ViziTo: A system for recommending touristic Points of Interest using Bimodal Social Network Analysis

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Introduction

Nowadays, during a visit to a new place, country or city, due to time and cost constraints, it is very important for everyone to have a planned itinerary with all points of interest (POIs) that he/she is interested in to visit. However, it is still difficult to determine which POIs should be visited, considering personal preference of a tourist. Thus, the problem remains on assessing the satisfaction level of a tourist after visiting a certain POI, and finding the best route to visit certain POIs under different constraints. The focus of this work remains on the former, in order to then provide to the tourists, the recommended POIs, during planning phase of a visit. In order to deal with this issue, in this paper we present the idea of using bimodal social network analysis (SNA), which estimates tourist's satisfaction factor with regard to the certain POIs, and thus decides to recommend or not POIs to the tourist's itinerary. We decided to embrace the usage of bimodal SNA, because today the usage of social network analysis is gaining in popularity when dealing with computational problems in general (Scott, 2010) (Wasserman, Faust, Iacobucci, & Granovetter, 1994). There are two main pillars on which our bimodal SNA-based approach is focused. First one is the bimodal social network which is composed of two modes, the tourists' mode and reviewers' mode in the network for a specific group of POIs. In this case we consider some of the main personal attributes for tourists and reviewers, like gender, age, nationality, profession, and also, we take into consideration the touristic attributes for each member of the network like type and category of the places that one tourist prefers more. The second one is the usage of SNA metrics, which metrics are adopted based on their appropriateness to the domain of the social tourist-reviewer bimodal network, in order to recommend one or a set of POIs to the tourist. Here, it is to be emphasized that the reviewers' assessment on POIs is taken into consideration, so the POI reviewed is then again used on a dataset and algorithm calculations. The ViziTo as a prototype comes to a solution and manages to recommend POIs to the tourists', built on top of the framework introduced above. Three separate datasets with different POIs have been used for this work. First and second datasets are two distinct Foursquare datasets with some hundreds of thousands of check-ins, POIs, etc. Third dataset includes over 200 local POIs in Kosovo. To the best of our knowledge, none of the existing systems considers and classifies tourists' and reviewers' as a) distinct entities in a bimodal graph, where the sharing of personal attributes is in common, however there are complete distinct levels of attributes used in relation to the touristic preferences, b) and the usage of bimodal- adopted SNA techniques and metrics to recommend POIs to a given tourist. Moreover, re-calling on the evaluation results presented in (Ahmedi, K.Rrmoku, K.Sylejmani, & D.Shabani, 2017) our approach shows to be feasible, based in satisfaction response that users have given and also based on the comparison that were done with different baselines.

Our Approach

The recommendation process, is a set of certain steps and algorithms which will be described in more details. As an input, our system uses the matrix, formed from the Similarity Weight algorithm as defined in (Ahmedi, Rrmoku, & Sylejmani, 2012), where the links and link weights between tourists and reviewers are composed based on the similarities found from personal attributes and touristic attributes of the certain tourist-reviewer pair. In this approach, no links exists between tourists or between re-viewers alone due to a network modelled as a bimodal. Then, the process continues with another algorithm, called RecommendPOIs, which based on the "islands in the net" theory (Batagelj, 2003), manages to recommend one or more POIs to the tourist as requested by the user through the ViziTo portal interface. The "islands in the net" method is based on link cuts of a network, hence the reduced network N(t) for a selected threshold t, also referred to as the "water level", where by raising the threshold or the "water level", the given network splits in smaller networks, or the entire network is "flooded", and just a couple of isolated nodes on the network remains. The main is-sue with the "islands in the net" approach, is that it can arrive to the point where it can have multiple links with equal weight, and in our domain meaning that we can have a tourist linked with several POIs with the equal weight, thus making it difficult for the algorithm to decide which POIs to take into consideration. In this situation, we have used two metrics of SNA, in-degree centrality and authority centrality adopted specifically to work in the case of bimodal network as ours in order to rank reviewers and POIs, and in this form, get the most highly rated POIs as recommendations at the final stage

