Interpreting Place Descriptions for Navigation Services

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1 Introduction

In human route communication, people describe places in natural language. These *place descriptions* are flexible, potentially vernacular and ambiguous descriptions of places, and in the context of route communication, of start or destination places. The main components are placenames and spatial relations. People are able to interpret human place descriptions, however current navigation services can not handle human place descriptions in general. Consequently the initial phase of communication between human wayfinders and navigation services—finding an agreement on start and destination—is broken. Without the agreement, no direction information can be provided, and the communication can not be closed successfully. We see a need for research bringing spatial intelligence into the fundamental mechanisms of parsing and interpreting place descriptions. An intelligent navigation service will have capabilities to imitate human route communication behavior (Winter and Wu, 2009), thus, at least the capabilities to make sense of place descriptions.

2 Interpreting Performance of State-of-the-art Navigation Services

The basic interpretation mechanism of state-of-the-art navigation services is string matching. Pre-processing parses key words, typically nouns only, from place descriptions put in by users, and then a string matching algorithm searches in a data resource to find those spatial features that best match in their name. For example, a parser might find "Federation Square" in a place description. Features containing in their attributes "Federation Square" are selected and provided to wayfinders. Approximate string matching can be applied when no exact matching exists, which can cope with incorrect spelling, but also with abbreviated or mistaken types (e.g., "Federation Sq" should come out as well). In addition, the current location of wayfinders can be used to constrain the search, i.e., local search. For instance, if "Melbourne" is part of a query of a wayfinder in Sydney, a location aware search algorithm will identify Melbourne in Victoria, not Melbourne in Florida.

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Nevertheless, these mechanisms are far from a comprehensive solution to interpreting place descriptions. Firstly, semantics is omitted. "Federation Square" is an open inner-urban area for public use, a city square named "Federation", not a restaurant or hotel called "Federation Square". Without considering the semantics, frequently irrelevant results are listed and cause confusion or information overload. Secondly, spatial relations specified in the place descriptions are neglected. In a request "Federation Square, Melbourne", a relation "*in*" is implicitly expressed by the comma. "Federation Square *near* Melbourne" indicates another spatial relation. In state-of-the-art navigation services, relation words are either not recognized as relations, i.e., parsed as key words (which are not found in the attributes of the spatial features), or ignored (in which case the two placenames linked by the spatial relation will be matched individually, no matter what the relation is). Thirdly, paraphrased places ("the large square in Melbourne") can not be resolved by current navigation services.

3 Research Challenges in Interpreting Place Descriptions

To design a navigation service capable to understand human descriptions of start and destination places, human behavior in route communication has to be studied. People prefer naming outstanding spatial features in the environment, because it takes less effort for them to recall these features compared to others. Additionally, people use qualitative relations rather than quantitative ones. Moreover, people often infer the most relevant result with given information. Thus, we assume a place description can be formalized as:

$$placename_A(+relation_1 + placename_B(+...))$$

Accordingly, an interpretation of place descriptions can be broken down to (a) interpreting placenames, (b) interpreting spatial relations and (c) being able to communicate about the generated meaning.

3.1 Placenames

A placename is a proper name for a spatial feature. In general, there are two kinds of placenames: individual placenames and paraphrased placenames. An individual placename includes a given name (mandatory), such as *Federation* in "Federation Square", and a category (optional), such as *Square* in "Federation Square". An example of an individual placename without a category is "Melbourne". Alternatively, people can refer to a place by paraphrasing it, i.e., by a qualifier (optional) and a category (mandatory), such as "the large square". The qualifier is needed for disambiguation, i.e., if several features of the given types exist. In this case the named specified qualifier must be outstanding or unique compared to other spatial features of the same category. The qualifier typically is linked to perceptual or experiential characteristics of the spatial feature. An example for a paraphrased place that does not need a qualifier is "the

island in the bay" if there is only one island. Therefore, already interpreting placenames—a smaller problem than interpreting place descriptions—requires more than matching name strings, but instead considering the semantics of categories, the salience of feature properties, and people's experiences of features in their environment.

3.2 Spatial Relations

Spatial relations help constraining the search and interpretation of a placename. Qualitative spatial relations frequently used by people can be classified into mereology (e.g., *part of*), topology (e.g., *adjacent to*), distance (e.g., *near*) and orientation (e.g., *North to*). Qualitative spatial relations are difficult to interpret because they are affected by many factors, such as the current location of wayfinder to spatial features, the perspective of wayfinder, and the scale of the wayfinding area. Hence, the interpretation has to be flexible with respect to these factors. Spatial relations can help to filter spatial features from sets that correspond to a queried placename.

3.3 Responses

Interpreting place descriptions happens to some degree of confidence. Navigation services require mechanisms to assess their confidence and take appropriate action, including offering a confirmation if the interpretation happened with sufficient confidence, or asking refining questions in more ambiguous cases. Confirmation could occur by rephrasing the place description with additional information. Refining questions also revert to spatial knowledge of the navigation service. Both cases require a capability to form proper and in the given context appropriate place descriptions.

4 Conclusion

In this paper we address research challenges in interpreting place descriptions. In particular we identify three subproblems: interpreting placenames, interpreting spatial relations and being able to communicate about the generated meaning. Related research contributing to this goal is abundant, for example we have started to work on the interpreting of placenames (Wu and Winter, 2009), but the three challenges are not yet solved.

References

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