# A biking geo-game to gather commuting data

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**Abstract**

Urban bicycling is seen as a reliable and environmentally friendly alternative for commuting. Governments are improving biking infrastructure and promoting usage while they highlight its health benefits and zero emission operations. There are interesting questions related to differences between infrastructure planning and citizens' adoption and usage, and the differences between plans and usage analysis making them incomparable because they follow different methodologies or spatial representation is missing. Better data collection and analysis tools are needed to improve comprehension of urban biking, and geospatial technologies and mobile devices would help to identify such differences and would help both city planners and urban bikers to optimize trips.

This documents contains a geo-game proposal that uses virtual resources or gems as game instruments to be be relocated. Players join teams and use bikes to "carry" them around the city to win; meanwhile data from mobile devices is collected to understand paths and players' displacements. Generated datasets will be also used to understand bike usage patterns and provide a new platform to engage citizens with data production and validation using gamified tools.

*Keywords*: Biking, Geo-games, Green Living, Open Smart Cities, Urban transport.

## 1 Introduction

Gamification is an emerging strategy used by cities to promote, persuade, invite or engage people, and at the same time used as a smart city tool for data collection and validation. "Mag-ike" is a research experiment oriented to use of game design tools in open smart cities to improve comprehension of transport dynamics and support green living actions during citizens' daily activities.

This paper contains a game proposal for allocating virtual resources around the city using bikes, while paths and displacements are collected. Players will initially come from Universitat Jaume I, Castellón, Spain (UJI). The proposal presents problem requirements, game design, and a short discussion about challenges using gamification, following the structure published by Schlieder [1-2].

## 2 Problem requirements

Biking is a well-recognized transportation alternative with many supporters and promoters. Cities are interested actors responsible for infrastructure improvements, and many have realized that bike usage and engagement could be improved by providing bike-friendly roads [3]. There are important decision factors for biking, such as comfortable road conditions and quality infrastructure, therefore public policies -- bike promotion programs, bike availability, public bike services and parking—can often explain growing bike usage [3], [4].

Measuring bike adoption is not an easy task and current methods usually demand personal contact and enough time to answer surveys. Information technologies could help with measurement, data processing, and bike usage estimations, and with gamification strategies more citizens could be engaged and motivated to participate. Our proposed geo-game aims to motivate citizens to create a team and play while biking, to allocate virtual resources around the city to win. No changes in daily commuting paths are needed since virtual resources will be placed at known crowded places.

Data from players will be collected constantly after game installation and will be used to identify biking patterns, then some comparisons against existing infrastructure will show gaps between designed and real paths, abnormal displacements, and intensity flows among other useful facts for city planners and environmental awareness promoters.

## 3 Game Design

"Mag-ike" (magic bike) players should belong to a team and collect the highest amount of resources (called Gems) from the university campus, carrying them only by bike around the city to finally depositing them at nodes (public bike stations). Players will be warned if they do not use bikes for carrying resources and could lose them; occasionally they will be guided to reach nodes close to their usual path to spatially balance data collection.

The game considers a multi-cache approach and there will be daily reports with accumulated scores and game status to help players to improve their results. A team wins after getting the highest score after 7 days.

Defining biking as the only allowed mode of locomotion ensures adequate data collection for this mode; this strategy could later be applied to different modes like public transport or private cars. To address this challenge both game narrative and mobile components (i.e. Google Fit, Moves, FocusMotion) are used to integrate game locomotion and data collection.

### 3.1 Players and Organizers

Players need to be bike riders in Castellón, they should usually go to or from UJI's campus by bike, and have an Android smartphone where the application could be installed. It is expected to have configurable setup to use the application for different cities or locations.

It is also expected that players who bike frequently clearly recognize its environmental advantages, and constantly use city biking infrastructure, including bike-paths, car shared roads, parking or rental facilities. Players' skills for using web and mobile maps, or some other geospatial tools are also desired, especially those related to route estimation for walking, biking, public transport, taxis, etc.

Organizers will be divided into two groups: i) Enrollment, to persuade players and promote the game, these could be researchers or teachers that directly talk to students and UJI members, so they should understand and comprehend game dynamics and objectives to present it easily and fast; ii) Support, will play and follow game dynamics to ensure all game conditions, and, in case of failure or abnormal behavior, inform administrators and organizers to support their decisions.

### 3.2 Geo-narrative and mode of locomotion

Following the main narrative for players, here we describe the game and its context:

*At the peaceful UJI Magic School students practice their spells and read grimoires while teachers make efforts to obtain the precious Obsidian Gems and its magical energy. In this School there are two main brotherhoods: The Alphas and The Omegas which always challenge each other, and school members (staff, teachers and students) belong to one of these brotherhoods taking part of all those challenges.*

*One day, some kind of energy alteration made the Nodes to explode. Now, both brotherhoods have to fix these Nodes or they will be annulled and forgotten. To repair the Nodes, the members of the brotherhoods should obtain some Obsidian Gems from the School and bring them to the Nodes, and by doing so will win Gold Coins. But the Gems are not stable and should be carried with care, not too fast and not too slow. The brotherhood repairing more Nodes, by bringing more gems to them, will win, and its members will be rewarded.*

*Also, members with more Gold Coins will gain acknowledgment and fame.*

*Only one question remains: Are you Alpha or Omega?*

### 3.3 Geo-content and Game Relocation

"Mag-ike" is a relocatable geo-game, where organizers can define a set of places that will be visited by players for carrying resources. These places could be public bike stations or some other added, removed or relocated place; those stations should be placed in open areas to avoid GPS limitations.

