Visualisation of Collective Spatial Keyword Queries and their Usability

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A collective spatial keyword query is a keyword query that returns geo-textual data in such a way that the result consists of items that cover the keywords collectively, but do not necessarily belong to the same category. But scientific research on this subject has so far concentrated on the algorithmic side of the problem rather than the visual. This thesis proposes a detailed concept for visualising collective queries on a map and evaluates this concept's usability and usefulness.

STANDARD VS. COLLECTIVE SPATIAL KEYWORD QUERIES

Searches for points of interest (PoIs) in a spatio-textual manner using a set of keywords and a target area are called spatial keyword queries. Standard spatial keyword queries retrieve homogeneous result sets where each item satisfies all keywords, e.g. hotels or restaurants or bars. In contrast, a collective spatial keyword query (CoSKQ) results in one or multiple sets of distinct, but spatially close items that jointly cover all keywords in question, e.g. a hotel that is close to a restaurant and a bar. [1]

OBJECTIVE

The main objective of this research is to propose a map-based visualisation of such collective spatial keyword queries, consisting of visual concepts for searching and displaying the results, as well as an evaluation of these concepts.

METHODOLOGY

A novel type of collective spatial keyword query, called TYPE2a SGK Query is introduced. It features a „center point" semantic that separates the first keyword and treats it as a starting point to search for the other keywords.

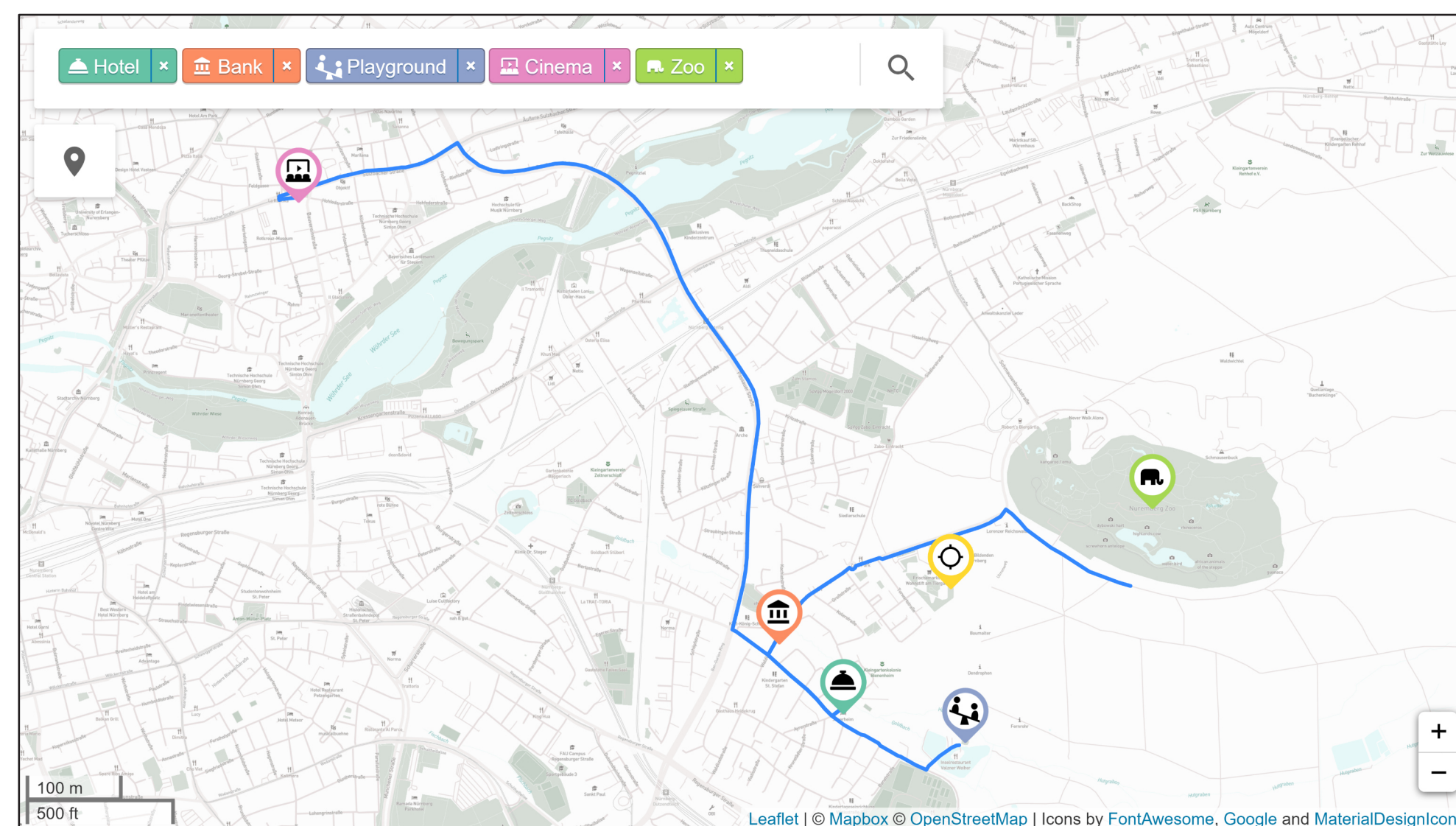Fig. 1: Combined marker showing a result cluster with four PoIs

