Visualization of Geo-annotated Pictures in Mobile Phones

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ABSTRACT
In this work, a novel mobile browser for geo-referenced pictures is introduced and described. We use the term *browser* to denote a system aimed at browsing pictures selected from a large set like Internet photo sharing services. The criteria to filter a subset of pictures to browse are three: the user's actual position, the user's actual heading, and the user's preferences. In this work we only focus on the first two criteria leaving the integration of user's preferences for future developments.

Categories and Subject Descriptors
H.5.2 User Interfaces (D.2.2, H.1.2, I.3.6) Interaction styles (e.g., commands, menus, forms, direct manipulation)

General Terms
Design, Experimentation.

Keywords
Mobile Photo Browsing, GPS, Compass, Arduino, Geo-Browsing, Maps

1.INTRODUCTION
Pictures are one of the most interesting media for geo-annotations and the technologies available on board of commonly used mobile phones are an opportunity to exploit, we present our experiments with geo-annotated pictures, sensors and visualization.

Furthermore, the release of worldwide known programming tools like the Google Maps API has fostered the development of a lot of geographical web applications also called mashups based on interactive maps and user generated content and, thanks to the availability of new devices that integrate camera, GPS and network, the number of geo-referenced images shared in public web sites is growing all over the world with fast pace [1]: geo-tagged images stored in Flickr were about 16 000 in the interval [October 2003 – October 2004], about 170 000 in [October 2005 – October 2006] and 350 000 in [July 2006 – July 2007]. The same query today shows more than 1 million of photo resources. These numbers allow to experiment worldwide and not only in a limited region with few pictures.

WWW 2009, April 20–24, 2009, Madrid, Spain.
ACM 978-1-60558-487-4/09/04.

This work introduces the prototype of a location based browser which selects and shows a set of pictures according not only to the actual user position but also to the actual user heading.

The issues both from a technical point of view and from a usage point of view will be discussed. The described functionalities are obtained using an external magnetic sensor connected to the mobile phone via Bluetooth.

2.ARCHITECTURE OF THE SYSTEM
To provide a view of surrounding points of interest based both on heading and position, the proposed system must of course connect with the GPS network. GPS is a system based on trilateration and its main objective is to provide position and not to provide heading. Nevertheless, if a GPS sensor is moving fast enough, it is possible to sample two positions after a short time interval, i.e. one second, and to determine the heading. Unfortunately this approach can only work for airborne, marine, and car/truck transportation but it is not viable for pedestrian mobility.

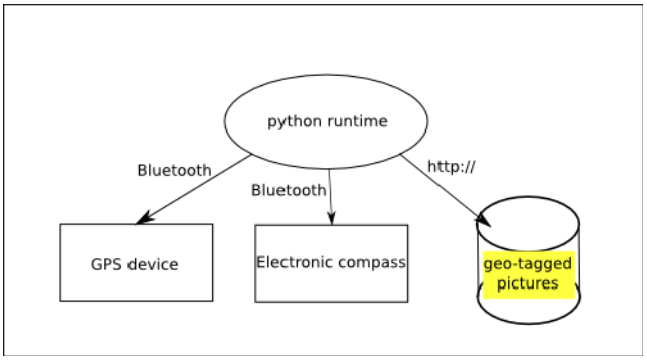


Fig. 1: High level architecture of the LBB system

Using acceleration sensors to determine heading is a theoretical solution: the double integral of acceleration gives the space associated with a movement. This computation is not practicable on a mobile terminal and the implementation must take into account a model for user movements in order to manage the problem like a pattern recognition problem

As alternative approach, the same functionalities are obtained using an external magnetic sensor connected to the mobile phone via Bluetooth. Also in this case we will analyze the technical issues arose during the design and the implementation of a Bluetooth compass and we will present some preliminary results in terms of user's satisfaction.

3.IMPLEMENTATION

The Location Based Browser is a novel way to visualize geo-annotated images while the user is moving. This work share some points in common with [2] but by virtue of different technical choices and recent technology advancements our prototype is fully functional for both GPS position and heading sensing.

