Published in Proceedings of 18th AGILE International Conference on Geographic Information Science, 9-12 June 2015, Lisbon, Portugal, which should be cited to refer to this work.

Motivating citizens to take action for biodiversity conservation using geospatial systems

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Abstract

Urban biodiversity plays an important role in every day's life. It influences not only physical and social health of inhabitants, but also water drainage, microclimate regulation, air quality, and thus has an economic value. The assessment and improvement of biodiversity in urban spaces does not only depend on the decisions of politicians, but to a high grade on the attitude and on the actions of citizens. In this article we discuss how citizens may be motivated to both contribute in biodiversity monitoring through two different geospatial applications and to take action for improving biodiversity in urban space.

Keywords: Urban Biodiversity, User Motivation, Augmented Reality (AR), Citizen Science, Crowdsourcing, Social Media, Volunteered Geographic Information (VGI)

1 Introduction

Urban biodiversity has an impact on the wellbeing of cities inhabitants. Moreover it has a direct and an indirect economic value [1] [2] [3]. However, as the population in many cities increases, at the same time as the number of people per dwelling decreases, green areas in many cities are gradually diminishing which leads to biodiversity loss. [4] [5] [6]

There are several ways for citizens to counter the loss of biodiversity, for instance electing politicians who are in favour of sustainable urban planning. Another possibility is to participate and to contribute to research projects aiming at analysing biodiversity or by getting involved with non-governmental organizations such as the World Wide Fund for Nature (WWF; www.wwf.org) or the International Union for Conservation of Nature (IUCN, www.iucn.org).

In recent years, technologies have developed rapidly. Indeed, computers, tablets and smartphones are available for almost any citizen in European cities. One consequence of this trend is the collection of volunteered geographic information (VGI). [7] Thereby most of urban residents can collect geospatial information. Several successful projects focussing on species and biodiversity have proven that geospatial data collection by volunteers is a working concept. Examples are the global ornithological network *eBird* [8] or the Swedish species reporting system *Artportalen* (www.artportalen.se).

We argue that three points are crucial for the success of geospatial applications focussing on biodiversity:

- An application needs to be adapted to the user's skills and expertise. [9].
- People need to discover the application e.g. through newspapers, social media, etc.
- Users must be motivated to use the application and to continue using it.

The user's motivation can be both extrinsic (i.e. the user is motivated by an external goal such as money a grade and so

forth to use an application) and intrinsic (the users likes using an application because he's for instance interested in the results or because he likes the interface.) [10]

In the case of the two cited examples, eBird and Artportalen, we consider the motivational incentive to be mostly intrinsic; i.e. people do not get an external reward for using these applications, they are using them because they are sharing a common interest in specific species with other people.

Another dimension of motivation is the difference between implicit and explicit motives to take action. Explicit motives are triggered by explicit instructions expressed using human language. Implicit motives on the other hand are triggered by nonverbal stimuli and are guided by what is pleasant or what is aversive. [11] Explicit motives are not as enduring as implicit motives and people do not experience inherent pleasure and reward after completing an action. [12]

In the following sections we will first describe our experience from a crowdsourced biodiversity mapping campaign that has been conducted in the Geneva cross border area and then present an ongoing project which aims at developing an augmented reality application that motivates citizens to assess biodiversity in urban spaces and to take action for improving urban biodiversity.

2 The Urbangene project

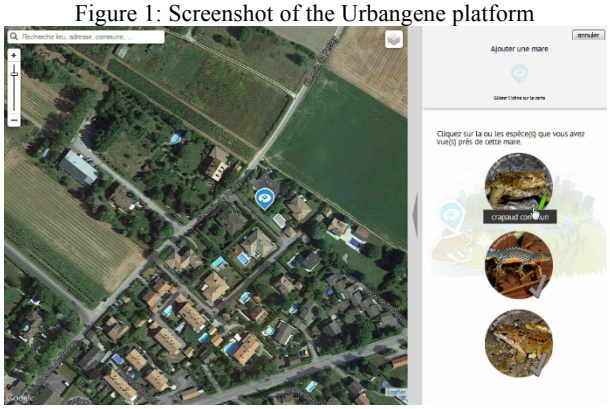
Ponds and streams are important biodiversity hotspots in urban environments, however aquatic ecosystems in urban areas are influenced and threatened by human activity, which often causes fragmentation, degradation or loss of environments and reduces connectivity between remaining habitat patches. In order to allow a conservation planning for urban aquatic ecosystems, with the goal to maintain, improve and connect urban aquatic habitats, it is thus important to locate and characterize these vulnerable environments. An important fraction of ponds is assumed to be located on private grounds, which makes the participatory crowdsourcing approach very valuable, as such information would be difficult to obtain otherwise.

