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Point of Interest Recommendation based on Personal and Friend's Preferences

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ABSTRACT: Due to growing advancements in mobile technology, use of social media has increased tremendously. To communicate and update friends about the whereabouts, Location based social networks are used by many people where they check-in at a location and update their status, post reviews and upload photos. This leads to research interest in Point of Interest recommendation, which recommends unvisited locations to user. In the proposed system, we develop a recommendation system for the user by considering user's personal preferences and friend's preferences obtained from check in history, to recommend new places to the user. Collaborative filtering along with tag and location correlation gives accurate point of interest recommendations.

KEYWORDS: collaborative filtering, location correlation, Personal Preference, Point of interest recommendation.

I. INTRODUCTION

Growing popularity of social media has led to extensive use of Location-based social networks (LBSNs) which are very popular today. Location based social networks like JiePang, Facebook Place, Gowalla allows users to update their whereabouts by providing check-in facility at a particular location. Users also upload their photos, post their comments about the location and tag their friends. The task of using this checked in information for recommending unexplored places to users like restaurants, sightseeing, activities etc., which is known by the name Point of Interest (POI) recommendation.

POI recommender system peculiar as compared to other recommender systems as it considers some additional aspects like frequency of check-in data at a particular location (which is usually sparse), social friend's interest, time of check in and location closeness of places w.r.t. to current location while recommending. POI recommender system helps the user visit new locations and make the travel experience better by recommending him places to visit as per his personal choice.

In major cases check-in information shared by the users on LBSNs is used for POI recommendation. Geo-tagged photos with information of location and weather condition, comments and time can be used by the applications for POI recommendation. Also when a user visits a new location, point of interest recommendation can be done based on local crowd preferences at that location. In the proposed system, collaborative filtering along with tag and location correlation is used for recommendation to effectively solve cold start problem.

Paper is organized as follows. Section II describes the related work. System architecture of the proposed system is explained in Section III. Section IV presents the System analysis and Section V presents the experimental results. Finally, Section VI presents conclusion.

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II. RELATED WORK

Zhiwen u et al. [1] proposes a system that uses collaborative filtering to recommend locations and route for visiting those locations. It provides multiple POI recommendation based on user's interest which changes with time. The data is divided into different time slots of the day and depending on the check in time at current location accordingly locations are recommended. Similar user preference and location popularity is calculated and accordingly POI recommendation is done and sequence of POIs is generated for travel planning.

H. Yin et al. [2] propose a system that uses Spatial temporal LDA model to recommend POIs at each region. Since user preferences are not same at all places i.e. they change depending on region visited, the proposed system recommends POIs accordingly. The proposed system uses local crowd preferences to recommend POIs when a user visits a new region. User check-in is used to study visitor's preference. Also an algorithm is developed to speed up the recommendation process. Daily activity done at different time is also considered.

Jihang Ye et al. [3] propose a system which uses check-in category to predict the category of user activity the user will do next. By using mixed hidden Markov model this prediction is done. Category level modelling reduces the huge prediction space which is result of millions of check in information. The system addresses the problem as two sub problems viz. predicting category of user activity at next step and predicting location depending on category distribution.

X.Lu et al. [4] propose a system which predicts sequence of travel routes as per user input. It uses geo-tagged photos uploaded by various people and aggregates them to recover possible travel routes. The system provides personalized trip planning using duration, visiting time and destination preference types. Mean Shift Clustering algorithm is used to discover popular locations. Then each destination is mapped to user preference for personalized planning. Internal path discovery algorithm and travel route plan algorithm are designed.

H.Yin et al. [5] proposes Probabilistic generative model which makes use of collaborative and content filtering. It uses user as well as local crowd preference for recommendation. Offline module is used to find co-occurrence patterns and Item contents. Online module takes user query to predict top recommendations for POIs but taking into consideration the interest of tourist and local crowd. The system uses threshold algorithm for speeding up online process.

Yonghong Yu et al. [6] surveys POIs recommendation in LBSN. The survey study finds that when user visits a location, they prefer to visit nearby locations as compared to distant ones. The user preferences as obtained from frequency of check-ins. Lots of Check-in information creates sparsity problem for POI recommendation. It shown by Ye, Yin in their study that social influence has limited contribution on user's check-in behavior. It identifies 4 categories of POIs viz. pure check-in, geographical influence enhanced POI, social influence enhanced POI and temporal influence enhanced POI. The survey concludes that although all kinds of information are used, still check-in data, geographical influence and temporal influence have significant impact on recommendation quality.

