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On the Assessment of Online Geolocated Social Content for the Identification of Landmarks in Urban Area

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1. Introduction and Background

Most of the major route services currently provide wayfinding instructions exclusively based on street names. However, it has been demonstrated that for the achievement of a given route, such instructions implied significantly longer delays compared to the landmark-based navigation assistance (Tom and Denis 2003).

Therefore, we know for more than a decade that a route instruction is cognitively suitable when it contains a minimum set of landmarks. More specifically, people's discourse essentially refers to landmarks at choice point areas; i.e. where the traveller is supposed to make a choice such as "turn left". Two other areas are also concerned: (1) the on-route point portions (landmarks located along the path enable the traveller to ensure he follows the correct route) and (2), the end point, where the presence of landmarks confirms that the traveller has reached the destination (Daniel and Denis 2004).

Based on those studies, researchers have developed systems that automatically detect landmarks. The set of proposed solutions for designing Automatic Landmark Detection Systems (ALDSs) follows the model formalized by Raubal and Winter (2002). This model is applied to the facades of buildings. According to the latter, the landmarkness is evaluated on the basis of three types of attraction: (1) the visual attraction (e.g. the size of the facade), (2) the structural attraction that mainly refers to the Lynch's structural elements; namely the nodes, boundaries and districts; and (3) the semantic attraction which essentially refers to the cultural and historical significance of the place.

Among all the solutions that have been proposed for designing ALDSs, three have had a significant impact. Firstly, Elias (2003) proposed to identify landmark candidates by using the ID3 algorithm on the building's attributes of a cadastral database. Secondly, Tezuka and Tanaka (2005) have developed a method to mine the web in order to extract landmarks. The task was essentially to evaluate the spatial context of web documents. Unlike Elias's approach, they tried to evaluate the way places are practiced rather than observed. Finally, Duckham et al. (2010) proposed a method that focused on the top-level categories to which buildings belong instead of their individual characteristics. Thus, their objective was to estimate the landmarkness of a building and not to measure it precisely. This approach is currently the most promising since their algorithm has been implemented on the Australian route service *whereis.com*.

Nevertheless, as explained by Sadeghian and Kantardzic (2008), all of the approaches proposed for designing ALDSs have failed to take into account dynamic parameters, including the measure of objects semantic salience that has often been reduced to the historical and cultural importance of a place; occulting systematically its social dimension yet intrinsic. Richter (2013) argues that this gap can be filled through the use of data generated by the social network users. Few approaches using crowdsourced data have been developed (e.g. Richter 2013) but for the moment, no research has been dedicated to the exploitation of geosocial datasets for the identification of landmarks.

Since the advent of the mobile Internet combined with the development of smartphones, the production of geolocated content from the social web platforms (i.e geosocial data) is now commonplace. We are witnessing a real proliferation of spatial data at a massive scale and it does not deal anymore with Goodchild's volunteered geographic information (Goodchild, 2007), but rather with ambient geospatial information (Stefanidis et al. 2013) that distinguish itself by its non-contributory characteristic. This kind of data enable us to access to local geographical knowledge that was previously hardly accessible and measurable. Furthermore, we argue here that this kind of data should be exploited to enrich ALDSs databases. Consequently, we propose to evaluate in the context of this research the potential of geosocial data for the automatic detection of landmarks.

2. Method

We propose to evaluate the potential of check-ins datasets through an *in situ* experimentation where two groups of participants will follow a predetermined route in Quebec City (cf. Figure 1). During the travel, they will be asked to choose places they consider to be potential landmarks. The selection will focus on four specific areas: the starting and end points, the choice-point areas and finally the on-route point portions. The first group will leave the site of National Assembly in direction of City Hall while the second will follow the reverse route. Each group will consist of two sub-groups whose members will be designated in function of their degree of familiarity with the study area. Ideally, we would like to have a sex ratio of 1:1 as the wayfinding skills vary from one gender to the other.