In the framework of the *Urbangene* project, a webmapping platform was developed to allow citizens to digitize ponds and to report specific species that have been identified in or around these ponds. [13] (see Figure 1). Once the user has found the system's URL, he is guided through instructions and questions.

A media campaign, mainly focussing on newspapers was started in order to make citizens aware of urban aquatic biodiversity and to motivate people to digitize ponds and to specify the species inhabiting these ponds. The first articles about the Urbangene platform appeared in four newspapers on the 20th of March 2014; four articles appeared the day after and the national Swiss Radio dedicated a short radio transmission to the project. Within two weeks, news about the Urbangene platform appeared 13 times on Swiss media.

Six months after the media campaign, we analysed the system's web server log and the system's database. [14] We found out that more than 900 users accessed the system. However the traffic on the system's webserver quickly declined the days after the media campaign, which suggests that only few users did come back.

Figure 1: Screenshot of the Urbangene platform



Moreover only a small fraction (about 3%) of the mobilized people digitized ponds on the platform. The majority of the latter (68%) digitized one pond while the remaining users digitized two or more ponds.

Another interesting finding was the high percentage of mobile device users - although the platform had been optimized as a webmapping platform – almost 10% of all users used a mobile device to connect to the system and between 20% and 40% of the users who digitized ponds were using a tablet computer or a smartphone.

In order to evaluate the quality of the digitized features, the locations of the 53 digitized ponds were compared to OpenStreetMap data (openstreetmap.org; Open Data Commons Open Database License), an existing database containing ponds from the Geneva Institute of Technology, Architecture and Landscape (hepia) and Google Maps imagery. (maps.google.com).

We were able to confirm the locations of 26 ponds (49%) using the reference data, 19 locations were not confirmed (36%) and 8 locations (15%) were either not far from a confirmed pond (and thus perhaps only an imprecision), not visible due to presumably covering trees, or objects that are other water objects (e.g. fountains or swimming pools).

The experience from the Urbangene project suggests that through media campaigns many citizens can be mobilized and motivated to participate in biodiversity crowdsourcing projects. Moreover the high percentage of mobile device users indicates that mobile applications are promising tools for mapping biodiversity-related features.

3 Collaborative AR platform for biodiversity

After the experience from the Urbangene project, a new project called *BioSentiers* was started with the aim to motivate pupils to take action for biodiversity in urban areas.

The concept of the project is that pupils use an augmented reality (AR) application, while walking with their teacher from the train station in Yverdon-les-Bains (located in the city centre) to Champ Pittet, a nature reserve within La Grande Cariçaie (Switzerland's largest lakeshore wetlands) situated outside the city. The application on one hand shows species on the way, such as plants or birds but also actions that citizens have taken in favour of biodiversity, for instance green roofs, dry stone walls or ponds.

The path from the train station to the nature reserve is about two kilometres and takes roughly 20 minutes to walk. On this way a visitor experiences a change in landscape from the urban city centre of the cantons' second largest city to the nature reserve.

Another key concept is that users can digitize new information such as observations on biodiversity or actions that they have undertaken in favour of biodiversity. The application, as compared to many other mainstream augmented reality applications, thus offers a high degree of interactivity and many ways to add and to verify data.

The main educational goal behind BioSentiers is thereby to make pupils aware of species living in urban and sub-urban areas, and to understand actions that citizens or the municipality have taken in favour of biodiversity. Multiple data layers have been collected, e.g. from the Swiss Ornithological Institute, from the city of Yverdon-les-Bains and from the Swiss Federal Office for the Environment.

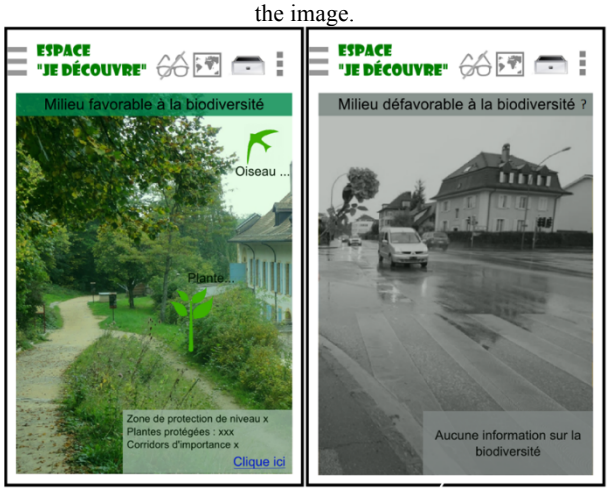
Figure 2: Screenshot of the BioSentiers mock-up

A second goal is to motivate pupils to digitize observations on urban biodiversity (e.g. different species that are visible where they live) and then to take action for biodiversity such as planting a plant on their parent's balcony or creating a pond in the garden.

