O-Mopsi: Mobile Orienteering Game using Geotagged Photos

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Abstract: Location-based mobile gaming combines gameplay with physical activity. We have developed a game, O-Mopsi, based on the concept of orienteering, which can be played on mobile phones with GPS receiver and Internet connection. In order to complete a game, a player must visit a set of targets that are photos chosen from a user-generated geotagged database. Game creation, management and live tracking can be done using a web interface. The game was presented at an annual international festival which is aimed at introducing science and technology to school children and the overall feedback received from the players was positive.

1 INTRODUCTION

Whilst using mobile devices for playing games is very popular and long-established idea, mobile gaming which uses the player's location and involves physical activity is a recent idea, although it starts to gain popularity. With the fast development computing devices, mobile location-based gaming has evolved from using wearable computers and head-mounted displays (Piekarski and Thomas, 2002) to using mobile phones with access to Internet and GPS localization.

We introduce a mobile location-aware game, O-Mopsi, which is based on the classical concept of orienteering and exploits the multimedia data available in a geotagged user generated photo collection (cs.uef.fi/mopsi/photos). A game is created by defining a set of targets and a player can complete the game by visiting all the targets in any order. A target is represented by a photo along with location information.

O-Mopsi can be played using a mobile application for Symbian phones, which is available at cs.uef.fi/o-mopsi/ along with the web interface.

The mobile client has functionalities such as plotting targets on the map, displaying compass data and giving audio clue with varying pitch and sound frequency about the distance to a target. Photos are used as an additional aid for identifying a target

The web interface allows game management, real-time player tracking, post-game trail analysis and suggesting tours calculated by either greedy heuristics or an ant colony-based optimization.

2 RELATED WORK

One of the first examples of location-aware games is *Pirates!* (Björk et al., 2001), which demonstrates how proximity-triggered technology can be integrated into computer game design.

A large number of location-aware games are adaptations of traditional board games or computer games. including *Quake* (Piekarski and Thomas, 2002), *Pacman* (Cheok et al., 2004), *Tic-Tac-Toe* (Schlieder et al., 2006), *Monopoly* (Li et al., 2008) or *Chase and Catch* (Misund et al., 2009).

Mobile gaming is often combined with education. For example, *Savannah* (Facer et al., 2004) aimed at children, who use devices with GPS to navigate and study animal behavior in a virtual savannah. Education is also the goal of *Skattjakt* (*Treasure Hunt*), (Spikol and Milrad, 2008), which encourages players to get physically active by solving a mystery surrounding a castle. It considers that mobile outdoor games are well suited for novel learning activities that involve physical motion, problem solving, inquiry and collaboration.

A common approach is combining game reality with physical reality. For example, *Song of the North* (Lankoski et al., 2004) is game inspired by Nordic mythology, which combines a virtual spirit world with the physical world and in which the players interact by using mobile devices. Another example of mixed reality is *Can you see me now?* (Benford et al., 2006), where players are chased through a virtual model of a city by runners (professional performers equipped with Wi-Fi and

GPS). The rules are similar with the game of catch, but the "runners" have to traverse actual city streets in order to capture the online (virtual) players.

In a location-aware game, photos can be used in various ways, such as a means of interaction (Suomela and Koivisto, 2006) or to provide additional information about game targets, such as in *See It* (Neustaedter and Judge, 2012).

O-Mopsi is based on the concept of virtual orienteering, similarly to applications such as OrientGames (www.orientgames.com) or Virtual Orienteering Game (www.vorienteering.com). The difference between O-Mopsi and most of the other orienteering-based games are that the targets are shown as photos and the order of visiting the targets is freely chosen.

3 GAME RULES

The goal of the game is to visit all targets in the shortest time. A target is identified by its location, photo and a short description. A game is created by selecting photos from the Mopsi photo collection.

A game starts when the player visits the first target. The order of targets is not fixed and it can be freely chosen by the player. A game ends when the player visits all the targets. To visit a target, a player has to be closer than 20 meters from its location. This threshold was chosen taking into consideration GPS inaccuracies. Players are ranked in the order of completion time. The total distance, the starting target or the order of visiting targets do not affect ranking.

The game shares similarity with the concepts of orienteering and geocaching (Cameron and Ulmer, 2004), which both require identifying and visiting a number of targets.

Orienteering requires navigating from point to point in a predefined order using a map and a compass. Unlike orienteering, in O-Mopsi the targets can be visited in any order, encouraging players to develop different strategies and to choose the starting point. Orienteering is focused on identifying the location on map whereas O-Mopsi provides additional hint in the form of photo of the target.

