ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 8, Special Issue 1, August 2021

A Suggestive Travel Recommender System from Geotagged data's using Deep Learning

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***Abstract*—In the past few years, with the proliferation of mobile devices people are experiencing frequent communication and information exchange. Recently in multimedia, web services contain a huge volume of geo-tagged photos. The users who upload these photos are sharing their travel experiences through them. Geo-tagged photos have crucial information imbibed within them, like location, time, tags and weather. Travel Recommendation methods that exist do not take into consideration user preferences and weather all at once. In this paper, a travel recommendation system is proposed for tourists in Mumbai according to their preferences, weather and live events. In the context of tourist visits, it is often the case that each person carries out a smartphone, to get information about touristic places. When one visits some location, a tourist guide application will recommend useful information, according to its current location, preferences, and past visits. The recommendations are carried out using the well-known Mahout library. As compared to previous recommendation based tourist guides, the key novelties of Guide Me are its integration with social networks and the unique set of options offered in the application. The usability and load tests performed to evaluate the service, including its recommendation engine, have shown both the adequacy of the designed interfaces as well as good response times. The offline one is used to create the knowledge model, that is then used for calculating suggestions. It is executed periodically when new GPS data are available for updating the knowledge model. The online one uses information from the current visit path of a tourist and the knowledge model to calculate a list of suggestions as possible next locations to visit.**

***Index Terms*—PoIs, Tourist Guide, Recommender System, DBSCAN, MTT, Trajectory pattern Mining**

I. Introduction

Every day, many people visit well-known touristic locations around the world. However, many unknown places deserve to be visited but people don't know about their existence, due to the lack of public information. Many points of interest may be located within a range of dozens of kilometers from our homes, but usually we prefer to travel hundreds or even thousands of kilometers to visit some other well-known locations. Recently, with the proliferation of smartphones and social networks, people got closer. Usually, people carry out a mobile device, being able to gather information about their surroundings, which is used by the so-called tourist guide applications to suggest touristic attractions, based on context factors such as location, weather conditions, and available time.

Travel planning is exciting but occasionally taxing especially when the tourists are not acquainted with the town. Therefore, various guidebooks such as Footprint Travel Guide taken into consideration in these guides. Also, moreover, it is very tedious to extract information about the information of travel in a detailed manner like the most favorable time of the day or season to visit a place. In the past few years, great advances have been made in camera phones and digital cameras for sharing media on social media sites like Facebook, Instagram, Flickr etc. Sharing the know-how of traveling is shared by users on these kinds of social web platforms. These web services that involve photo sharing contain approximately billions of images covering most of the lands in the world. Moreover, majority of these photos contain geo-tagged information, time and a huge variety of textual information. The system generates suggestions consisting of touristic places, according to the current position of the tourist that is visiting a city and a history of previous visiting patterns from other users.

My Involvement

In this paper, we address the development and the key features of a tourist guide, named Guide Me, with a mobile and a Web application, that allows for users to consult places of touristic interest. Geotagged photos can be pinpointed on to a 2D Cartesian map to visualize the location of the click and this location determination could be done when they are uploaded to worldwide photo sharing services which are online such as Flickr. The service offers a set of search filters to facilitate the exploration of new locations. In order to easily attract new users, the Facebook and Twitter social services are integrated in the service, allowing for users of these social services to easily register as a new user or to login into the Guide Me service. Thus, it is possible to follow a user directly through the Guide Me service. The system suggests new locations based on both the user's past actions and its current location. It takes into account the preferences of other users, through a recommender system (RS). Users provide information regarding the locations that they visit. The RS uses this information to suggest a list, sorted by decreasing preference, of new places of interest to other users. Currently, there is no interaction between the RS and the supported social services. In future work, we intend to implement this interaction, for instance, by considering user rating or comments and friends similarity. GPS (Global Positioning System) to geotag photos taken with an external camera GPS (Global Positioning System) could be put to use by smartphones while geotagging photos captured via an outsourced camera. In addition to that, various software tools can 2 be implemented to visually indicate the information related to GPS. This kind of indication

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accidentally corrupted or stripped while putting up on online sharing services.