Several concepts have been adopted to motivate users to use the application:

- In partnership with the service for compulsory education in the region, the usage of the application corresponds to a certain number of credits that teachers need to accomplish within the regional educational plan. Teachers thereby are encouraged to use the application.
- Every user who adds or comments data earns points; based on these points a ranking is established. Users who add false information will be penalized and withdrawn points. The service for compulsory education suggested that a reward; e.g. a boat trip on the nearby lake is offered to the user with the highest rank.
- In order to motivate users to add data in regions where no data is available, a black- and white filter is applied to the image (see Figure 3), thus implicitly motivating users to digitize observations or to take action.

Figure 3: Two screenshots of the mock-up – on the left several species are near the user and the image is thus showing colours; on the right no information on species is available at the users' position and a black and white filter is applied on the image.



In order increase data quality and to decrease the risk of fraud three measures have been taken:

- Users can denounce false data; e.g. if multiple users have contested a feature it can be considered false
- Automatic controls for erroneous data are implemented; e.g. impossible observations of specific plants digitized in the lake are deleted automatically
- A web-based data-management system will be implemented in order to give specialists access to the data. Specialists are able to delete and modify data.

4 Discussion

Motivating citizens to collect information on urban biodiversity through mobile and web-based geospatial applications as well as encouraging people to take action for biodiversity is an interesting challenge.

The Urbangene project demonstrated that many people can be recruited to use a crowdsourcing application focussing on biodiversity through media campaigns; however only few user could be motivated to add content and to continue using the application.

One possible explanation to this finding might be that the users did not get enough in return for their work. Moreover, in order to optimize the system's usability, the interface had been designed in a very straightforward way, giving explicit instructions how to digitize a pond and how to specify a species. The users were only able to see the ponds that had been digitized along with the user's names and the identified species - no further interaction with the data was possible.

Another important finding was the relatively high percentage of not confirmed digitized features. Therefore several measures have been taken in the BioSentiers project in order to increase data quality: data verification through other users, automatic data controls and an interface allowing specialists to manage data.

Based on the findings from the Urbangene project, we have decided to focus on different motivational aspects in the BioSentiers project: at first extrinsic motivation to use the application is given through the fact that teachers can earn credits by using the application with their classes. However while using the application, several incitements are presented to the users in order to encourage them to continue using the application after their school excursion; extrinsic incitements such as rewards, but also the metaphor to "change" a place's greyscale image to a colourful image (see Figure 3) by adding data.

The fact that many users found the Urbangene platform through social media is encouraging. Users are motivated to interact socially and collaborate for the good of a common interest through an application. This fact might be behind the success of for instance applications such as eBird and Artportalen. This finding was also a reason why we have chosen to implement many ways for users to interact with other users through the BioSentiers application: e.g. by commenting data added by others.

5 Conclusions

User motivation is crucial for any application that focuses on data added by its users. However motivation is triggered through different incitements that can be divided into implicit and explicit motives. We have found evidence that strengthens the results found by researchers that explicit motives are less enduring than implicit motives. It is therefore important to give implicit incitements to users; e.g. by making the possible consequences of a user's actions visible or by offering possibilities to interact with other users

Another important aspect is that users can be motivated by extrinsic incitements, such as rewards or grades and intrinsic motives as for instance the will to improve biodiversity in a city. Our first study showed that it is important for crowdsourcing platforms to be designed to facilitate its usage, however it is also vital for the success of such applications to offer something in return to the users.

Data quality is a sensitive subject; after the experience from our first study, we argue that any crowdsourcing application should offer tools and methods to verify and correct erroneous data; either automatically, through other users or using specialists.

Another important finding is that through social media networks large quantities of users can be recruited with relatively little effort. The creation of communities can play a major role for the creation of successful geospatial systems.

Mobile devices such as smartphones or tablets are promising tools for biodiversity monitoring during outdoor activities. Applications for such systems have the potential to e.g. automatically register coordinates for biodiversity sighting and for uploading respective pictures directly in the field. Furthermore the usage of mobile devices is increasing and users could be recruited to spend some time using a crowdsourced system during their journey to work or other activities during which they could use their mobile devices. Another advantage is that most social media platforms such as Facebook or Twitter are available on mobile devices. Thereby users could be recruited through mobile social media applications and then directed to crowdsourced mapping platforms without the need to switch device.

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