The ViziTo Application

The ViziTo portal is a web based system, developed in ASP .Net and based in MS SQL Server database. jQuery and Bootstrap have also been used to ensure mobile responsiveness. For implementation and testing purposes of the web portal, two distinct Foursquare datasets, which we will refer to as Dataset1 and Dataset2 have been used. Dataset1 contains 2153471 users, 1143092 venues, 1021970 check-ins, 27098490 social connections, and 2809581 ratings that users assigned to venues; all extracted through the public API in Foursquare, except the user's check-ins, which are fetched from (Levandoski, Sarwat, Eldawy, & Mokbel, 2012). Dataset2 contains 11326 distinct users, 1591615 venues, 2290997 check-ins, and 47164 social connections. We have normalized these two datasets to contain 75 distinct POIs with 518 user check-ins, and 81314 distinct POIs with 119070 user check-ins, respectively, which are fetched from (Gao, et al., 2012) (Gao, Tang, Hu, & Liu, 2013). This normalization is implemented in order to have a filtered number of users' check-ins: in first dataset users with more than 4 check-ins, and in the second dataset, users with more than 10 check-ins. In the third dataset used, with 200 POIs, we conducted a survey in terrain with tourists and reviewers, regarding their preferences as tourists, and then we asked their satisfaction level per recommended POIs. Since there are two roles in our domain, tourist and reviewer, this is adapted in the web interface application developed for this purpose. As depicted in Fig. 1 below, in ViziTo application interface, on the first step, a user should provide personal information and travelling information. Note that this information is required as input to our Similarity Weight algorithm, discussed above in this paper.

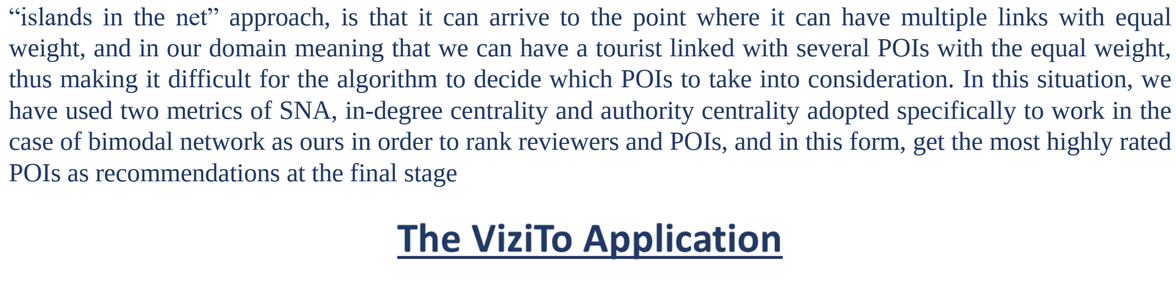

Fig. 1. ViziTo user interface: user personal data entry (up), user traveling data entry (down)

After a successful registering process, a user is asked to define its role, hence it chooses between a role of tourist or reviewer. This is implemented by asking a user "if he/she wants the system to recommend POI?", as depicted in Fig. 2 below. It is here that in the back end, we identify the role of the user, whether tourist or reviewer. If the user decides to get the POI recommendations, meaning that he wants to continue as a tourist, the process then continues on selecting the type and categories of POI that he/she is more attracted, together with number of POIs that they want to be recommended on their list (from 1 to 5 POIs), depicted n Fig. 3 below.

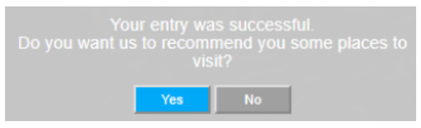

Fig. 2. Users' choice on whether getting or not the POI recommendations

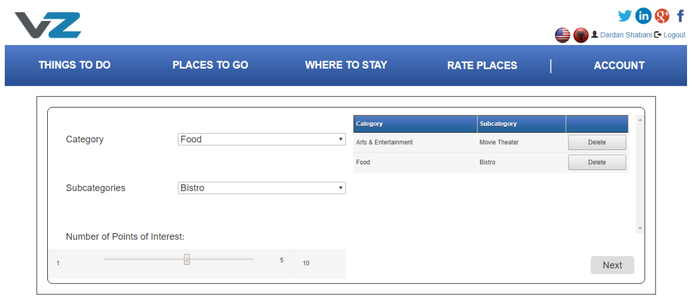

Fig. 3. The interface of choosing the type and category of a POIs to be recommended, as well as how many POIs

This information is then sent to the RecommendPOIs algorithm, as a touristic profile of a user. Now, we have a complete profile of a user, with personal attributes given on the registering process and further the touristic profile completed with certain touristic tastes, respectively types and categories. On the final step, the algorithm recommends the POIs according to the input, hence the web application presents the recommended POIs for a specific tourist (user), as depicted in Fig. 4 below. Returning to the Fig. 2 again, now the case of the reviewer is to be analyzed. On that step, if one decides not to get any recommended POI, choses the option "No", and the portal redirects to the Rating page, where as depicted on Fig. 5 below, a user can rate a certain POI