II. Related Works

In this Section, we briefly review the key features of existing tourist guides, proposed in the past few years. The Tourist Eye service is available as a Web application, with mobile clients for iPhone and Android. It offers a wide range of points of interest organized by categories such as attractions, restaurants, and entertainment. Registered users can mark touristic places as visited, provide a comment stating their degree of satisfaction, and they can describe their visits, by taking notes and photos in the mobile application. In order to visualize points of interest, the Google Maps service is integrated within the Web and mobile applications. Users can plan their trips, composed by points of interest, and the map service is used to display routes between these locations. The Tourist Eye service has an integrated RS such that new points of interest are automatically displayed to the user. The Guide Pal Guides allows for users to download varied content and to consult information regarding restaurants, coffee shops, places to visit, and other attractions. In order to list the existing points of interest, the user selects the desired city and category. The my Trip travel guide service is mainly used for big cities such as Paris, Berlin, and Madrid, among others. It is available as a separate application for each one of the major cities (for iPhone and Android) and allows people to consult information regarding points of interest without an Internet connection. Users can plan an itinerary or create guides for the cities by providing the detailed information on the touristic attractions which they plan to visit. After specifying the dates for the trip, each user can manually compose its itinerary or allow my Trip to generate one. Each point of interest is accompanied by a description, a photo, opening hour, prices, as well as the comments and ratings from other travelers. It includes an augmented reality tool to preview the points of interest near the user's location.

The tourist guides mentioned above are well-known applications. Recently, the research community has been focusing on new methods to solve known deficiencies of RS, with hybrid systems, that integrate different approaches as well as standard RS approaches. we have a mobile recommendation and planning system, designed to provide effective support during a tourist visit through context-aware information and recommendations about points of interest, exploiting tourist preferences and context. This approach combines classification and association rules in a prediction context. The method was evaluated on a set of case studies being able to shorten limitations presented in RS, while enhancing the recommendation quality.

III. Meaning of Recommender Systems

Recommender systems (RS) are used to generate meaning-

as content-based filtering (CBF). Another approach, designated as collaborative filtering (CF), use evaluations about items done by other users. In CF methods, the recommendation process is based on ratings of "similar" users, that is, users who have simi- lar preferences. The CF methods are classified into two categories: memory-based (or user-based collaborative filtering – UBCF) methods and model-based (or item-based collaborative filtering – IBCF). Comparing CBF, UBCF, and IBCF, we conclude that each of these techniques has its own advantages and

draw- backs. Content-based methods have the difficulty in distinguishing between high-quality and low-quality information on the same topic or to extract relevant characteristics from certain items such as multimedia items.

The sparsity problem affects mainly the memory based methods (UBCF), but model based ones (IBCF) may also be affected. Location discovery for the tourists is nothing but making clusters of the heavily clicked locations. Various algorithms for making clusters like mean shift or k-mean are used for clustering pictures utilizing the inbuilt geo-tags to pinpoint the locations. But, DBSCAN has an edge as compared to all the other density based algorithms,

1. To define the parameters for input and to categorize clusters of various shapes, the knowledge of domain that is necessary is minimalistic.

IV. Filtering of outliers takes place with notable efficiency on data of very large scale

The parameters required by the DBSCAN algorithm include minPts (The minimum number of points required to form a cluster) and R(radius).

The proposed methodology, DBSCAN is applied for clustering pictures for the discovery of 2D location coordinates with the help of associated geotags.

V. Proposed Methodology

The proposed methodology, DBSCAN is applied for clustering pictures for the discovery of 2D location coordinates with the help of associated geotags. This Section presents the simplified service architecture as well as the employed technologies used for the development of the components. The system is mainly composed by a representational state transfer (REST) service with a data access layer which exposes a set of endpoints in order to be accessed by the client applications. The architecture of our recommender system has two main modules: offline and online. The first one aims to create the knowledge model, which is the basis for computing suggestions. Its execution takes place when new data is available for updating the knowledge model. The online module uses the current user information and the knowledge model in order to produce a list of suggestions.

