# Citizens as volunteer cartographers:

# A pedestrian map case study

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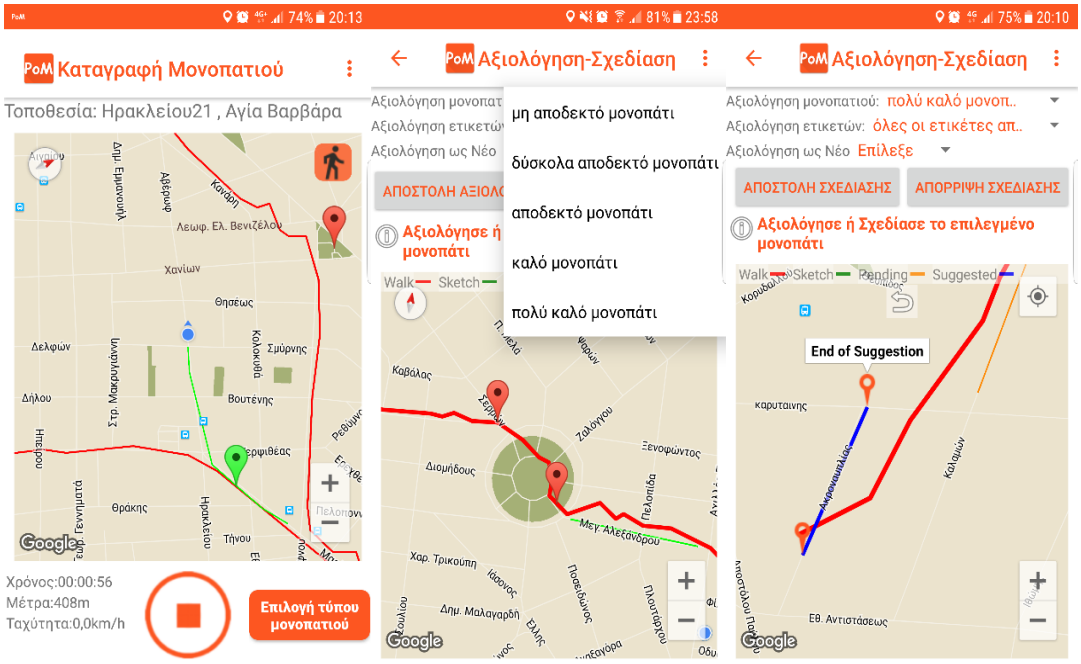
## Introduction

Until recently, making of a relatively accurate map required skills and knowledge which were obtained through education and training. The emergence of digital maps and modern geographic tools (sensors, devices, software) that automate or/and abstract complex processes has made it possible for virtually everyone to become a little bit of a cartographer. In particular, any person with minimal or no training at all, can be considered as a mapmaker in terms of information contribution (Volunteered Geographic Information - VGI) or limited map editing (e.g. as on OpenStreetMap [1]), to say the least. We decided to investigate the effects of unsupervised collaborative mapmaking (including map editing) of non-expert users for pedestrian maps. The case of pedestrian maps is not at all randomly chosen, but stems from the fact that popular maps (e.g. Google Maps) are focused on motorized transportation, neglecting the needs of pedestrians. Community-based information provided by pedestrians' utilizing their mobile devices, could become the remedy, providing a map more suitable to their preferences [2].

## Application

Firstly, we implemented an Android application, PeersOnMap (PoM). The main methods which the application employs to engage untrained smartphone users and harvest their collective power are crowdsourcing, peer reviewing and gamification. The core function of the application is to collect the user's location data while he/she walks through an urban environment with minimal interaction (**figure 1a**). The location information that is collected can be considered as the basis of a new pedestrian network of paths or map which is not identical to the vehicle roads. Moreover, most maps do not provide direct information/visualization of walkability of paths . PoM allows the user to rate the walkability of his/her own recorded paths. The rating of paths' walkability

although subjective, can be evaluated by others, leading to collectively objective results. Recording and retrieval of user location is trivial and broadly exploited in many location-based apps. There are also online map editing services, such as OpenStreetMap (OSM). We took a step forward and included the editing part of paths into the mobile application.




(a) (b) (c)

**Figure 1: a) Path recording, b) Path evaluation, c) Path sketching**

Thus, the user, through the app's interface is capable of adjusting and improving recorded paths, while still in the field (**figure 1c**). This is important because much collaborative map editing applications use distant editing techniques like satellite images or aerial photographs. In contrast, in our approach the user experiences first-hand the walking path network by himself/herself. Hence, we suppose he/she can make better and more qualitative edits/contributions. Besides correcting paths, users can also review other users' paths for walkability (**figure 1b**). Peer reviewing of paths has a double aim. Firstly, it is necessary to objectify paths' walkability values and secondly to discourage and limit the effects of malicious behavior. To motivate users to provide as much information as possible, a gamification system was applied. The gamification system involved a score system for each of the actions that have been already explained with a leaderboard, as well as an achievement system on Google Play.

