

# GeoLife2.0: A Location-Based Social Networking Service

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## ABSTRACT

*GeoLife2.0 is a GPS-data-driven social networking service where people can share life experiences and connect to each other with their location histories. By mining people's location history, GeoLife can measure the similarity between users and perform personalized friend recommendation for an individual. Later, we can predict the individual's interest level in the locations visited by their friends while have not been found by them. The locations with relatively high interesting level can be recommended. Therefore, GeoLife2.0 can expand a user's social network, provide them with a trustworthy resource matching their interests and help them sponsor geo-related activities like cycling with minimal effort.*

## 1. INTRODUCTION

The increasing popularity of location-acquisition technologies, such as GPS, GSM networks, etc, enable people to conveniently log the location histories they have visited with spatio-temporal data. Such real-world location histories imply to some extent users' interests, and bring us opportunities to understand the correlation between users and locations.

In this article, we move towards this direction, and report on a personalized friend & location recommender. In our recommender system, a particular individual's visits to a geospatial region in the real world are used as his/her implicit ratings on the region. By exploring the location histories of the users, this system helps each individual automatically discover potential friends in a GIS community. In addition, geographical regions that might match individual preferences are recommended. Therefore, a user can conveniently deliver invitations to proper persons in the community, and hence sponsor with minimal effort a social activity, such as hiking, cycling, etc. Additionally, people are more likely to discover, from others past experiences, some interesting places, which might not be found by themselves.

A framework, referred to as hierarchical-graph-based similarity measurement (HGSM), is proposed to uniformly model each individual's location history, and effectively measure the similarity among users. In this framework, we take into account three factors:

- 1) the sequentiality of people's movement behaviors,
- 2) the visited popularity of a geospatial region and
- 3) the hierarchy property of geographic spaces.

Further, using a collaborative filtering (CF)-based method, our system involves the location histories of a user's potential friends to estimate the user's interests on a set of geospatial regions he/she has not visited. Meanwhile, by understanding the profile of a geospatial region, a content-based method is integrated into the location recommender to reduce the cold start problem.

We evaluate this recommender system based on the GPS data collected by 112 subjects over a period of 1 year in the real world. As a result, HGSM outperforms related similarity measure, including *similarity-by-count*, the cosine similarity and Pearson similarity measure. Moreover, beyond item-based CF method, our system provides users with more attractive locations and better user experiences of recommendation.

## 2. FRAMEWORK

Figure 1 gives an overview of the architecture of our recommender system, which consists of three parts: location history representation, user similarity exploration and location recommendation.

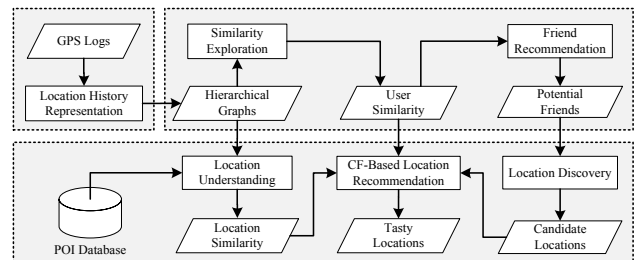


Figure 1. Architecture of GeoLife

First, based on individual GPS logs, we build a hierarchical graph for each user. This hierarchical graph is capable of modeling the user's location histories on different geospatial scales.

Second, given two users' hierarchical graphs, we are able to match the similar sequences shared by them on each layer of the hierarchy, and calculate a similarity score for them. Later, a group of people, called potential

friends, with relatively high scores will be retrieved for a particular individual.

Third, we conduct a hybrid recommender based on a collaborative filtering and a content-based method to predict a particular user's interest level in the geographic regions. Using a POI database, we understand the profile of a geospatial region by exploring the categories of POIs within the region. Such profiles enable us to detect the similarity between geospatial regions, and recommend location based on users' diverse requests.