Yin et al. [7] proposes to use probabilistic model named TRM for prediction of POIs taking into consideration semantic, temporal and spatial patterns of user's check-in activities. The system recommends places to user when he is in his local home region as well when he is out of town to a new region. The proposed system can effectively solve sparsity and cold start problems .Semantic patterns minimizes the effect of data sparsity when analysing unknown place recommendation and temporal patterns are used in hometown recommendation. Its limitation is it assumes user's interest is stable across geographical regions.

Zhiwen Yu et al. [8] propose a system that recommends a travel package by making use of user choices. Depending on start location, time period and season recommendations will be affected. Two level hierarchical modelling is used to classify POIs. Popularity of POIs is calculated as heat of POI which is season and time dependent. User check-in data is

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mapped to spatial temporal trajectories to find frequent travel routes visited by the user. Thus using user location model spatial and temporal features are explored. The system also generates travel route sequence.

Qi Liu et al. [9] build a model system for recommendation by making use of topic analysis and user interest. Using the characteristics of existing travel packages, topic extraction is done considering the constraints like locations, seasons, landscape features and tourist which is used for recommendation. After analysing the patterns among tourist in each group, the model is modified. Through experiments it is proved that the proposed model identify the features of the travel data for proper recommendation of travel packages.

Chen Cheng et al. [10] propose to find successive personalized POI recommendation in LBSNs. Two prominent properties in the check-in sequence: personalized Markov chain and region localization are used for this purpose. Using modified matrix factorization method, the system analyses user moving in region. Probability of user visiting a location at a time is calculated using first order Markov chain. This system does not consider aspects like location category, activities that can be performed, preferences related to time period and social influence on recommendation.

Gregory Ference et al. [11] propose location recommendation system using collaborative filtering. It recommends places to user even when the user is new to a location by making use of user preferences, social friend's opinion or preference and geographical closeness to the current location. It uses the fact that similar users will like similar places. For local destinations similar user preferences are considered and social influence is considered for out of town user while recommending them places.

Bo Hu et al. [12] propose a system model that considers the impact of both social interaction and user check-ins. It studies the social recommender systems. Based on friend's interests and their check-in behavior, location recommendation is made. The system does not consider influence of POI rating or ranking on recommendation. Future work can include transportation and other competitive POIs into consideration.

Yan-Ying Chen et al. [13] propose a personalised travel recommender system by making use Bayesian learning model on people attributes extracted from geotagged photos. Using geo-tagged photos uploaded, different attributes are extracted like user age, gender, cultural background, profession and the type of people user is travelling with like family, friends, couple etc. People attributes and travel group types are detected by annotating pre-processed facial images.

J.Sang et al. [14] propose a probabilistic approach where series of recommendations are made in context with user's current location, time and user's check in history. The recommendation of POIs is done on basis of ranking. User and context collaborative approach is used as there exist correlation between contexts as well as users. Future improvement would be to consider other factors such as price, comments, social influence and more context information like weather etc. while recommending.

III. SYSTEM ARCHITECTURE

We propose a recommender system for recommending point of interest of various locations to user based on his personal preferences and friend's preferences. It has following steps: finding frequent locations, finding user preference, finding similar user interest, sequence of route generation and POI recommendation using tag correlation.

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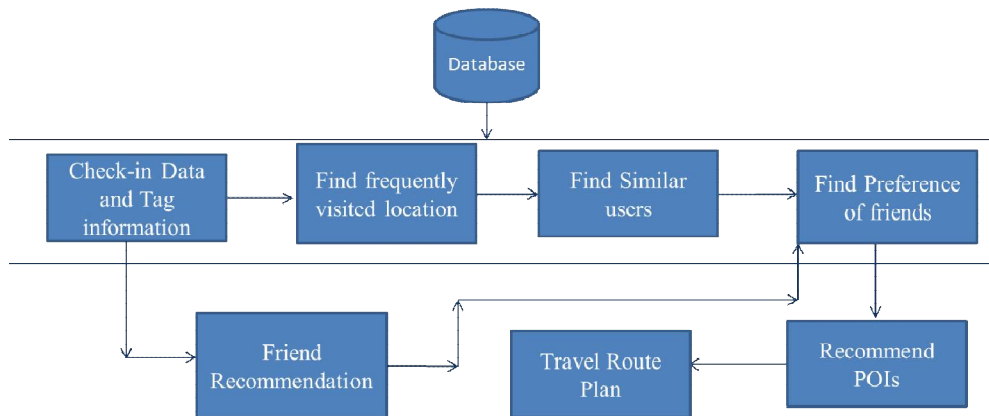


Fig 1. System Architecture

As per system architecture, user registers to the web application and login. User can check-in at current location and upload his visiting location details and photo. Based on use current location and user preferences, the system recommends POIs to the user . While recommending POIs friend’s preferences are also considered. If user wants to plan one day trip, the system will generate a route i.e. a sequence in which the POIs can be visited.

