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Forecast of Places Using Social Photo Tags and Similar User Preferences

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Abstract: Travel recommendation through social network is popular since every people has GPS attached with device to locate the place. The photos are shared among different users and each photo consists of photo and textual description about the photo (i.e. tag and geo-tag). Similarity between the users is identified through content and collaborative based filtering. But data sparsity becomes a major thread for recommendation. The tag information is commonly sparse in dataset. This can be overcome by recommending similar tag to increase the personalized recommendation. The suggestion of tag can be base on the visual similarity of photos with training dataset. Based on user's similarity the Point of Interest (POI) of different places is ranked orderly. Thus personalized recommendation of places to users is recommended.

1. INTRODUCTION

Recommender Systems (RSs) are software tools and techniques which are used for providing suggestions for items to be used by the user in internet[1]. Recommendation system mainly involve in decision making processes, such as what to buy, what to see or listen. They are primarily used by individuals who lack sufficient personal experience or competence to evaluate the potentially overwhelming number of alternative items that a Web site. Also defined as information filtering subclass which is used to predict the preference and rating that user prefer for an item [2]. Instead of delivering a static experience to users who search for and potentially buy products, RS provide a richer experience by increasing the interaction. They identify recommendations autonomously for each users based on past searches and purchases, and on other behavior of user. Different users and groups get diverse recommendation, since suggestions are mostly personalized. There is even non personalized recommendation for users. Personalized recommendations are given as items with listed order. To perform ranking, system try to predict what product and service are suitable for user based on user preference and constraints. The user preferences are collected explicitly from user like rating for item or interpreting all user action [1][3][4]. For recommendation the data and knowledge source are item, user and transaction. Items are the recommended objects and are given a value, utility or complexity. The value of an item is positive if the item is useful for the user or negative if the item is not useful or if user done wrong suggestion when choosing an item. The recommendation system can be categorized as collaborative based filtering, content based filtering and hybrid filtering. The photo uploaded by user also contains tag and geotag with user identification. The geotag specifies the geographical location of the place where the photo has been taken [5]. The longitude and latitude values specify the current location of the place. The tag represents the textual description of the places used by the user who uploads the photo. The tag here generally specifies the characters of the location or a name [6]. Thus it help other user to know about the place without having any prior knowledge about it.

Online social networks facilitate connections between people based on shared interests, values, membership in particular groups (i.e., friends, professional colleagues), etc [7]. They make it easier for

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people to find and communicate with individuals who are in their networks using the Web as the interface. An online social network is a social structure made up of a set of social actors (such as individuals or organizations), sets of dyadic ties, and other social interactions between actors [8][9]. The social network perspective provides a set of methods for analyzing the structure of whole social entities as well as a variety of theories explaining the patterns observed in these structures. Social media is being used popularly for the purpose of sharing the information. Some examples of social networks are facebook, twitter, flickr, etc. All kinds of data such as audio, video, photos, textual data can be shared using social media. Any user can communicate with other user. The main advantage of social network is for recommendation purpose. Social network sites like flickrs used to upload photos can be used for recommending important places for visit. Every user has unique user identification and upload photos of them. Similarity between users can be found based on the previous history as where they have visited in common [3][4]. The users are said to have similar taste if they have visited more places in common. Hence online social networks help people to gain more knowledge of everything. Images are being processed here. Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, such as a photograph or video frame [10][11][12]; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible [13][14].

2. RELATED WORKS

Shuhui Jiang et al (2015) stated that different methods are used to recommend the photos to the user based on their interest. Author topic model based collaborative filtering (ATCF) method is used to facilitate comprehensive point of interest (POI) recommendation for social user [15]. It involves in mining users topic preference from textual description attached with photos via author topic model (ATM) and travel topic and user topic preferences are identified [18]. POI is ranked according to similar users who have similar travel topic preferences. Thus the personalized recommendation is provided based on user similarity and place with high point of interest. Community detection is an important problem in complex network which is useful in a variety of applications such as information propagation, link prediction, and recommendations and marketing. Le Yu et al (2013) proposed the LDA based link partition (LBLP) method involves in topic models to predict the link prediction in turn calculate the community factor for every link [16]. Ling Yun et al (2008) stated that the topic model is also used to discover Micro-Blog users' interest. Users metadata like labels is been put into user document which is used to infer user's interest [17]. Jing Li et al (2013) said that every photo has geo tag information such as longitude and latitude value attached with it. An unsupervised image GPS location estimation approach is used with global feature clustering and local feature refinement. Two processes involves as an offline system and an online system [19]. Takeshi / kurashima et al (2012) developed a cluster structure with large image set with GPS information (geotag) in an offline process. From above each cluster a representative images are selected and an inverted file structure is used. When an image is given in online process, its geotag information is estimated and feature refinement is done. Collection of each users geotagged photos is sequence of visited places, useful for gathering location histories of tourist which in turn provide various travel route that connect important landmarks [20]. Rongrong Ji et al (2011) Calculated the probability of user visiting the landmark and present location information, route recommendation method outputs a set of personalized travel plans (based on user's preference, present location, spare time and transportation mean). A tourist trip recommendation system is used in which user must specify the source and destination place [21]. Lina Yao et al (2015) developed a system provide shortest path visiting many popular places along the path. Here a graph is constructed with photo as vertices and visual closeness as connection strength. Consider both user rating and semantic content data of web services for recommendation process [22]. Unobservable user preferences are represented