Geocaching requires finding a hidden treasure (a collection of things placed in a container called geocache and placed in a location available to the public). The GPS location of the cache is published online and other people need to find the cache and replace an item from the collection by another. O-Mopsi also requires find a certain GPS location defined by another player, but the location is identified by a photo. Additionally, in Geocaching, the time does not matter and targets are not grouped into games or other entities.

O-Mopsi uses virtual targets, whereas orienteering and geocaching use physical objects.

4 O-Mopsi WEB

O-Mopsi web interface can be used for creating and managing a game, displaying the proposed shortest path of a game, displaying game results and viewing real-time player progress.

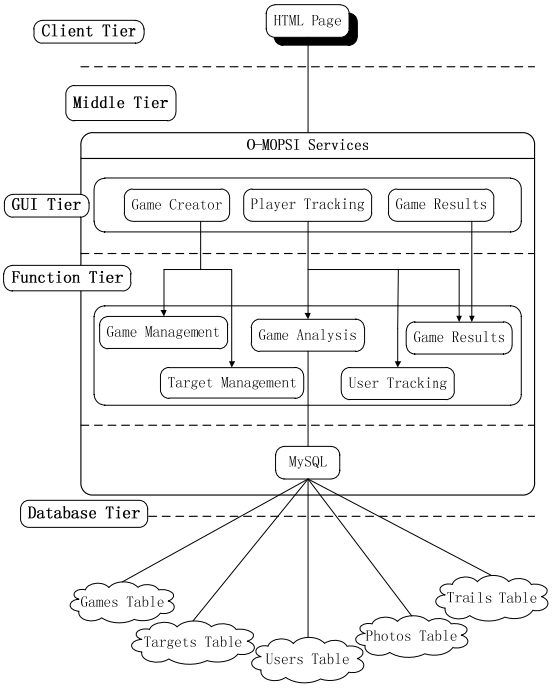

Figure 1: Architecture of the O-Mopsi website.

Fig. 1 shows the architecture of the website, along with the main functions. We use Google Maps for displaying targets, the interface is developed using PHP and JavaScript and the game data is stored in a MySQL spatial database.

The client tier contains the HTML page which is presented to the user. The middle tier is composed of the GUI tier and the function tier. The GUI tier includes interfaces for the creation of the game, for the live tracking of the players and for the game results. The function tier includes all the server logic operations: game and target management, game analysis, user tracking and game results. Finally, the database tier consists of the tables needed to store game data (games, targets, users, photos and trails).

4.1 Game Management

A game is created by providing a description for a set of targets. The targets are selected from the Mopsi photo collection with the help of keyword search or using the location-based recommendation documented in (Waga et al., 2012b).

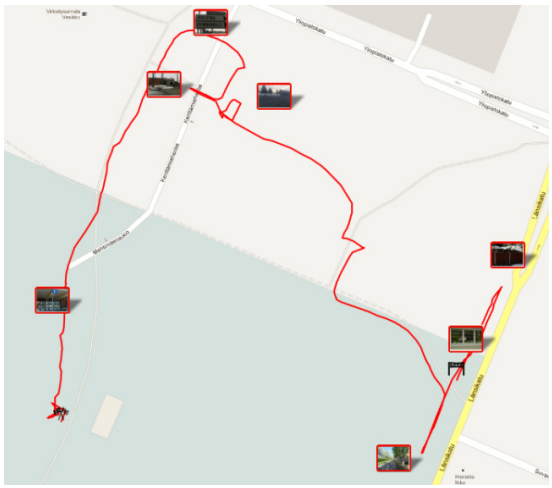

Figure 2: Live player tracking.

4.2 Game Tracking and Analysis

Player's location and the targets can be seen in real time on web in the Game Hall (see Fig. 2). This allows viewing the player's progress and analyzing the players' trails along with other characteristics such as speed or moving type using the algorithm in (Waga et al., 2012a). The user has also the option of viewing the shortest route calculated by ant colony optimization algorithm (see Fig. 3).