Players should start each trip at UJI Campus, where they can take up to three resources (Gems), then bike to any of the defined locations and leave one or more resources. There is a notification when the player heads toward one of those locations and has at least one resource to deposit. During a player trip the device will monitor speed and movement patterns to ensure he or she is biking; if not, notifications will be triggered and after three attempts carried resources will be unusable and the player should get more at UJI campus.

Players can go to any of the selected places and dispose resources, they can take up to three and leave either three, two or one at the same place, the way that a resource is left at a place is by selecting resources from the screen, and confirming they will be left there, then a notification will be received. There is no need for players to take any unusual route, however some suggestions based on visited places or common routes will be generated.

Every night resources will be counted to identify the brotherhood with more healed nodes, players' personal rewards from carried resources and trips to UJI's campus. The game finishes with a winning brotherhood having more daily points and special rewards for players with more golden coins.

### 3.4 Temporal Balance and Duration of the Game

The game is designed for 7 days, and on each day one point is given to the team with best performance, score reports allow players to re-arrange strategies, and some of them could be also suggested directly through the mobile application. Personal scores will be also delivered allowing players to share their achievements.

After the initial campaign teams could be re-organized, and players with best scores will belong to a special category where they could ask for players to join their brotherhood.

### 3.5 Geogame mechanics and rules of the game

Following are the main game rules:

Game campaign:

- Players could access to game just after the initial date defined by organizers.
- Game will consider activity during game campaign of 7 days; data could be collected out of those dates but will not be considered for scores.

Players will use their mobile phones for:

- Collecting Gems at UJI's Campus
- Choosing and dropping Gems at nodes
- Receive notifications about game and scores
- Register user data
- Leaving either team or game
- Reviewing scores, dashboards and maps with game state

Points and Golden Coins

- Points are given to brotherhoods, one each night for the one with most healed nodes, or having more Gems from players. i) If both brotherhoods have left the same amount of Gems in a node on one day, the healer of that node is the one that left the first Gem of the day. ii) If both brotherhoods have healed the same amount of nodes, the point goes to the brotherhood with more carried Gems, if both

have carried the same amount the point then goes to the one that brought the first Gem of the day.

- Golden Coins are given to players individually, one for each Gem left at a Node. i) If a player goes twice to UJI's Campus, gets additional Gems and leaves them in a node each of those Gems will give two coins to the player.

## 4 Technology and other equipment

The game platform includes software and hardware components in a client-server configuration. The server side mainly stores data regarding players (i.e. device and personal info), places (locations and states), resources, scores, and bike paths. It also holds and balances web service requests for feeding/collecting client actions, and delivers notifications and support external analysis. The client side holds all user interaction components, tracks player movements and paths, controls resource interaction, displays score dashboards, and notifies users with game news. Communication is based on restful web services that push requests when the client (mobile) has internet connection, while server listens and summarizes scores considering just those actions reported the same day. Cloud services will be supported when they are needed, all client activity will be tracked, recorded and analyzed mainly on server-side.

Components for server side starts with a postgreSQL and postGIS spatial database, then a business logic layer that controls all push requests, data access and notifications; ending with a service layer that encloses web server, authentication and client requests.

Components for the client are enclosed in a native Android application including movement and navigation tracker (like Google fit or Moves), mapping framework to show facilities, resources and trigger location based actions (when and where resources are picked up or left), front-end interfaces for resources interaction, score dashboards and device notifications.

All players will be requested to allow access and storage of sensitive data, like device position, movements and paths, and to install third-party components to guarantee not only successful data contributions, but also efficient game interaction. Players that do not allow all requests will not get rewards according to their behavior, and contributions to teams could not be added.

## 5 Discussion

Gamified tools are proven engagement tools [5]–[7], however their success depends on game promotion and players' attitudes. Urban bikers often share their experiences and promote biking using information technologies, therefore playing while biking should be feasible for collecting data.

Technology considered for implementation could ensure monitoring and mode of locomotion, API's like Google Fit and Moves or FocusMotion SDK bring several functionalities to monitor users' movements and are optimized to efficiently use battery, built-in sensors and mobile data connections. Comparing data from bike usage with existing infrastructure would easily show existing gaps between planned paths and real movements of citizens: interesting inputs for city planning and citizens feedback regarding forbidden crosses, shortcuts or alternative routes, while additional behavioral patterns could also be found.

Game campaigns could be associated with academic events or promotional exhibitions like "bike-day", "pro-environment week", "Science fair", etc.

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