The formulation of profiles of these 2D locations coordinates and database building is done after the discovery of locations. The prime focus in this section is the context

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the mobile applications. For information storage, we use the MySQL relational database. The Service and Log DAL were implemented using the Java Hibernate Framework. In lines 1-12, identification of the trips which are taken by various users from the pictures captured by them on those places is done. Sorting of pictures of every user is performed according to temporal location-wise order in the first step. The obtained data is visit 'v' which is from a picture 'p' captured by user 'u' at time 't' on location 'l'. It should be noted that more than one picture can be taken by user 'u' at a place. Comparison of the timestamps of two photos indicate that given the difference in timestamp of the pictures taken at a particular location is less than the visit threshold, both pictures are of one trip. The median timestamp related to the pictures is considered to be the time of visit 't' of the trip 'v'. Line 13 indicates the calculation of context history according to which the places are visited.

For obtaining the contextual information about weather and seasonal, this time stamp offers a great deal of help. Regions can be very small where there are several close PoIs. Their size depends on the PoIs distribution, and especially on the distance from one PoI to another. The main motive is obtaining the user preferences of users 'U' in a collection of locations 'L' and making use of the links (group of visits 'V' between locations 'L' and users 'U' for making a weighted undirected graph.

GUL = (U; L; EUL; WUL),

MUL = [hij]

The string sequences of travel and history of travel of the users determine the similarity amongst the users in the proposed methodology. A user trip is defined as a string sequence of places which are visited sorted with respect to their timestamps. The REST API provides a single data source for client applications, both existing as well as others that may appear in the future. This API was developed using Java and the Play Framework The process to identify trips runs in many steps. In the first step, sorting of pictures is done in the temporal order. Secondly, the entire history of travel is divided into trips of users on the basis of difference of the timestamps of two successive pictures being greater than the duration threshold of trip. In the third step, it's realized that a person can take multiple pictures in a specific visit. Just one picture needs to be considered in the case of two successive pictures in the same place and pictures are replaces by the related location in the location database (LDB). A trip database is kept up after all the user trips for every user has been taken into consideration. The Web application is focused in technologies for user interface definition and structuring such as HTML, CSS and JavaScript to enrich user's interactivity. The server side of the Web application was developed using the Play Framework. The Twitter Bootstrap framework was used to generate a layout with the desired dynamic content, thus providing an user friendly platform. MTT which is the user-user similarity matrix is made after the previous step. The similarity between two users 'ua ' and 'ub ' is represented by

The user will input a query which is Q = (ua , s, w, d) in which the user who is the target is 'ua ', the information about the season is 's', the information about weather is 'w' and the city being visited by 'ua ' is 'd'. In order to provide quality recommendations for our users, we have used the Apache Mahout Recommendation Engine library. Mahout provides several CF algorithms, for user and item-based recommendations. Nowadays, this library is widely used for the implementation of RS. The result will be a collection list of 2D location coordinates in 'd' which are recommendations for 'ua '. Q is computed to give the above output in the following steps. Firstly, filtering for forming the contender collections of locations L' is done considering the constraints with respect to context. User locations are obtained from GPS systems and sent to the offline module whenever a new position is detected. The recent movements of a user are used to set up the current trajectory, which is then compared with each practicable T-pattern Tree path. For each pattern match, a score, called Punctual Score, is calculated by assigning a value to each node of the current trajectory, which is then compared with those contained in T-pattern Tree.