by introducing a set of latent variables. The three major requirements considered for effective recommendation are high recommendation accuracy, recommendation serendipity and recommending newly deployed services.

Data sparsity is considered a thread for the performance of recommendation system. Jing Liu et al (204) stated that personalized tag recommendation is provided by identifying user preferred, geo-location and relevant photos from available community contributed photos. First an intermediate subspace for the visual domain is considered, next unified subspace is mapped from the intermediate subspace and the textual space respectively [23] [24]. When untagged photo is uploaded, the user-preferred and the geo-location-specific tags are found by the nearest neighbor search in the corresponding unified spaces. Dong Liu et al (2011) developed a multiple graph-based multi-label learning problems is used, which simultaneously explores the visual content, semantic correlation of the tags and the prior information provided by users [25]. Yongli Ren et al (2013) developed a robust tag-specific visual sub-vocabulary learning algorithm is used for the construction of those tag-specific graphs. For a query (user, item) a set of key rating is identified using the historical information of user and item. An adaptive imputation method is used for calculating the missing values in set of key rating [26]. User similarity identification plays an important role in recommendation system since used for finding users preference level. Liang Liang Cao et al (2010) stated that a user provides photo or keyword to describe the point of interest and the system searches database for places which visually match with user input [27]. Quannan et al proposed a hierarchical graph based similarity measurement framework is used for modeling each individual location history for geographical information system and then measure the similarity between the users [28]. Xueming Qian et al (2014) considered three social factors as interpersonal influence, interpersonal interest similarity and personal interest to fuse into a unified personalized recommendation model based on probabilistic matrix factorization. The interpersonal influence and interest similarity would reduce the cold start problem in recommendation system [29]. Hence more personalized recommendation of items is recommended to the users. Point of Interest (POI) is been popular since the location-based social network services have been used. The number of places can be less than the number of users in POI recommendation hence difficult to recommend [30]. The social influence, user preference and attraction of places are considered and for selecting the candidate the geographical influence is being used. Based on customized linear weighting, a unified POI recommendation is used which fuses user preference to a POIs with social influence and attraction of locations methods. Shih His Fang et al (2014) developed package Attraction based Trip recommendation framework is used to recommend effectively the personalized trips which satisfy multiple constraints combining the packages and attractions [31]. A score inference model is used to store the scores of attraction and the packages considering the temporal based property and user preference. Xiangyu Wang et al (2015) stated the photos, description, user check in pattern and location are explored to find the semantic similarity of locations. In user check in behavior the venue semantics play a major role. Using the venue semantics as regularizer, unified POI recommendation is used [32]. Location semantic similarity is given more importance than user venue check information. The method effectively utilizes the venue semantics to model the user's interest indirectly and improves the recommendation performance.

2.1. Limitations of Existing Work

Hence the tag present in source is mostly noisy and incomplete data called sparsity problem. This data sparsity problem decreases the performance of recommendation. Most of process does not involve in personalized recommendation. Hence the recommended object will not be of user interest. Next important problem identified is percentage of accuracy provided by recommendation system to user according to user's interest. While uploading photos in social network a particular user upload more number of photos from single location. The replication of same location occur which reduce the performance of recommendation system. Personalized recommendation is not provided properly to the user hence unwanted and irrelevant items are recommended to user who is not relevant to them.

3. PROPOSED WORK

The main aim of our proposed work is to increase the personalized recommendation for the system. The input to the system is photos taken by user with tag and geo tag information. Some input have the possibility of having missing or incomplete tag information which decreases the performance of the recommendation system. To overcome this problem preprocessing process is done in tag information. After the preprocessing process all photos has proper tag hence data sparsity is reduced. Replicated photos send by each user may cause degradation in system. Therefore all replicated photos are removed. Clustering process is done with geo tag information which specifies the location of photo taken. Similarity between users is identified to find similar taste and preference between users. Next process involves in ranking point of interest. Based on similar user and POI, personalized recommendation is provided to user.

3.1. Tag Information Preprocess

Some of the data in photos have missing tag information which leads to data sparsity problem. To overcome this problem the tag information are preprocessed. The input to this module is photos with tag and geotag information by the user. Initially number of tags for particular place is assigned through training with dataset. For a new photo with improper or missing tag, first visual similarity of photos is identified. If the photos get matched, the mostly used tag for that matched photo is recommended to this improper tagged photo.

