server uses local SQL Server database for storing data regarding games, users and traffic signs. The server communicates with mobile applications using JSON in order to reduce the amount of used network bandwidth. The server also supports the use of Google Cloud Messaging (GCM) - the asynchronous notifications supported on Android OS. It is used to notify other users about the game that is waiting for new players. In the future prototype development, server application should be significantly improved in order to support more network connections and much larger network traffic.

The part of the system that consumes the collected data is based on the existing GinisLS system. GinisLS is GIS for local municipalities, developed in the CG&GIS laboratory of the Faculty of Electronic Engineering Niš, University of Niš. Among others, the City of Niš uses GinisLS system as its official GIS. GinisLS consists of the two major subsystems (Figure 3):

- GinisLS Desktop (GinisLS Client and GinisLS Server).
- GinisLS WebGIS (GinisLS WebGIS, GinisLS WMS&WFS).

In the proposed system, we are using data integration on the database level in order to import data collected using LBG subsystem into the GinisLS. The GinisLS Desktop user is able to see the traffic signs layer. Traffic signs are divided into three sub layers according to the already discussed groups. For each traffic sign type there is one sub layer. This provides the ability to the user to select only those layers of traffic signs that are of interest to her. The user in the official local municipality is further able to review data and optionally choose to additionally edit both the location and attributes of the data. After verification process, the reviewer can choose to store the traffic sign in the GinisLS Database. From that point, such traffic sign feature becomes the official geo-data of the local municipality. Traffic signs that are reviewed and accepted are available to the wider public using GinisLS WebGIS solution. It is a three-tier WebGIS application that supports data different searches by attribute values of the geo-data. This way, players are able to track how their contributions, made during game sessions, become useful to others. It can have the positive impact in motivating players not to cheat and to be fair during competition and also to give their best when mapping traffic signs during game.

Figure 2: MapSigns game Activities
5 Conclusion and future work

This paper presents our work in progress on building the system that uses location-based game MapSigns for mapping real world objects as by-products of the game. The aim of this research is to see whether LBG can be used to motivate players to collect geo-data that is not otherwise collected by other popular VGI applications. We propose the game storyboard that requires from players, as the winning condition, to collect data as accurately as possible. The game concept proposes the role of Judge that is used in the data validation process at the end of the game session in order to assure that the quality of collected data will be as high as possible.

Afterwards, we are trying to integrate data collected in this manner with the existing GIS that is used on the local municipality level. We present how such data could be consumed in the existing GinisLS system used in the city of Niš. We hope that presented system could be used in the future to kickstart geo-data collection process that is not of the primary interest for different types of users but could be valuable for some specific purposes. We plan to add a non-gaming mode of the application that will be used for data collecting geo-data by users that have high number of winnings and played games. Also, we hope that proposed system could be used for collection of different types of geo-data other than traffic signs like park benches, mailboxes etc.

Since the project is in its initial stage, there are a lot of issues that need to be addressed. For instance availability in different countries could be the problem since different countries use different sets of traffic signs. Therefore application should provide seamless extensions with sets of traffic signs that are used in different countries. Also, the systems should support integration with popular GISs, data export etc.

In the future, the MapSigns gameplay should be improved by conducting case studies with multiple players. Winning conditions and borderline cases should be also further investigated to prevent game cheating and assure the best possible data quality.

References


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