A. Finding Similar Users

People who have similar interest , tend to influence our decision . This fact is used to find other users preferences using collaborative filtering approach.

Cosine similarity ,Pearson Correlation etc. can be used to find the similarity between users. For this purpose a similarity weight W to find similarity between user u and user v is used which can be calculated as follows:

$$W_{u,v} = \frac{\sum_{C_{u,l} = C_{v,l}} C_{2u,l} \sqrt{C_{2v,l}}}{\sum_{C_{u,l} = C_{v,l}} C_{2u,l}}$$

This similarity weight is used to find User Preference P of the user for a given location l as follows:

$$P_{u,l} = \frac{\sum_{C_{u,l}} W_{u,v} \sum_{W_{u,v}}}{\sum_{C_{u,l}} W_{u,v}}$$

Where U - denotes set of users .

L - denotes set of locations.

$C_{u,l}$ - represents check in activity of user u at location l

$C_{u,l} = 1$ indicates user u has visited location l

$C_{u,l}$ will have value 0 if no check-in at location l .

$P_{u,l}$ - User’s Preference indicated by values between 0 and 1.It tells the rank of location l which would be visited by user u .

B. Finding Frequent Locations

Using apriori algorithm, we find the location most frequently visited by users. Apriori uses location dataset and count candidate locations sets proficiently.

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C. Travel Route Plan

To generate the travel route for user, travel route planning algorithm is used. The algorithm sorts the recommended POIs in the order of their proximity from the current location .

D. POI Recommendation Using Tag and Location Correlation

Using tags, we find the relation between user and friends and use this information to recommend places. We first find the tag features of current user and his friends. Then we match these features with the tags of other users whose check in fall within the current location and use this information to recommend POIs to the user as per his current location.

E. Friend Recommendation Using Tags

Using tags as feature, we find which users are similar to others. We find the tag relation between users to recommend friends. The more similar the important tag set, the closer the two users should be. After ranking the tag similarity of the new user and already existing members in network, we choose the most similar members as possible friends to recommend to the new user.

IV. SYSTEM ANALYSIS

A. Algorithms

1. Algo:- POI Recommendation

Input: Tags, Contactlist ,userid

Output: Recommended POIs list

Step 1: Select tag features of current user
and his friends.

Step 2: Get contact list

Step 3: For each contact of Contactlist

Find tag network w.r.t. current location

For each feature obtained from tag network

Check for which ids the tag features match the tags of current user and tagged list

Add places accordingly to the POI list

Step 4: Display the recommended POI list.

B. Performance measures used

To analyse the system performance, Precision is used as the measure which is found out as follows:-

$$\text{Precision} = \frac{\{\text{number of POIs recommended and relevant}\}}{\{\text{number of POIs recommended}\}}$$

V. EXPERIMENTAL RESULTS

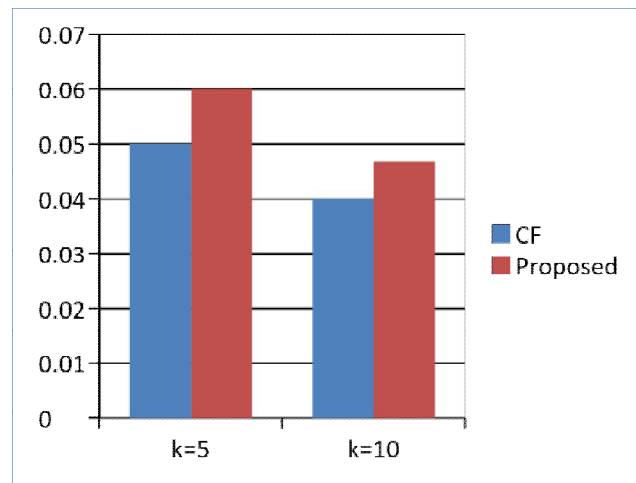
Experimental results show that hybrid approach along with Tag and Location correlation provides better recommendations of the POIs. Better precision is achieved when proposed approach is used. Below is the graph which compares collaborative filtering and proposed technique for precision values for different k values. Proposed system gives more precision than collaborative filtering method.

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VI. CONCLUSION

The proposed system provides personalized Point of Interest recommendation based on user preferences and friend's preferences. Whenever user visits new location, recommendation is made on other users' as well as friend's preferences for that region. The proposed system also generates a travel route plan for the user. Using collaborative filtering with tag correlation more accurate point of interest recommendations can be made to the user.

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