3.2. Removing Replication And Clustering

A single user may upload many numbers of photos from a particular place at a time. This replication of photos may degrade the performance of the system. Hence from all similar photos from particular user only a single photo for a particular place is considered in the system. After removing the replicated photos, the clustering is done using the geotag information present in the photos. In clustering, mean shift clustering done after k-mean clustering. While performing k mean, k clusters are formed based on geo tag information. For each k clusters mean shift is applied to form clusters based on density. Hence each places will be a clusters now.

Start

Initialize k

Perform K-mean algorithm

$K = \{k_1, k_2, \ldots, k_n\}$

For each k_i

Apply mean shift clustering

end

3.3. User Similarity Detection

Similarity between the users is identified based on the previous history of places they have visited. This similarity between users is identified for personalized recommendation based on their preference. Hence user similarities are identified to find places of their interest. Consider $U = \{u_1, u_2, \ldots un\}$ be number of users and $P = \{p_1, p_2, \ldots p_n\}$ be number of places visited. Cosine similarity is used to calculate the similarity between users as shown below equation.

$$sim(u,v) = \frac{\sum_{pep} r_{u,p} r_{v,p}}{\sqrt{\sum_{pep} r_{u,p}} \sqrt{\sum_{pep} r_{v,p}}} \quad (1)$$

Here $sim(u, v)$ is similarity between user u and v, $r_{u,p}$ is ranking of user u to place p and $r_{v,p}$ is ranking of user v to place p.

3.4. POI Ranking

Point of Interest (POI) specifies the most interesting places visited by most of the people. Based on similar user the POI is ranked. If a new user uploads a photo he has no previous history to find the similarity between users. Recommendation can be based on age, location or based on season. The results will be the order of the places from high rank to lower rank.

3.5. Personalized Recommendation

Based on user similarity and POI ranking most personalized recommendation is provided to the user. The recommendation can be based on number of day available, budget available, places with more POI places. The shortest path of the route can be provided to the user which can be a greater benefit for the user.

3.6. Psuedocode

The input to the process is photos taken by user which contain both tag and geo tag information and the corresponding output of the system is recommending or suggesting places to user of their interest as shown in Fig 1. Initially attach tag information to each photo during the training process. Now all photos have corresponding tag information. Now if new photo is added check if the photo has incomplete date. If there then perform visual similarity with the trained set, If any match is present then tag and geo tag of matched photo would be added to photo which has incomplete data. Now for each user collect all photos and check if there is any repeated photo in individual user. If present remove the replicated photo since it may decrease the performance of the system. It is followed by clustering of photos which are nearby by using the geotag and visual matching. Perform user similarity detection based on behavior of user in previous history. Now based on user similarity the places can be recommended to user with higher preference level.

```
Input: photos with tag and geotag
Output: Recommending places(photo) with user preference
start
    attach tag for each photo(while
    training)
        if new photo added
        check for incomplete data
            if incomplete data
                verify photo similarity
                    if similar photo present
                        suggest tag and geotag
group photos of individual user
    if same photo repeated
        remove repeated photo
    else
        no change needed
perform clustering of photos
detect user similarity
rank places in order of preference
end
```

Figure 1: Psuedocode

4. EXPERIMENTS AND RESULTS

4.1. Dataset

The photo uploaded by user also contains tag and geotag with user identification as shown in Fig 2. The geotag specifies the geographical location of the place where the photo has been taken. The longitude and

Figure 2: Image with Tag and Geotag

latitude values specify the current location of the place. The tag represents the textual description of the places used by the user who uploads the photo. The tag here generally specifies the characters of the location or a name. Thus it helps other user to know about the place without having any prior knowledge about it. In the below figure a photo is shown along with the corresponding tag information. Unique photo ID is provided to each photo and each user have unique user ID. The geotag value (i.e.) latitude and longitude values are specified. The tags like Barcelona, park, spain specify the characteristics of location where the photo is taken. The number of photos taken into consideration for training are 50 and tested with 10 photos.