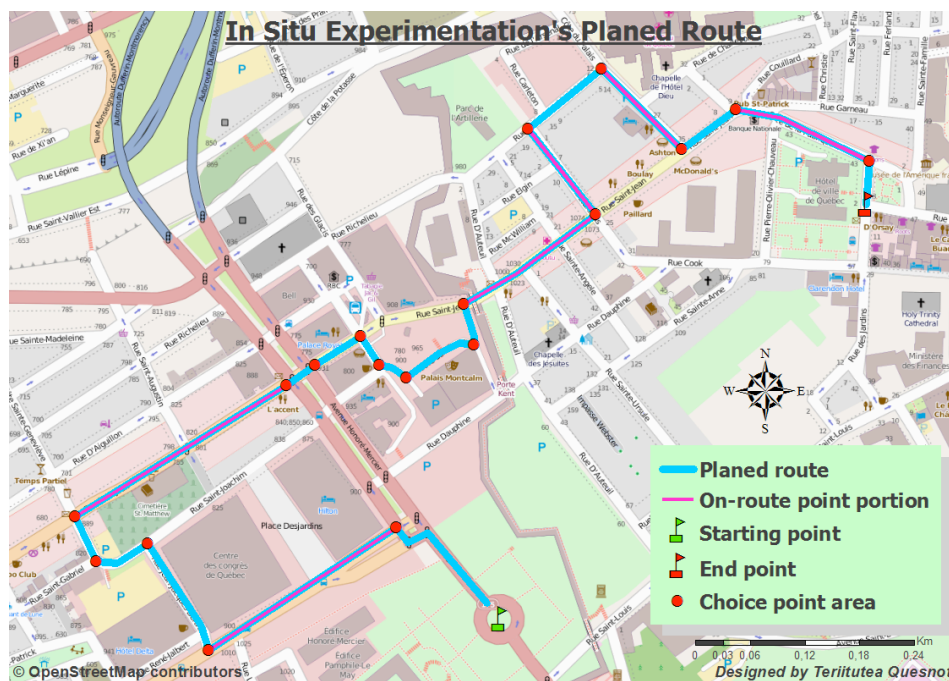


Figure 1. The *in situ* experimentation's planned route.

We consider that the potential of geosocial data in terms of detection of landmarks will be confirmed if a correlation larger than random is found between participant's selection of landmarks and landmarks identified through our approach. We propose to measure the *landmarkness* of a place on the basis of three scores using geolocated data taken from both Foursquare (*Swarm* in the coming months) and Facebook's APIs.

The first score corresponds to the *estimated visual salience*. Since the access of precise building's height data is quite difficult, we plan to estimate the visual salience of each Foursquare and Facebook's category by using the criteria established by Duckham et al.

2010; namely the *place's physical size*, its *prominence*, its *difference from surrounding*, its *daytime and nighttime salience* and finally *its proximity to road* (cf. section 5.1 of Duckham et al. for further details). The second score is dedicated to the *place's uniqueness* since it represents one of the valuable criteria in the detection of landmarks. Equation 1 is applied to compute this score.

$$\forall n, m > 1 : UNQ(p) = \frac{\sum_{i=1}^n p_i \in C}{\sum_{j=1}^m p_j} \quad (1)$$

where UNQ = uniqueness score
 p = place
 C = category

The final score represents the *geosocial activity* of a place. This score, applied to Foursquare's check-ins and related information such as tips and "likes", is calculated through the Equation 2. Since the Facebook's API does not provide the distinct number of users who have checked-in at a given place, we propose to calculate the sum of check-ins, "likes" and "talking about" regarding Facebook's geosocial activity score.

$$\forall m \geq 1 : GSA(p)_{4sq} = \frac{CK(p) + LK(p) + TP(p)}{\sum_{j=1}^m USR_j(p)} \quad (2)$$

where GSA = geosocial activity score
 $4sq$ = foursquare
 p = place
 $CK/LK/TP$ = number of check-ins/likes/tips
 USR = number of users

Once these scores normalized on a scale of 0 to 1, we can compute the *landmarkness score* of a place by calculating their arithmetic sum. Therefore, the places selected through our approach will be those with the highest landmarkness score.

3. Expected Results and Impacts

Since it is an ongoing research, we have not yet realized the *in situ* experimentation. However, two main challenges underlie this research. In fact, the experiment will enable us to check if social networks data are reliable to fill the gaps noted by Sadeghian and Kantardzic (2008) regarding the landmarks semantic salience. In this case, designing a geosocial-based ALDS that relies exclusively on a user-generated place database would be conceivable. Therefore, data produced by users of social platforms will be concretely exploited through the feeding of a landmark-based navigation system and not only used for the description of phenomena such as social ties or urban dynamics; as was the case so far. Consequently, we believe the results of this experiment will undoubtedly contribute to the advancement of knowledge in the area of geographic information science and particularly in the field of spatial cognition engineering.

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