WORK DONE AND RESULTS ANALYSIS

About 10,000 geotagged photos were collected, which were taken in the city of Mumbai taken via Flickr, including other picture information was also extracted. The public weather API Wudermground was used to collect all the past records of weather. The DBSCAN parameters is set as the following- minPts to 50 pictures, density ratio 'w' to 0.5 and ε(radius) to 50 meters for discovering the location objects from pictures. The mobile application interfaces, which can be accessed by any user; and the administration interface. All users can consult points of interest near their current location, apply filtering criteria (e.g.by country, city, category, and weather conditions) to shorten the amount of results. Users also have the possibility to consult recommended locations, mark locations as visited or wanted, follow and unfollow other users. Users with administrative privileges can perform all tasks, such as insertion or update of touristic locations. The main focus of the mobile applications is the user's current location, which is represented by the geographic coordinates obtained using the positioning service available on the user's device, provided by GPS or Wi-Fi connections. By knowing the user's current location, the service suggests places of interest nearby, and their corresponding distances. When the positioning or location services are not available, the application allows to consult the points of interest, without displaying the distance between the user and the touristic location at hand. The quality of the trajectory set is a key element for building the knowledge model with which the recommendations are computed. Therefore, it is important to understand in advance whether a set is valid for the effective evaluation of suggestions.

The Web application provides a subset of the functionalities of the mobile application. It allows users to authenticate using their Facebook account, consult visited, wanted, and recommended locations, as well as the detailed information

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location through the Google Maps service. To evaluate the effectiveness of suggestions we adopted an empirical approach that estimates the percentage of errors in making recommendations using a test set. The set of samples is divided into two disjoint subsets, a training set used to build the knowledge model (90%) and a test set (10%) used for evaluation. Each trajectory in the test set is iteratively divided into two parts: the first part represents the current trajectory on which we want to receive recommendations, and the second part is used for comparisons with the suggested regions. Since the data used are latitude and longitude values, these values should be normalized between -1 to 1; the above functions are used to normalize the data. The scattered plot for DBSCAN clustering, in which black dots represent the noise points and colored circles represent the different clusters formed after clustering. DBSCAN resulted in 34 numbers of clusters for our dataset. According to the results, if we consider the context and trip similarity, context being of weather and season, the accuracy of the recommendation process increases. Supported by these results and on the still relatively small size of the Guide Me database, we have chosen Slope One with unlimited is the most suitable recommendation algorithm. We present a comparison of the proposed solution versus a greedy solution, Nearest. Due to the scarcity of recommendation systems available and low availability of datasets used in other articles, we developed a simple recommender called Nearest, which returns a list of suggestions containing regions closest to the current region of the tourist, thus not adopting any process of mining. With the increase of the dataset size, we could limit the algorithm to use 500 000 difference keeping a reasonable performance.

VI. Visual Representation

We have also performed a usability evaluation, done by means of a survey delivered to 30 users. The survey was divided into four sections

(i) General information about user's gender and age range

(ii) Set of questions related to user's experience with mobile applications

VII. Questions Regarding the Usefulness and Attractiveness of the Application's Screens

(iv) Question about the possibility of installing the Guide Me application in the future, and also the request for some comments and suggestions.

Users have started by filling in the first two sections of the questionnaire. After, they were provided with the iOS device running the application and a maximum of 5 minutes to interact with it. No help was given during that period of time. Finally, they were asked to fill the third and fourth sections of the questionnaire describing their opinion regarding the application. The majority of the users have liked the implemented set of features and the overall design of the

VIII. Conclusion

In this paper, method for an efficient travel recommendation is built by profiling locations according to location, weather and live events which in turn provides the input for modeling the user similarity and preferences by making a user-location similarity matrix and a user- user similarity matrix. DBSCAN clustering algorithm was found to be the most suitable for clustering the locations for this model. Recommendations are made based on selected parameters. We proposed a recommendation system that can assist a tourist visiting a city. It is able to generate suggestions of potential PoIs, depending on the current position of a tourist, and a set of trajectories describing the paths previously made by other tourists. Many people are busy in their daily routine and when an opportunity to travel comes, one typically chooses to spend more time (and money) to visit well known touristic locations such as the Eiffel Tower or the Big Ben. Sometimes, people forget or ignore the fact that their home country also has great places to visit. Many approaches for tourist guides have been proposed, but all of them are mainly focused in well-known touristic locations. We also evaluated our proposed system against a simple baseline solution, which produces a suggestion list of regions closer to the tourist's current position. Results show that our solution clearly outperforms that one. We also proved that the response time enables it to be used interactively. Comparison of the proposed model is done with the base line methods like FR(Frequent Rank), CR(Classic Rank) and PCAR(Personalized Context Aware Rank).

