Context Aware Decision Support Mobile Application for Recommendation in The Domain of Hotels

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Abstract— In any application, the recommender system plays a main role. These systems assist the users to make a proper decision on the basis of the recommendations provided by the application. Recommender systems provide the personalized recommendations based on the users interest and preferences. Users have to search number of pages on internet to find appropriate information on any particular topic. It is difficult to process such a big data and also very time consuming. There are many recommendation algorithms currently used by many applications, e-commerce websites like collaborative filtering, knowledge based filtering, etc. Here we have proposed a recommender system which uses Context aware graph based recommendation algorithm to provide relevant, personalized recommendations which overcome the drawbacks of both the techniques, thereby increasing accuracy. Context-aware recommender systems adapt the contextual situations of the user and generate more effective recommendation. A graph based approach is proposed to assist the decision support to users and accept contextual information like day time, location, day type, company involved, etc. and process it in an advantageous manner. Here, we have described the application of such system within the domain of hotels.

Key words: Context Aware Graph Based Recommender, Collaborative Filtering, Data Mining, Knowledge Based Filtering, Context Awareness

I. INTRODUCTION

Context Aware graph based recommending technique is introduced to overcome the problems of existing recommender systems. This filtering technique generate more relevant and effective recommendations by adapting the context like time, location of the user and have become one of the most effective in recommender systems. To assist use of context aware recommendations and its development CGR i.e. Context Aware Graph Based measure is proposed which incorporate contextual information in an effective and advantageous way. This approach provides potential similarity between items and target user to provide the further recommendations of items. The challenging part of this algorithm is to use the contextual information to provide intelligent and useful recommender systems. This approach is much superior to the traditional filtering methods like collaborative and knowledge based approaches

II. RELATED WORK

In the rapid expansion of the internet which have increased the necessity of filtering the huge amount of data which is available to users. Because of this it is required to build the recommendation systems. These systems will provide users recommendations which are relevant to their interests and the past preferences which will help users to go through large amount of information and ignore the irrelevant data. There exist several approaches to create personalized recommendation to users. There are two most common filtering algorithm used nowadays. Collaborative filtering and knowledge based filtering. These both approaches make predication based on knowledge base of the product domain and users interest.

Existing Recommender systems:

A. Collaborative Filtering:

This filtering technique is one of the oldest technique. This method mines the data by recognizing the pattern among user's ratings, similarity, data sources, viewpoints, etc. It identifies the users or items which are more similar to the target user and then use the ratings of those similar users to generate recommendations to this target user.

There are various advantages as well as disadvantages. Prediction quality of this filtering technique improves as their database of users preferences increases day by day.

The main problem in this technique is when new items gets added to the system. Before they should be recommended these items are required to be given ratings by the users. Then users having the similar taste these items are recommended.

As this algorithm makes recommendation based on users past preference it gives problem when users interest changes.

B. Knowledge Based Filtering:

This filtering technique is based on knowledge of the items. It makes recommendation based on users past preferences and behavioral patterns. The user first is asked to give his favorites or mostly used items. Based on the user's behavioral data, on his input items matched are provided as recommendation. It is represented in the form of tree data structure where nodes which are old are already present data and the ones which are leaves are the recent recommendations. This technique is very sensitive to users preference and does not require and previous knowledge of new user. It just needed to understand the domain of items very well. In this data does not change and can be used again when considering users choices.

By comparing these both existing techniques many problems were observed like recommendations are static, quality of recommendations is mostly dependent on huge dataset based on user history. The data may subject to anomalies like statistical data, and most of the recommendations are insensitive to user preference.

III. CONTEXT AWARE GRAPH BASED MODELLING

Context Aware Graph Based Modeling: CARS predict user's preferences and tastes by adapting contextual information in recommending items. These preferences are generally shown in the form of ratings and are modeled as a part of not only

users and items but also of context. Recommender process is defines formerly by R U * I * C. where R: Ratings U: User I: Items C: Context. Highest rated items are recommended to the user which is calculated by the function R. Context factors included can be anything related to user which can be accepted by user's mobile device like location, day type, day time, companions involved at that particular time. The recommendation problem is examined as a searching problem to find appropriate items based on the give context.

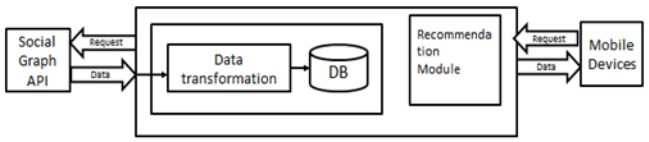

Fig. 1: A Context-aware and Social Graph based Hotel Recommender System

As Context Factors often change, over various ratings we separate the contextual information with the static information like users and hotels. Example, U x I represents that users have accessed hotels, U x A connects users with their attributes, U x C shows users activities and their contextual condition. We can represent it in adjacent matrix M

