Extraction of landmarks from OpenStreetMap for use in navigational instructions

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Abstract

Landmarks are an important part of portraying navigational instructions, especially to pedestrians. Whether an object can be seen as a landmark or not is often dependent on its visual characteristics. However, in data sources such as OSM, such information is rarely available and so cannot be used for the identification of landmarks. The 'type' of feature (or its use) can be used to derive assumptions as to whether it could be a landmark or not. By coupling this information with geometric calculations about the route it is possible to extract the most suitable landmark from OSM data for turning points which can then be used to provide navigational instructions.

Keywords: Navigation, OpenStreetMap, Landmarks, Wayfinding

1 Introduction

Although there has been a large amount of research conducted into navigation and the use of landmarks (in particular, identifying what makes a landmark), methods for the automatic extraction of these features from geospatial datasets remain problematic. In many cases, such extraction process require multiple or specialized datasets which makes the transferability of methods difficult. It is well documented that landmarks are an important part of describing a route through space [2,4,6], but in many commercial navigation systems the portrayal of landmarks is lacking [3,5]. The focus of this study is the implementation of an algorithm that quickly identifies landmarks that can be used in such navigational instructions using only the OSM dataset.

The physical appearance of structures such as the façade colour and size are often seen as important factors when identifying landmarks [3–6]. Other factors are also considered such as the proximity to the road [2,3] and number of neighbours [3]. With regards to the façade appearance, it is often the case that such information is obtained from more specialist datasets, such as 3D city models in the case of [3], or georeferenced photographs in the case of [4]. Although such information is useful, it can be difficult to acquire for large areas. A key point in [2] is the use of landmark *types* for identifying whether a structure could be a landmark as opposed to the more *individual-level* information (such as the colouring of individual buildings). A similar type-based method has also been implemented in [1]. Both of these studies also use the topological relation of the structures to routes for defining the most suitable landmark for a particular waypoint. Although the algorithms used in [1] are simpler than those in [2], one key benefit of the approach in [1] is that only one data source is used for deriving the landmark information – OpenStreetMap.

The study presented here aims at implementing similar methods as [1] and [2] in that it is the feature type that is used to identify suitability and not individual-level attributes. Though the algorithms used are not as thorough as those by [2] they do include a number of different features (such as museums) which are not included in [1]. In addition, OSM is the only source of data used for determining the landmarks. It must be noted that the method developed aims at being compatible across multiple locations, and as such may not produce optimal results in specific instances (such as in the presence of highly unique and prominent landmarks).

2 Landmark extraction methods

Based on the findings from the literature, an algorithm has been developed that aims at extracting the most suitable landmark for a navigational waypoint from the OSM dataset. The algorithm takes into account both the type of an object and its topological relationship to the waypoint. In the first stage of identification, landmark candidates are determined based on the type (hotel, shop, art work etc.) of feature that they are tagged as in the OSM dataset. The second stage of extraction aims at identifying the most relevant feature from this candidate set with regards to the reference point that the landmark is to be used for (such as a turning point in a route). The individual methods within these stages will now be discussed in more detail.

2.1 Determination of landmark candidates

The determination of landmark candidates from the OSM dataset is performed using the attribute tags that have been given to features by contributors. As in the approaches of [1] and [2], these tags are used to provide a general 'assumption' as to how salient a feature is. In the case of this study, the tags used are "shops", "tourism", "railway", "historic", "leisure" and "amenity". Not every feature that contains one of these tags is included, as the value of the tag itself is also assessed (i.e. amenity-restaurant is a possible landmark, but amenity-dentist is not).

2.2 Identification of landmarks for particular locations

As mentioned, the appearance (and usage) of a feature is not the only contributing factor to whether it is a landmark or not, but also its location with regards to a reference point and features around it. The aspects addressed in this study relating to location are how far the candidate is from the turning point, whether the traveller will pass it or see it in the distance, and whether they will be able to see it on their approach to the waypoint. Each of these aspects is addressed in the final calculation of suitability. In the selection process, both point and polygon features can be used as landmarks. In the case of point features, a buffer is placed around the point at a distance of 10m and this buffer polygon is used as the feature boundary.

3 Example

As an example of the extraction method, Greater London (UK) has been used as a study region. OSM data was obtained, clipped to the city boundary and stored in a PostGIS database. SQL implementations were added for the aforementioned algorithms.

The landmark candidates extracted for the study region can be seen in figure 1. In total approximately 23,000 candidates were identified in the study region.

Table 1: Suitability scores for landmark candidates

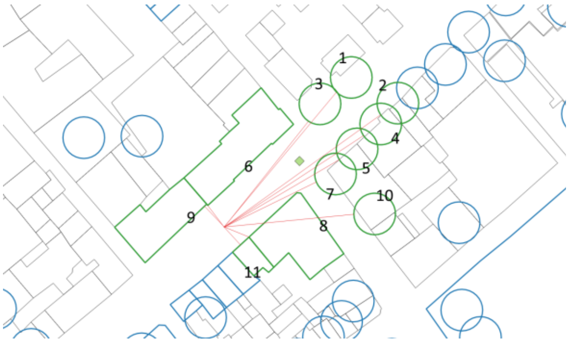
Candidate	Location	Visible	Distance	Suitability Rank
1	After	Yes	37	7
2	After	Yes	45	9
3	After	Yes	19	5
4	After	Yes	32	6
5	After	Yes	18	4
6	After	Yes	15	3
7	After	Yes	8	2
8	Before	Yes	15	1
9	Before	Yes	49	10
10	After	No	35	11
11	Before	Yes	44	8

Figure 1: Landmark candidates and road network in Greater London

Once the candidates have been identified, the actual determination of the most suitable landmark for a reference point can be determined. Here, the reference point is located close to Covent Garden in London (figure 2) and forms the turning point (green diamond) along a route. For determining the metrics, a ‘source’ point is placed 50m along the route before the turning point. Lines of sight (red) are generated between the source point and the landmarks for determining visibility (if it crosses a building, the landmark is not visible). Results of the metrics are seen in table 1.

The algorithm identifies the candidate marked as number 8 on the diagram as being the most suitable. The main reasoning that this is ranked higher than others is that although it is not the closest object to the waypoint, it is fully before the waypoint. This is a reasonable outcome as stating a navigation instruction such as “*Turn right after Covent Garden station*” leaves less ambiguity than using a landmark that the traveller has not yet fully gone past.

Figure 2: Landmark candidates



4 Summary

Based on identifying the contextual type of a feature in the OSM dataset and its positional relation to a waypoint of a route an algorithm has been developed and implemented in PostGIS for determining the most suitable feature to present as a landmark in navigational instructions.

Implementation of the algorithm on real data has shown that suitable landmarks can be successfully extracted for a particular navigation instruction from just the OSM dataset. However, real world testing of such navigation instructions is required to ensure that the most suitable landmark is actually being identified, or that at least the landmark chosen allows for successful navigation.

One main enhancement to the algorithm that is required is to provide weightings for the different feature types as done in [2]. It is likely the case that some types of features (i.e. a church) are more salient in an environment than others (i.e. cafés).

Overall, although there is room for improvement, the algorithm implemented in this study has shown that it is possible to extract landmarks for navigational instructions purely from OSM datasets based on feature type and location in relation to a navigational waypoint.

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