## Pilot Experiment Design

A pilot experiment was designed to test the application's usability and proper operation and to elicit some early conclusions. The gamified application had been available for students of the Informatics Department of Ionio University in Corfu - Greece to download and install in their Android smartphones. As an incentive, a bonus grade was offered for completing a series of tasks with the app. The arena of the game was specified to be the town of Corfu, of less than forty thousand inhabitants, in the homonymous island of Greece. It was stated to potential participants that the ultimate goal of the game, besides player rankings, was to collect enough data to produce a new, more appropriate map for pedestrians. Participants were given 20 days to play with the app. They were also provided with an online manual (which included the details of the point system) and a video demo showing the full capabilities and functions of the app. The tasks which the subjects of this experiment were encouraged to fulfill were: a) record and rate at least 5Km of paths, b) review at least 5 other users' paths, c) draw at least 5 path corrections of total length of 1Km or more, d) answer an online questionnaire at the end of the game.

## Preliminary Results

### Logged Data

Most of the participants installed the application but weren't motivated enough from the gamification system or/and the bonus grade offered, to fulfill the tasks. This phenomenon agrees with the findings of Haklay in his analysis of OSM user-generated content [3]. The users who adequately used the app mostly worked on recording paths, than reviewing or editing them (**Table 1**).

The application depends on peer reviewing for cancelling out inappropriate behavior. Despite this, we detected unacceptable user input, indicating that still, some users will resort to cheating in order to accumulate higher scores.

### Questionnaire Answers

Most of the respondents have never edited a map but where very interested in the idea of contributing in the creation of a pedestrian map. About half of the participants were motivated from the contribution in the creation of the pedestrian map and approximately the other half were motivated from the gamification features of the app. It is impressive that while many of the participants were motivated by the score system and achievements, all of them claimed that they didn't use any strategy to gain more points. Concerning the preference type of contribution among a) recording new paths, b) reviewing other users' paths, and c) re-editing existing paths, the users' answers dominated the recording new paths choice.

| Stage | Number of participants |
|---|---|
| App installation | 30 |
| Record paths (at least 1Km) | 15 |
| Record paths (at least 5Km) | 13 |
| Review paths (at least 1 review) | 7 |
| Review paths (at least 5 reviews) | 3 |
| Design/correct paths (at least 1 path) | 4 |
| Design/correct paths (at least 5 paths) | 3 |
| Questionnaire | 14 |

**Table1: Participation in each stage**

## Discussion

The results of the pilot experiment give us insight in our first attempt to take advantage of VGI benefits.

First of all, the insufficient general motivation mentioned before, means that the following assumptions could be valid. Either the gamification system applied (scoring system with leaderboards and achievements) is inadequate to motivate users for this kind of application, or no gamification system is adequate to motivate users for this kind of application. The first implies more research in the appropriateness of the gamification system is needed, and the second that the application has to be addressed into targeted groups/communities of people that their interest in the application goal is inherent and not limited to the game mechanics or external incentives.

Secondly, users' inappropriate data uploading can be disastrous for applications which rely on uncontrolled user contribution. If gamification features or some sort of compensation is also included, then the temptation of cheating grows. As a researcher, discovering that your data are not valid, not only is disappointing, but in general reduces the confidence of gaining sound results. To avoid similar circumstances, VGI gamified applications should embody a carefully designed and implemented malicious behavior prevention system.

Concerning the participants that show interest in the purpose of VGI apps, we can't postulate that in any case they will be willing to take part in every aspect

of the project/voluntary work. As our experiment showed, there is a preference for specific types of voluntary work. Although we haven't extensively investigated if usability issues are involved, we suggest that this kind of preference is due to different levels of activity enjoyment. Consequently, type of voluntary work shouldn't be handled with a rationale of volunteers will do everything they are asked for. Instead, VGI apps should focus on targets which are easier to hit. In order to achieve this, we propose that a preceding examination of the willingness of supporting in different tasks could yield better results both in quantity and quality, as well as, reducing unsuccessful attempts.

## Conclusions

Early data from the pilot experiment showed that crowdsourcing apps which rely on active volunteering should be very carefully designed as there is little control to participant behavior once they go live. In particular, our experience with the PoM app revealed issues which have unclear causes and should be further researched. Does extrinsic motivation provide higher quality results in similar apps and does it contribute to the long-term engagement of users? What are the factors that induce volunteer's willingness to take over a specific task and how can we take advantage of this in the design of the app? Though we believe every amateur citizen could be a source of valuable geographic data, we can't blame them of inconsideration or misuse. It is up to the app designer to understand the contributors, exploit their preferences and ultimately extract their precious good offered.

## References

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[3] Haklay, M., & Weber, P. (2008). Openstreetmap: User-generated street maps. IEEE Pervasive Computing, 7(4), 12-18.