Once the application is started five photos are shown in the display. The 5 pictures are selected in function of the actual GPS position and the current heading of the user. To test the system without a permanent connection to the Internet, a large collection of images is preloaded on the phone into a local database. For each image are also saved latitude, longitude, URL of the resource, and description.

The direction is provided by an handmade wearable compass composed by a Arduino(tm) Bluetooth board and on a sensor which senses the magnetic field according to the Hall effect on semiconductors joints. When the user wears the electronic compass and starts the bluetooth handshaking procedure with the mobile phone, the direction is automatically detected and transmitted to the mobile phone through the bluetooth link.

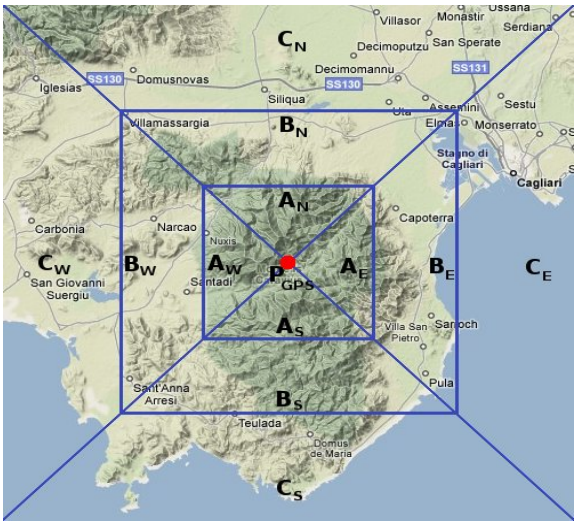
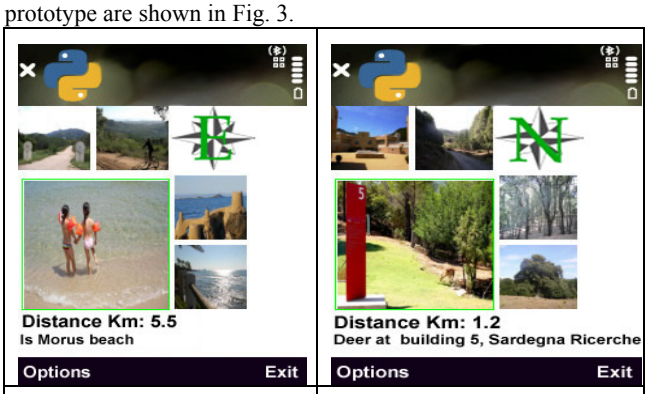


Fig. 2 The region around the actual GPS position is split into four zones which are further divided into three sub-regions from Ai (the closest to PGPS) to Ci (the farthest).

In our prototype only four main directions have been considered (N,O,S,E). Despite this limited resolution we consider it sufficient to the objective of the system. Given the actual user's position P_{GPS} estimated by GPS tracker (Fig.3), the region is divided into four areas (N,O,S,E). The four zones are further divided into three sub-regions (Fig.2), from A_i (the closest to P_{GPS}) to C_i (the farthest). One picture from the A_i subregion is displayed with the best resolution, the four smallest pictures are from the subregions B_i and C_i. The criteria is similar to what authors propose in [3]: distant points of interest are displayed with a smaller thumbnail.

When the user press the left or right arrows the set of images rotates and the description of the central image is shown on the bottom of the phone screen. Some snapshots of the running prototype are shown in Fig. 3.



(a) (b)

Fig. 3. Two snapshots of the application on a Nokia N95.

4.CONCLUSION

In this paper a new mobile browser for geo-referenced pictures, based on GPS and compass has been proposed. The preliminary tests show that users find very interesting and useful this type of application. In order to make the prototype even more functional and effective, in our laboratories several subjective and objective usage tests are under development. Next generation mobile terminals will be equipped with both GPS and compass, enabling a large deployment of this kind of applications.

5.REFERENCES

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