Tour Planning for Separate Individuals: Individual Tourists Mobile System

Sina Abolhoseini*, Omid Reza Abbasi*, Naser Tahani*

* K. N. Toosi University of Technology, Department of GIS Engineering, Faculty of Geodesy and Geomatics Engineering, Tehran, Iran.
abolhoseini.sina@gmail.com - oabbasi@mail.kntu.ac.ir - tahani_nasser@outlook.com

Abstract. Tourism is one of the most valuable sources of income in many countries. Tourists are usually unfamiliar with the destination country and things are getting worse when they decide to travel individually. Travelling individually can get exciting when tourists are communicating with each other and share their sightseeing. Here we propose a mobile application to recommend similar tourists to each other for tour sharing and planning a tour based on the individual’s separate location. Tour path must have the minimum length and the maximum number of common paths. This problem can be defined as “Multiple Traveling Salesman Problem with Mutual Nodes”. A demographic recommender system is used to find similar tourists based on their nationality, education, age and interest. Also, Ant System (AS) algorithm is used to plan tour for individuals.

Keywords. Tourism, Recommender System, Tour Planning, Ant System.

1. Introduction

“Motivation is the need that drives an individual to act in a certain way to achieve the desired satisfaction” (Beerli & Martin, 2004). Researchers are still attempting to understand the tourists’ motivations, which are the foundation of tourists’ behavior. Understanding tourists’ behavior results in developing better tour plans and more satisfactions as a result.

It is found that tourists interact with each other in order to formulate, understand and mediate their own experiences, and, in turn, to facilitate the experiences of the others (Lean & Staiff, 2016). So, we tried to provide a new method to help tourists increase their interaction with each other while
visiting a specific city. To this end we propose a new system to gather similar tourists together and help them navigate between POIs which is falling within mobile Location Based Services (mLBS).

mLBSs are operating on smartphones and they are becoming widespread and popular. People are using these services to find their position-related answers such as “Where is the nearest Gas Station?” and “Which direction should I take to get to it?”. Navigation systems and services are examples of most widely used mLBSs. These systems can be used to assist tourists in the on-trip period and provide them with the right pieces of information in order to increase their satisfaction from the trip. In the first stage, services provided shortest-path route guidance from the tourist’s location to the next recommended point-of-interest (POI) (Cheverst, et al., 2000). Derived information from social networks can be used to provide route recommendations based on the user’s personalization (Rey-López, et al., 2011). These tours can be recommended using artificial intelligent optimization algorithms, as tours can be considered as a travelling salesman problem (TSP) ((Maruyama, et al., 2004), (Shiraishi, et al., 2005)).

The purpose of this paper is to propose a novel mobile system to integrate people recommender systems and tour planning systems in order to join individual tourists while visiting specific POIs (Joy Share). Demographic RS is used to recommend similar tourists to the user and Ant System is used to plan the tour and join tourists. The tour planning problem can be addressed as “Multiple Traveling Salesman Problem with Mutual Nodes” where several salesmen want to visit mutual nodes together.

2. Joy Share

Demographic people recommender system and tour planning system can be applied in a single smartphone application to let users find similar people, share the tour with them and find the optimal route for each individual. Figure 1 is presenting the flowchart of the proposed application.

![Figure 1 Flowchart of the proposed mobile application](http://doi.org/10.3929/ethz-b-000225612)
User enters the required information to sign up in the application. This information includes nationality, age, education, interests and the location of the hotel. Then, application sends a request to the RS web service and extracts similar people based on the users’ information. This web service queries other users’ information from the database. User selects the similar people or some of them to share the tour and the POIs to visit. Selected people and POIs are the input of the Tour planning web service. Application sends another request to the server to find the optimal route for each individual. This service extracts other user’s location from the database.

2.1. People Recommender System

When people want to plan a tour they may want to share their tour with similar tourists in order to enjoy more. To this end we can use a recommender system (RS) to recommend other tourists and share the tour with them. A Simple demographic RS is used in this paper to detect similar tourists for recommendation.

2.2. Tour Planning System

Ant System (AS) indicated better results in optimization on graphs and network analyzes (Abolhoseini & Sadeghi Niaraki, 2017). In order to solve this problem by using Ant System (AS), we have to define the solutions. To plan the appropriate tour for each individual, each ant should be formed as presented in Figure 2. It should be noted that each ant represents a solution for the proposed problem.