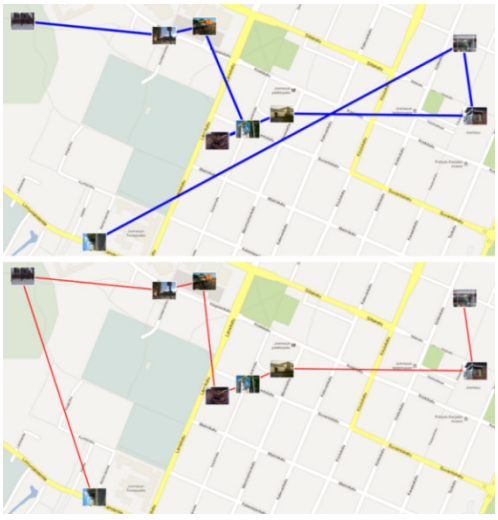

Figure 3: Ant colony optimized route.

5 GAME CLIENT

The game client is available for Symbian phones. It is developed using C++ and the Qt libraries. A Windows Phone version is in development and iOS and Android versions are considered in future. After logging in, the player can choose to join a new game or continue an existing active game.

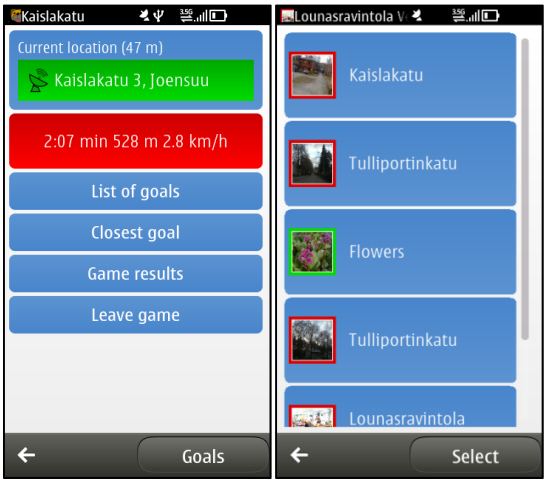

Figure 4: The main screen of the application (*left*) and a list of targets (*right*).

During gameplay, the player's location is tracked and stored on server. The main screen of the application (see Fig. 4) shows the current location, accuracy and statistics such as playing time, distance and speed. It also contains shortcuts to the map, option to highlight the closest target and to view the full list of targets.

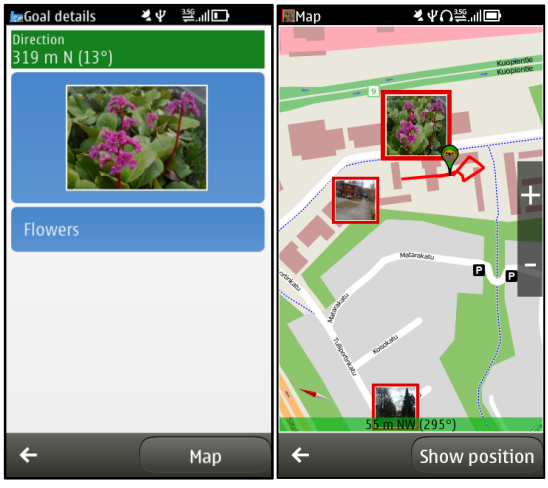

Figure 5. Viewing target details (left) and highlighting the chosen target on the map, along with the player's trail (right).

A target can be identified by its photo highlighted on the map (see Fig. 5). For aiding navigation, the application displays the distance and bearing to the selected target along with player's orientation taken from the phone's compass sensor.

Additionally, the player is guided by sounds while the map is open. When the player approaches a target and is closer than 500m, a beeping sound is played at fixed intervals. The interval between sounds is inversely proportional to the distance, starting from 5 seconds (500 m) and decreasing by 1 second every 100m. The sound frequency increases or decreases as the player becomes closer or further away from the target. Reaching the target turns off the sound guidance.

6 FEEDBACK

O-Mopsi was designed for the annual SciFest festival (www.scifest.fi), which brings together thousands of school kids, high school students, and teachers to learn about science and technology (Jormanainen and Korhonen, 2010). SciFest is organized in Joensuu, Finland in April.

O-Mopsi was presented during 2011 and 2012. Because limited availability of smart-phones, the players were organized into teams. After the game, a short feedback survey was filled by the teams.

Table 1: Players' ratings of the game.

Feedback	Very good	Good	Adequate	Bad
Scifest 2011	3	6	0	0
Scifest 2012	3	7	0	2

Feedback (see Table 1) shows that the game as mostly rated as good or very good. According to users, game rules are easy to understand and playing the game is enjoyable.

7 CONCLUSIONS

O-Mopsi is a location-aware game based on the concept of orienteering, in which targets can be visited in any chosen order. Testing O-Mopsi in a real-world situation during an international festival produced positive feedback.

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