Users	Hotels	Contexts		Attributes
Users	UU	UI	UC	UA
Hotels	II	0	IC	IA
Contexts	UC	IC	0	0
Attributes	UA	IA	0	0

Table1 1: Adjacent matrix showing relationship between different nodes in CGR

Nodes in the graph are searched randomly from node i in G, the neighborhood node j having the probability proportional to the weight of the edge Sij. We can obtain the steady probability by using the following equation.

$$P(n)=d*S*P(n-1)+(1-d)*e \quad (1)$$

Where S:Row normalized transitivity matrix, vector 'e' is personalized vector which represent the interest of a particular user in that item. The relationship from the source node i with the target node j and the weight of the relationship 'L', the transitivity matrix is

$$S_{ij}= \{W(L)(I,j,L)/\sum_k(i,k,L)\} \text{ if } w(i,j,K)>0, \quad (2)$$
$$0 \quad \text{otherwise}$$

Weight is calculated using two contexts first is instead of checking ratings online user might wanted to ask his/her friends and secondly weights are assigned by considering the factor like how many times user have selected that particular item. For recommendation to find the likelihood of new items i in I to be accessed by u in U, by biasing two personalized vectors the two probabilities are combined.

P(i|u) = P1(i) + P2(i) where P1(i) and p2(i) are the ranking values of i with respect to e. **P1** represents current user's (u) neighborhood interest in items whereas **P2** represents the items which are similar to the set I_u.

Relevance of Context aware graph based approach can be found by the following algorithm.

Input: U: User, I: Items, A: Attribute, C: Context, d: day type, Empty Graph G :{ V :Vertex, E :Edges} ;
Output: The vector of G;

1) Add all the elements in U, A, I and C as graph nodes to G.
2) Assign unique indexes for each node.
3) Add edges to G and assign a type label T for each edge.
4) For all i in V do
   For all j in V do
   If(There exists and edge from to i to j) then
   Get the edge type T and weight w (L);
   Sij = w(L) w(i,j,T)/for all k: sum(w(i,k,T);
   Else
   Sij = 0;
   For all j in V do
   Sij = Sij/ for all k $\sum(S_{ik})$;
5) for all j in V do
   If(j==index(u) then Ej' = 1;
   Else Ej' = 0;
6) Compute P1(n) = d*s*P1(n-1) + (1-d)e';
7) For all j in V do
   If(j in Iu) then Ej'' = 1/|Iu|;
   Else Ej'' = 0;
8) Compute P1(n) = d*s*P2(n-1) + (1-d)e'';
9) Return (P1+P2)/2;

IV. ARCHITECTURE

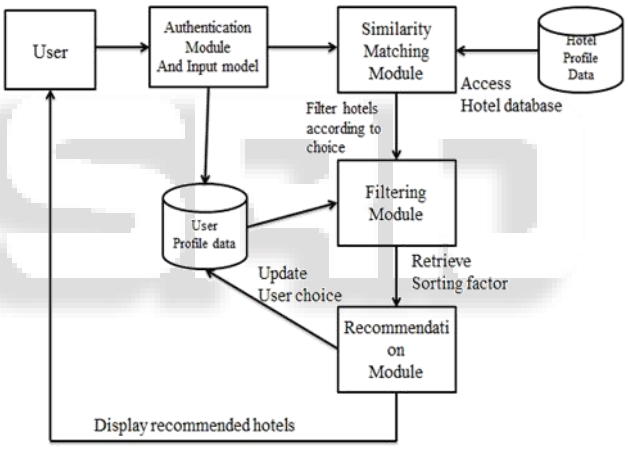

Fig. 2: Architecture Overview

In architecture diagram user is authenticated first and then user's choice of Hotels is accepted according to his preference. User's context is accepted using the mobile device of the user with the help of GPS. User's context consists user's location and the time. The accepted choice is passed to the similarity matching module where hotels database is compared with the users choice .In this module first criteria search is performed and then on selected hotels collaborative filtering is used to get hotel that are booked by similar user based on user age group and user type such as single or with family. With the help of similarity factor generated above similarities between two hotels is found from hotels, context and their attributes. Also similarity between users is found with the help of the past choice of hotels. Context based graph formation takes place at this step. Then the output is transferred to the filtering module. In filtering Module the users past preferences is compared and by using the filtering algorithm above on the graph formed in the before step a list of hotels is recommended .In this module hotel similar to hotel booked by user in history are consider for recommendation. Here hotels with same rating that user

booked previously are filtered .In recommendation module the sorting factor for current choice is retrieved and the hotels are displayed accordingly.

V. CONCLUSION

We proposed a graph based approach is proposed to assist user by accepting the contextual information like day time, location, day type, company involved, etc and process it in an advantageous manner using item based collaborative filtering as well as user based collaborative filtering for the recommendation of hotels. Using this approach most relevant hotels are recommended than traditional approaches such as collaborative filtering and knowledge based filtering. Also, performance of system can be improved by taking more contextual factor and using large database.

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