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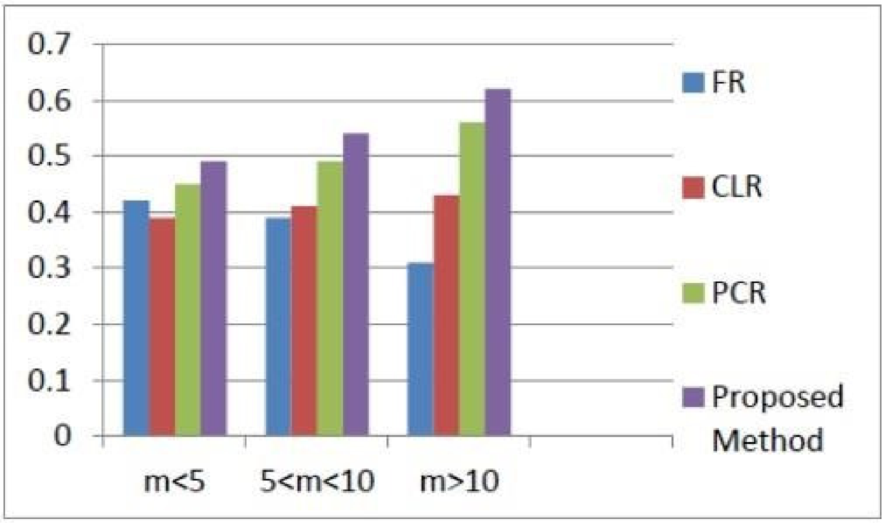
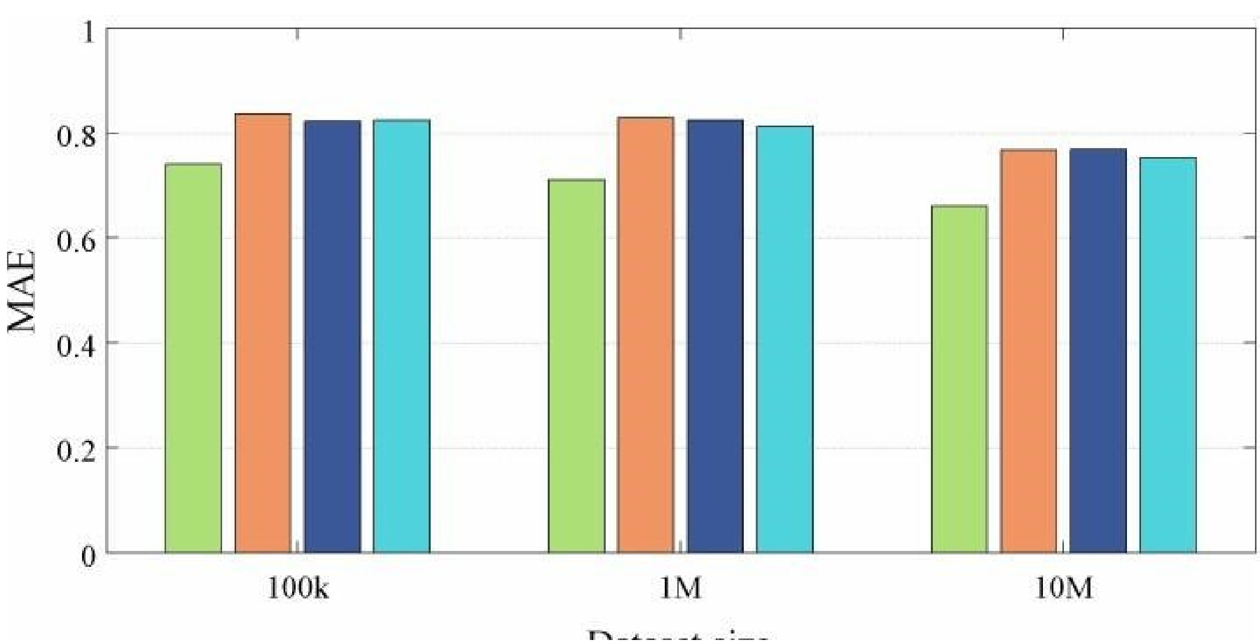