Fig. 2: Screenshot of CoSKQVis with individual markers and routes

Three UI elements were created: a search bar with an autocomplete feature, a button to specify the query location and the map component to display search results (Fig. 2).

Combined markers (Fig. 1) employ typification as a generalisation mechanism to avoid clutter and the visual variables size, orientation and colour are used for encoding higher-level information.

Individual markers are shown with routes from the center point to all other found PoIs in the result (Fig. 2).

PROTOTYPE

A prototype called CoSKQVis (Collective Spatial Keyword Query Visualisation) was implemented as a web application (Fig. 2, link in the sidebar). It employs a simple API that accesses a geodatabase containing about 300 000 PoIs in over 100 categories, extracted from OpenStreetMap.

USER TEST

A comparative user study was conducted with the target group of advanced users of navigation and web mapping systems. Participants had to solve a task that involved finding five suitabe PoIs with either CoSKQVis or Google Maps. Afterwards attributes of usability like learnability, efficiency, errors / accuracy, ease of usage and subjective satisfaction were surveyed in a mixed qualitative-quantitative approach.

RESULTS

While 61 volunteers participated in the user test, only 38 submitted a valid result for the task and were considered for the evaluation of attributes.

Opinions on ease of use, efficiency, subjective satisfaction and learnability were surveyed quantitatively and for the specific task given all of them were rated significantly better than the commercial alternative Google Maps (e.g. Fig. 3). Also, the users' confidence in the found set of PoIs was a lot higher than for the alternative.

The prototype received positive reactions to the search bar and the markers, but the use of the visual variables size and orientation was evaluated as not very intuitive. The absolute majority of users also thought that collective spatial keyword queries can be useful in certain scenarios.
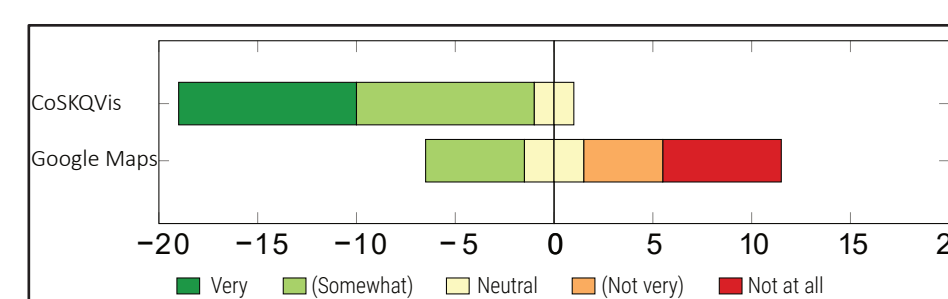

Fig. 3b: Distribution of results for Question Q11: „How efficient was the process to find a set of PoIs?"

CONCLUSION

There is definitely a need and interest for research in the topic of visualising collective spatial keyword queries. Such queries can add a whole new dimension of usefulness and usability to the search for points of interest. Enabling mapping or navigation applications to accept and subsequently visualise such queries might increase their benefit immensely, even more so if the visualisation provided direct routing between the found elements.

REFERENCES

[1] Cao, X., Cong, G., Jensen, C. S. & Ooi, B. C. (2011). **Collective spatial keyword querying.** In Proceedings of the 2011 international conference on Management of data - SIGMOD '11(p. 373). Athens, Greece: ACM Press.

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