4.2. Experiment

SIFT algorithm is used for any object in an image, interesting points on the object can be extracted to provide a feature description of the object. This description, extracted from a training image, can then be used to identify the object when attempting to locate the object in a test image containing many other objects. SIFT keypoints of objects are first extracted from a set of reference images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors. Euclidian Distance is used to find the similar image for visual matching in equation 2 where (x, y) and (a, b) are center and points to find distance respectively.

$$d\left((x,y),(a,b)\right)=\sqrt{\left(x-a\right)^2+\left(y-b\right)^2} \tag{2}$$

For clustering through k-mean the distance is measured as in equation 3 and mean shift clustering uses the equation 4 and 5 to cluster location based on density.

$$k=\sum_{i=1}^{c}\sum_{j=1}^{c_i}\left(\left\| x_i-y_i \right\|\right)^2$$

$$m(x)=\frac{\sum k\left(x_i-x\right)x_i}{\sum k\left(x_i-x\right)} \tag{3}$$

$$k\left(x_i-x\right)=e^{-\left(x_i-x\right)^2} \tag{4}$$

K represents the clusters and $m(x)$ represent cluster formed by mean shift clustering. After finding the similar images, all tags are grouped to provide that tag to others. Whenever an new image is used visual

matching is done with all other image present in the system. If tag information is not present, the visually matched tag information is provided to that photo image.

4.3. Result Analysis

The performance analysis is done by comparing the number of tags present before and after preprocessing tag information. First the photos are not preprocessed, so only the user specified tags will be attached to every photo. In preprocessing similar images are grouped and all their tags are also grouped together. Hence the number of tags attached to each photo will increase after preprocessing tag information. In the below figure 3 it states the comparison between number of tags to each photo with preprocessing and without preprocessing. From this inference it shows that only after preprocessed tag information the number of tags for every photo is increased. In photo 6, the number of tags for a photo is null without preprocessing. But after image matching the similar tags from other photo is being attached hence the performance is increased. In photo 8, the similar photo is not trained, hence returns the same number of tags.

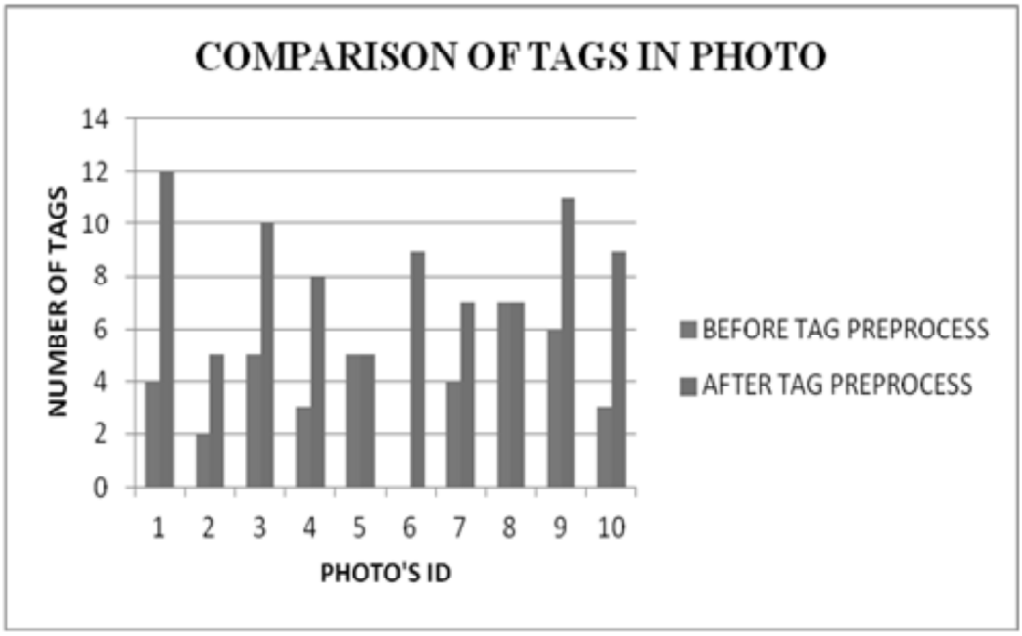

Figure 3: Tag Present Before and After Preprocess

The purposes of this process are

(i) Increase the number of tags for each photo.

(ii) If the photo's doesn't have tag to represent the description of image, visual similarity of photo is done. Hence even uploaded photo without tag and geotag present, corresponding tag can be attached to that particular photo (thus reduces the data sparsity).

(iii) Since the number of tag increases for each photo, the user similarity detection can be more accurate.

5. CONCLUSIONS AND FUTURE WORK

Recommendation system is being used widely now a day in social network. Different types of recommendations are possible such as recommending movies, books, items etc for other users. Using the image (photo) along with geo tag and tag information can be used to recommend places or location to other users based on their interest. Many photos uploaded have incomplete data which leads to data sparsity problem. To overcome this, few data sets are trained with photo and tag. Whenever a user uploads with

incomplete data, feature matching (visual matching) is done. Now the matched photos tag information will be attached to photo which has incomplete data hence data sparsity problem is reduced to some extent. User similarity between is detemined since the user who have similar type of interest in past history they tend to have similar taste in future also. Author topic model was used to find the user similarity based on distribution of user over tag used so that similar user increase the recommendation based on user preference. Hence the data sparisty problem is reduced and improves personalized recommendation of interesting places to the users. In future, different types of recommendation can be made based on different category.

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