Fig. 1.

TABLE I

PoIs Region	Real Dataset				Synthetic Dataset			
	SC(%)	RS(%)	DC(%)	Rate	SC(%)	RS(%)	DC(%)	Rate
5	0,70	0,12	0,75	0,06	0,91	0,92	0,71	0,08
10	0,67	0,06	0,75	0,03	0,96	0,05	0,64	0,03
20	0,86	0,03	0,69	0,02	0,97	0,03	0,61	0,02
30	0,83	0,02	0,66	0,01	1	0,02	0,06	0,01



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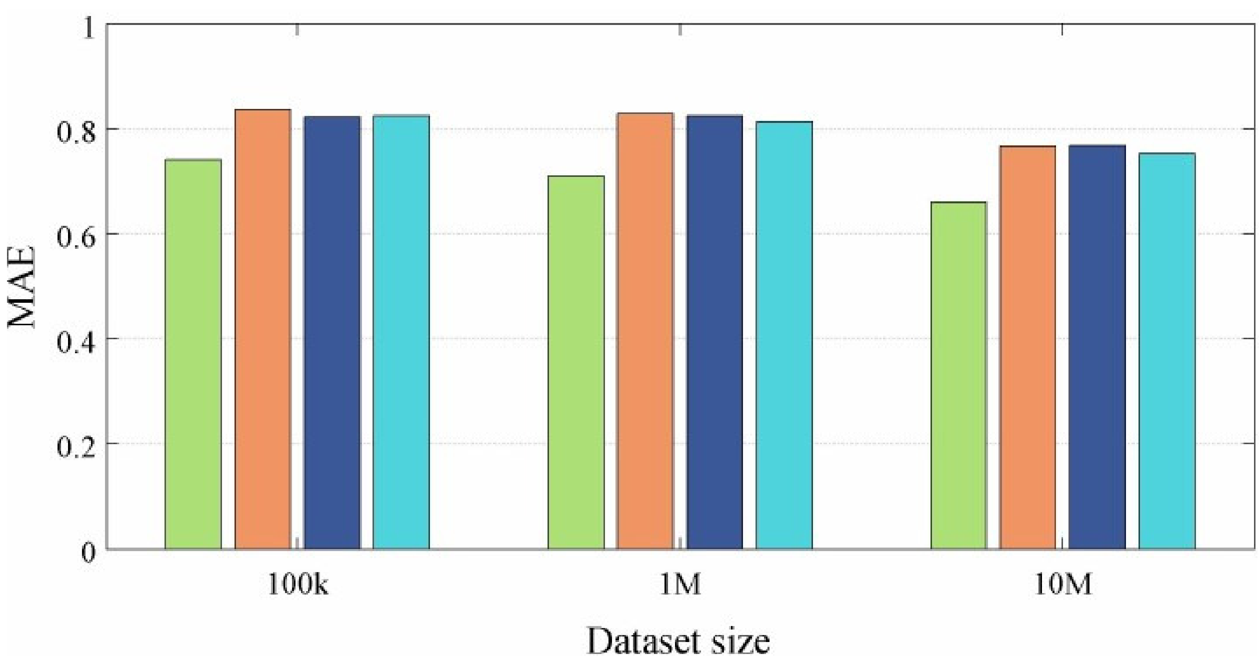

Fig. 3.