![Figure 2 Ant’s structure in AS](image)

We use Ant System to minimize the length of the tours for each individual and maximize the total number of the common paths. Common paths are representing the mutual paths between tourists. According to the goal definition, evaluation function can be determined as Equation 1.

\[
f(T) = \sum_{j=0}^{n} \sum_{i=0}^{m} dist(i,j) + \frac{1}{commonpaths(tour)}
\]  

(1)

Function \(commonpaths(tour)\) returns the number of times streets are repeated that specific tour between each individual separate route. Also, \(m\) is the number of streets in the route of \(j\)-th individual and \(n\) is the number of individuals. By this term, fitness value increases when different tours over-
lap. Also, this fitness function will help us to minimize the total distance of all routes. It should be noted that, each user has different conditions regarding his starting location, returning location, and preference of destinations to visit.

3. Results and Discussion

3.1. Dataset
Shiraz is the capital city of Fars Province and it is one of the key tourism sites in Iran. It is located in southwest of Iran and it has a moderate climate. Also, it has been the regional trade center for over a thousand years. Large number of sightsees attract tourists to Shiraz every year. Garden, Palaces, Thombs and Museums are the main sightsees in the city and Histrical Palace of Perspolis, Ardashir, Bishapur and Pasargad are available near Shiraz city. Over 48000 tourists visited Shiraz just between March to May 2017. So, part of historical area of Shiraz city was selected to test the developed app (Figure 3).

![Figure 3](image.png)

**Figure 3** Historical area of Shiraz city for evaluation

3.2. Results
This application is developed for android OS and in Android Studio Environment. For further analysis of the application, it is installed on Samsung Tab3 with android 4.4.4 tablet.

One user is assumed to test the application. First, application finds the similar tourists in the city. User selects the recommended people and application sends a request to the tour planner web service (Figure 4). To solve the problem of tour planning with AS, it is crucial to set appropriate values for their parameters. In general, parameter determination is achieved
through experiments (Eiben, et al., 1999). Results are stored in each user’s relation in database. Table 1 is showing the results of tour planning. First four results are for each individual separately and the last row shows the common tour for all four tourists. As it can be seen, the distance each individual is going to traverse is increased, but all of them are visiting the same sightsees with the same order. It means that AS performed well.

![Planned tours for each recommended individual](image)

**Figure 4** Planned tours for each recommended individual

<table>
<thead>
<tr>
<th>Tourist Account</th>
<th>Tour planning algorithm results</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>abolhoseini</td>
<td>[Narenjestan, Masjed Nasir AlMulk, Masjed Jame Atiq, Karim Khan Citadel]</td>
<td>5551.4</td>
</tr>
<tr>
<td>tahani</td>
<td>[Karim Khan Citadel, Masjed Jame Atiq, Masjed Nasir AlMulk, Narenjestan]</td>
<td>5862.9</td>
</tr>
<tr>
<td>abbası</td>
<td>[Masjed Jame Atiq, Masjed Nasir AlMulk, Narenjestan, Karim Khan Citadel]</td>
<td>4782.3</td>
</tr>
<tr>
<td>karimi</td>
<td>[Karim Khan Citadel, Masjed Jame Atiq, Masjed Nasir AlMulk, Narenjestan]</td>
<td>4780.5</td>
</tr>
</tbody>
</table>
| **Shared tour for all individuals** | [Karim Khan Citadel, Masjed Nasir Al-Mulk, Narenjestan, Masjed Jame Atiq] | abolhoseini: 5730.3  
tahani: 6041.8  
abbasi: 4898.7  
karimi: 5079 |

**Table 1** Results of individual tour planning and the shared tour for all individuals

4. Conclusion

A tour sharing system is proposed in this paper to help tourists enjoy their trip by sharing their tours with similar individuals. Tourists can find similar people in this app and invite them to join for a tour which is planning by a tour planner based on AS algorithm. This system is developed for android operating system and it can be installed on android smartphones and tablets.
A demographic recommender system is used to recommend similar tourists to the user based on age, nationality, education and main interest. The purpose of this recommender system is to recommend similar tourists to the user in order to invite them joining a tour to visit specific POIs together. The efficiency of this recommender system needs further investigations.

AS performed very well in planning a tour for several individuals with separate origins in order to visit a set of mutual nodes. This problem can be defined as Multiple Traveling Salesman Problem with Mutual Nodes. As it was reported in the tests, users had to travel longer tours in order to enjoy each other’s company. This might lead to decrease in the costs (e.g. transportation) and increase in the pleasure of a tourist trip. Accuracy and precision of the proposed AS algorithm needs further investigation using other optimization algorithms such as Genetic Algorithm.

References
Maruyama, A. et al., 2004. A personal tourism navigation system to support traveling multiple destinations with time restrictions. IEEE, 18th International Conference on Advanced Information Networking and Applications.
Shiraishi, T. et al., 2005. A personal navigation system with a schedule planning facility based on multi-objective criteria. s.l., Proceedings of 2nd international conference on mobile computing and ubiquitous networking.