Finally, top  $n$  geographic regions, which are most likely to attract the user, is recommended and shown on a Web map.

### 3. PROTOTYPE

Figure 2 presents the user interface of our system. A particular user John can sign in GeoLife using his MSN Messenger account. After logging onto GeoLife, in the right box of the window, John can discover a group of potential friends and a set of geospatial locations recommended to him. These potential friends are more likely to share similar tastes with John as compared to other users in this community. Below the recommended friends, the top five geospatial regions, which might match John's interests, are also listed with corresponding thumbnails. These regions are mined from John's potential friends' past experiences while John does not found them by himself.

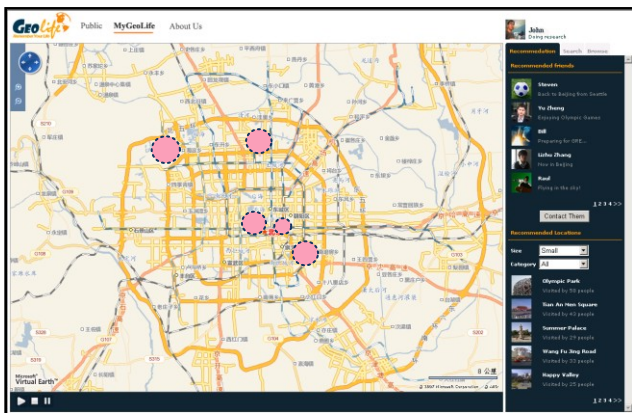


Figure 2. Prototype of GeoLife

As depicted in Fig 3, John can take a closer look at a recommended location by clicking the icon of this location in the result list. In a pop-up information box, John can obtain summarized information of this region, and view a set of photos taken by other users within the region. Thus, he is able to make a decision whether or not he should visit this place before really traveling there.

If John is attracted by the location shown in Figure 3, he can invite a group of people from the community to visit there together. As demonstrated in Figure 4, by clicking the 'Contact Them' button, John will be provided

with an interface, where he can send his proposal with a suggested destination to the potential friends in this community.

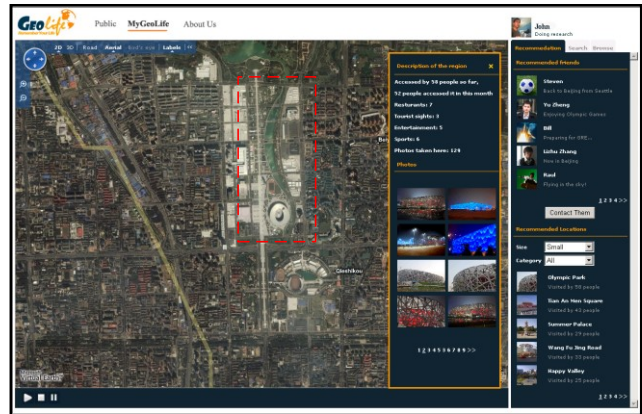


Fig. 3 View a geospatial region in our recommender system

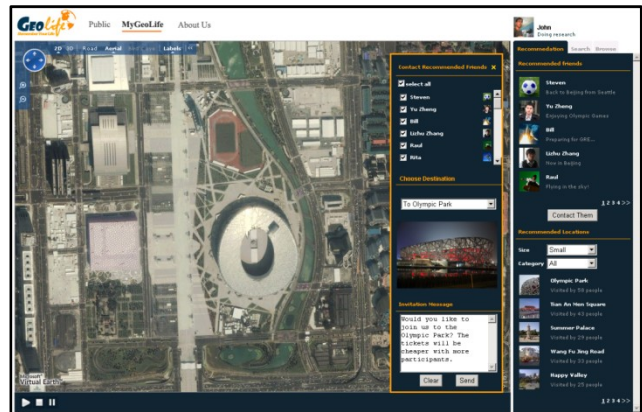


Fig. 4. Sponsor a social activity with the potential friends

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