Location and Orientation Based Point of Interest Search Interface

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ABSTRACT
In this paper we present an interactive point of interest query interface, based on the location and orientation of the user. This interface gives clues about the position, relative to the user, of all the points of interest in the vicinity. The interaction provided can also be used to complement the presentation of points of interest on a map, helping identify the association between the icons drawn on a map, and the corresponding real world objects in the neighbourhood of the user.

Categories and Subject Descriptors
H.5.1 [**Information Systems and Presentation**]: Multimedia Information Systems – *artificial, augmented, and virtual realities.* I.3.6 [**Computer Graphics**]: Methodology and Techniques – *interaction techniques.*

General Terms
Algorithms, Experimentation.

Keywords
Location and Orientation Services, Geo-Referenced Information Visualization, Mobile Devices.

1. INTRODUCTION
The adaptation to specific usage context in mobile devices is a key feature to overcome usability and display limitations. Some aspects of the evolution of mobile devices, namely the integration of digital cameras and position, orientation and tilt sensors, allows them to have a wider contextual awareness and consequently the development of new interaction techniques and information queries.

On a previous work, we have developed a system (MoViSys) which allows the visualization, on mobile devices, of points of interest (PoI) over maps, based on the user preferences and location [1]. From that work we concluded that there was a necessity to enrich the visualization of points of interest on maps. The purpose of the work presented here is to complement the, already existent, query interface with methods that allow the association between PoI drawn on a map, to the real world objects they represent. The need to associate PoI, signalled on a map, to real world objects emerges in use scenarios where, on a given location, several points of interest are shown and there is a difficulty to correctly identify to which physical objects they correspond to. Although some systems [2, 3, 4, 5] already provide a way for the user to identify the landmark he is aiming at, by using the device's orientation, they do not easily convey to the user the information about what other places of interest are surrounding him. In our application, the proposed interface includes the capture of real time pictures, over which a compass rose is drawn and where surrounding PoI are marked. This allows the user to better perceive his geographic orientation and gives him clues about the surrounding PoI. To help the user to associate the existent PoI to their physical counterparts, stored pictures of these points are shown.

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2. INTERACTIVE POINT OF INTEREST QUERIES
We have designed an application to query PoI based on user's location and orientation.

We have chosen to make an initial query that identifies all the existent PoI in a quadrangular area, aligned with the primary axis and centred in the location of the user. As a result of this query, the obtained list of PoI is then organized taking into account the location of the points in relation to the user. For efficiency and flexibility purposes, we do this initial query having in mind that the user can do several queries in the same location, using different directions. By using a quadrangular search area the calculations required to determine the inclusion of the PoI in that area are far simpler, when compared to intersections with other kinds of regions.

Next, the location of these points in relation to user is identified. Since the user can be near a PoI and if it corresponds to a building with a large volume, it can be visible in a wide array of orientations. To make the placement of the PoI in each location closer to the actual surroundings, we have chosen to create a bounding box for each of them that try to replicate the actual gross building area they occupy. For each of these bounding boxes, we calculate the location and relative orientation to the user, allowing us, afterwards, to quickly calculate which of these are inside the area the user is currently facing. When the actual building area is not known, we use a square area, whose side size has a default value that is dependent on the point of interest category.

2.1 Interface
The developed interface was designed to allow the search of PoI in the vicinity of the current location of the user, helping him in the visual identification of the real objects that correspond to the

displayed results. For this reason we have combined, in the interface, stored pictures of the PoI, with pictures captured in real time by the device's camera. If a PoI corresponds to the object that is currently being aimed at, its picture should correspond to the real time picture captured by the device's camera. To make easier PoI identification, for each PoI several pictures can be stored, corresponding to several observation orientations. The shown stored picture should be the one that was captured with the closest orientation relative to the location where the user is currently standing.

Although the presence of several pictures for each PoI can improve the comparison between the stored picture and the real time image, it is important to note that, when pictures are not available, an icon associated with the PoI category is shown instead.

The search interface is split into three main areas: Real Time Picture Area, Digital Compass Area, and Selected PoI Area (Figure 1).

Figure 1: Interface areas

In the Real Time Picture Area (Figure 1-1) are shown pictures captured in real time, by the device's camera. This interface area helps the user to compare the pictures shown on the PoI selected area, with the real world objects he is watching. Moreover, it confirms the direction the device is pointing to.

In the Digital Compass Area (Figure 1-2), the digital compass representation is composed by the cardinal and intermediate directions. The orientation of the device is shown as the upper vertical direction, as indicated by the compass. When there are PoI for a particular orientation, small coloured circles are placed over the edges of the different compass bearings. The circle will be green if this is the direction of the currently selected PoI. The other circles will have a red colour because the PoI they represent are not currently being visualized.

Finally, in the Selected PoI Area (Figure 1-3), there exist four subareas that show, respectively:

(a) - A stored picture of the currently selected PoI. By selecting the stored picture, details-on-demand about the currently selected point of interest are shown in a new window.

(b) and (c) - Two arrows to successively select the different PoI, in a clockwise and counter clockwise sequence, respectively.

(d) - The identifier of the currently selected PoI.

To be able to see PoI located in other directions we can aim the device in the desired direction, or press the coloured circle placed on the desired direction in the compass.

2.1.1 Dynamic Mode and Static Mode

To allow the access of information, about the different points of interest that exist in the search area, in a flexible way, there are two interaction modes: dynamic and static.

In the dynamic mode, the digital compass rotates according to movement and rotation of the device, and the closest PoI in the current direction is shown in the Selected PoI Area. Over the compass, the green circle will be placed on top, showing the current direction. By using the available arrows we can sequentially select the PoI that exist in that direction only.

In the static mode, the movement of the compass is deactivated. To select this mode we can select the "Turn OFF" button, in the digital compass area, or, in alternative, select one of the red (smaller) circles in the desired orientation. In this mode we can obtain information about all the PoI that exist in the surrounding search area. When we select a different orientation, the corresponding circle will turn green and increase its size. The PoI that is shown, by default, is always the closest to the user in the selected orientation. To select the following ones, we can use one of the two arrows. After having gone through all of the PoI in the current direction, the ones in the next direction are shown.

3. CONCLUSIONS AND FUTURE WORK

On a short term, we intend to integrate this application in MoViSys, as a way to complement the PoI visualization over maps that exists in that system. On the other hand, MoViSys already includes a filtering function that calculates the relevance of the results as a function of user defined preferences. The use of this filtering function will ease the task of searching for the most relevant PoI.

Another aspect we want to consider is the creation of an automatic process to identify the PoI that are in the field of view of the device's camera. The first step is already concluded, with the organization of the PoI according to their location in relation to the user, and the sorting in function of the distance to him. We are aiming, in the future, to use the real time picture capabilities, to be able to automatically compare the PoI stored pictures, to the ones captured on real time.

4. REFERENCES

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