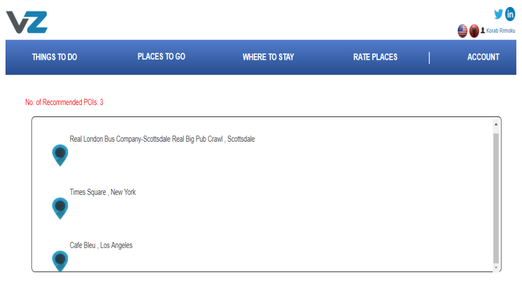

Fig. 4. The recommended POIs

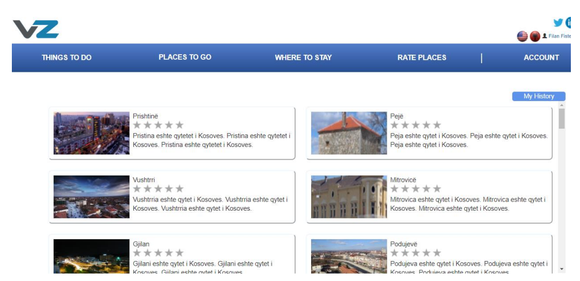

Fig. 5. The rating interface of a Reviewer

Otherwise, if a user decides to visit the portal just for information purposes, it can still browse and search different POIs that are on our database. This option is enabled by using the "Places to go" option of in the main page menu of the web application, where a user after choosing the category of POIs that he/she is interested, a certain number of POIs of that category are displayed in the map, as depicted in Fig. 6 below, where a user can get more information regarding those individual POIs of interest.

Conclusion and future work

Our system as described above and the web portal implementation confirm our belief on the role of incorporating the SNA bimodal model and its "islands in the net" and centrality metrics into POI recommender system. This demo presents the whole process of recommendation algorithm using web portal from user registration step until to recommendation as final step. Final step determines if user would like to have a recommendation of POIs (tourist profile) or provide a review for already visited POIs using 'Rate Places' option, which is reviewer role. The demo itself aims to promote specific category of tourism which is retrieved from user input and reviewers also. The proposed system represents a bimodal network comprised of tourists and reviewers as main actors unlike the other state of the art solutions. Well known ranking algorithms: centrality authority and in-degree were adopted to retrieve better ranked reviewers within island during process of recommendation of preferred reviewer's POIs to tourists. Same ranking algorithms have been used to rank POIs of reviewers in case when there are more preferred POIs of reviewer. As part of future work, it is planned to focus more:

- on geographical aspect of recommendations, hence considering the actual location of the user when recommending POIs;
- considering more SNA group metrics in recommender systems;
- expand the dataset of POIs;
- enabling filter of distance range between home city of user and recommended POIs in order to eliminate region distribution of POIs;
- feedback during recommendation process as an evaluation method from end user also removing visited POIs from next recommendation if tourist has already visited one of recommended POIs.

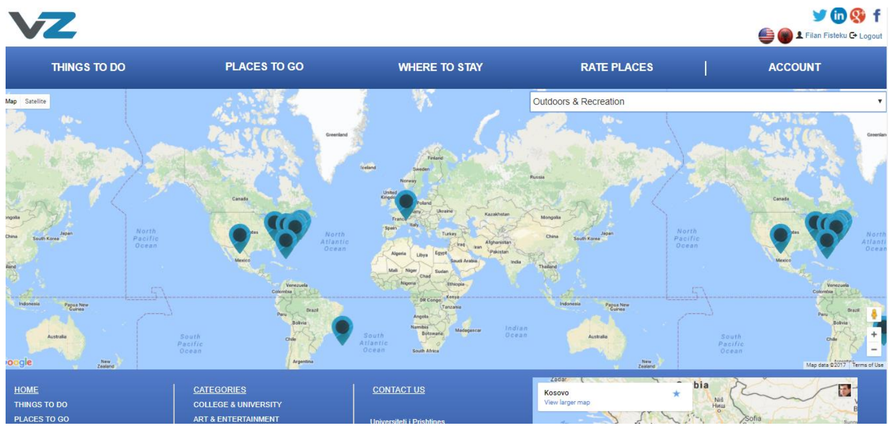

Fig. 6. The "places to go" interface of the "ViziTo" application

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