Bridging the Gap between LBS, GeoVisualisation, and Decision Support

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Mobile devices are widely used now in the context of location-based services. People often consult their mobile phones, PDAs or mini-laptops (sub-notebooks) for obtaining navigation information, getting an overview of closer surrounding or information about specific objects, calculating optimal driving route, acquiring trains schedule etc. Another application is field collection (verification, update) of data. Some services for on-line information access are available. For example, one can request a list of nearby restaurants, select one, and book a table. These services are usually based on information about the location of the person.

There is another valuable kind of information that can be made available easily: a history of positions of the person and his actions (requests for information and services). This history can be used for making the mobile services more focused and useful. For example, the routing system can take into account the speed and duration of the movement, moments and locations of stops etc. The system that recommends restaurants can use the information when the user ate last time, at what time he usually eats, and what types of restaurants he used to visit. Of course, privacy concerns should be taken into account.

Another direction of improving mobile services is in use of visualization and interactivity. Currently graphics, mostly in the form of maps, is often used for presentation of results. Usually these maps are bitmap images pre-stored on the device or acquired from a server on request. In some cases the bitmap images are enhanced by SVG or Java vector information: drawing a street route as a line with texture, showing locations of some objects by icons etc.

Numerous restrictions of mobile devices limit possibilities to use graphics in applications. These limitations are:

- ✓ Slow CPU;
- ✓ Small amount of memory;
- ✓ Small screen size and low resolution;
- ✓ Limited interaction possibilities;
- ✓ Low bandwidth of network connection.

However, fast development of hardware and communication technology allows us to expect that in the nearest future mobile devices will have parameters similar to today's desktop computers. This will make possible to use mobile devices for new tasks and problems. In particular, we foresee expanding possible usages from information access to data analysis, problem solving, and decision making.

Therefore we expect that in the nearest future several directions of information visualisation and interactive data analysis will become the important topics in the LBS world. Let's consider a

typical task of a mobile device user: selection of a hotel in some city not visited before. Currently this task is supported by a possibility to specify a query to a service provider posing a set of restrictions (location, quality, price etc.) with further selection using a map of locations combined with information screens about each individual hotel. More advanced technology could significantly improve this procedure.

1. It is very difficult to formulate a "reasonable" query in an unknown situation, e.g. a typical range pf prices in a particular city or time period. Too strong requirements will result in empty responses, while too relaxed queries could result in thousands of options that is long to receive and difficult to analyse. Therefore it would be very useful to get some information about distribution of values of attributes before formulating a query. Graphical displays like histograms could be used for this purpose. The optimal solution could be the dynamic query engine that provides an immediate feedback after précising or relaxing each element of the query.
2. It should be noted that the selection problem involves multiple conflicting criteria. Usually increase of quality results in higher price etc. Therefore an alternative solution seems to be more suitable: the user can specify the desired characteristics of hotels instead of posing restrictions. In response, the system provides him a list of options similar to his request or better. Taking into account tolerance could make the system more efficient (for example, proposing a 5-stars hotel for 100 EUR if the request was for 3-stars not more expensive than 95 EUR).
3. Characteristics of the selected subset of options could be presented visually. Thus, instead of putting icons on the map, the system could use utility bars that demonstrate how good each option in respect to all criteria is. Interactive manipulation (for example, visual comparison of options by clicking to a reference option on the map) can greatly facilitate the selection process and support more effective decision making.

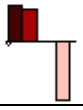
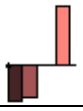
	Option A	Option B
Initial appearance of the symbols (no comparison)		
Comparison to option A		
Comparison to option B		

Figure 1. "Visual comparison" using utility bars.

Of course, there is a need in modification and adaptation of the methods for specific categories of users of mobile devices, their tasks and information needs, computer skills. However, it is clear that transition from information services to decision support has great potential.

Prototypes of the visualisation and decision support services will be demonstrated at the conference.