PERSONALIZED TRAVEL RECOMMENDATION SYSTEM FOR TOUR PLANNING

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Abstract:In this paper we presented a personalized travel sequence recommendation system that uses travelogues data, community contributed data which includes images, heterogeneous metadata (e.g. Tags, geo-location, and date taken) associated with those images to recommend users the Point of Interest (POIs) to visit. We had constructed a Topical package space by collecting travelogues, community Contributed data. The system will analyze this synthetic data set to get the maximum Point of Interest between sources to destination of user travel route within specified distance. Unlike most existing travel recommendation approaches, our approach is not only personalized to users travel interest but also able to recommend a travel sequence rather than individual Points of Interest (POIs).Travelogues data is the data collected from travel sites (e.g. www.hellotravel.com) that offer rich depictions about historic points and voyaging background composed by clients. Moreover, group contributed data with metadata (e.g., photos, POIs, date taken, tags and so on.) collected from social mediasites record client's day by day life and travel understanding. But can this information from various travelogue sites and group contributed sites used to recommend user a well-planned travel sequence such that maximum POIs other than individual POIs would be covered the current system would fail here. Hence the proposed system provides personalized travel sequence recommendation to users by analyzing his or her Topical interests and recommends POIs the user should visit. We used Naïve Bayes algorithm to obtained suitable packages that user fits in also to we used Content Based Collaborative Filtering for recommendation of POIs the user should visit. To obtain results such that maximum Point Of Interest would be covered we used Greedy algorithm so that we can get optimized results with maximum POIs.

Keyword -Travel Recommendation, Topical Package Space, Point Of Interests (POIs), Naïve Bayes, Content Based Collaborative Filtering,Greedy Algorithm.

I. INTRODUCTION

Presently automatic travel suggestion is a vital issue in both research and industrial area. Considering a real life scenario when a Person plans a travel tour he or she has their Individual Point of Interest bonded within certain boundaries. In this case the person can miss some Point of Interest (POIs) other than Individual POIs between their routes i.e. between sources to destinations. Online social networking sites like Facebook, Flicker, Twitter and so forth offers incredible chances to address many testing issues, for example, GPS estimation and travel suggestion. Many travelogue sites (e.g., https://www.hellotravel.com) offer rich depictions about historic points and voyaging background composed by clients. Moreover, group contributed photographs with Meta data (e.g., Images, Tags, date taken, scope and so on.) collected from social media record client's day by day life and travel experoences of users [1].

If we consider the current system and compare it with our system we would understand that the tourism sites are based on Package that the company offers to the clients which includes fixed tourist spots and fixed POIs. In such case the user may miss other interesting places that reside in between the source city and the destination city. Thus there was need of system that would analyze the data from Travelogues and data contributed from Social the Sites to suggest other POIs to User rather than his individual POIs. This helps users to plan his travel tour sequence such that maximum possible Point Of interests are visited that the user might be interested.

In order to developed such system there was need of dataset i.e. data from Travelogues and Community Contributed Photos that includes (Longitudes, Latitudes, Season, Cost, Tags, POIs, Date Taken, Visiting time etc.). Thus to implement this system we should be build our own Tropical Package Space which constitute of some famous places in India. The Tropical Package space is combination of data from Travelogues and Community contributed data. Thus their felt need of developing system that would help the user to plan his travel tours such that all the POIs that User might be interest gets visited.

II. REVIEW OF LITERATURE

Shuhui Jiang, XuemingQian, presented a personalized travel sequence recommendation from both travelogues and community contributed photos and the heterogeneous metadata (e.g., tags, geo-location, and date taken) associated with these photos. Unlike most existing travel recommendation approaches, the approach is not only personalized to users travel interest but also able to recommend a travel sequence rather than individual Points of Interest (POIs). To recommend personalized POI sequence, first, they have ranked route according to the similarity between user package and route package and then displayed the optimized travel sequence such that it cover maximum POIs of user are covered [1].

S. Jiang, X. Qian, J.Shen, Y. Fu, and T. Mei, they proposed an Author topic model based collaborative filtering (ATCF) method for personalized travel recommendations. Using author topic model users topic preference can be mined from the textual descriptions attached with users photos. Through author-topic model, travel topics, and a user's topic preference can be elicited simultaneously. In this recommendation system, POIs are ranked according to similar users, who share similar travel topic preferences. This method overcomes the problem in location-based collaborative filtering, without GPS records, in author topic model based collaborative filtering method mine similar users accurately according to the similarity of users topic preferences [2].

ShiniRenjith, Anjali C, they elaborated a collaborative travel recommender that describes the architecture of a personalized mobile travel predictor by performing content-based filtering and inductive learning techniques depending on travel foot prints. Also explained about how Content-based filtering can be applied in identifying user interests based on the past transactions of the individual. This can help in formulating a user interest profile by analyzing the attractions/sites that the user has already visited. This model can help predicting user behavior that is highly consistent with his/her interests. Content-based filtering also referred to as cognitive filtering, helps in predicting future travel intentions based on a comparison between the attributes of an attraction and the user profile. Each attraction is represented as a set of attributes like the type of attractiveness of the place - beach, theatre, park, shopping mall, etc. The user profile is formulated with the same attributes and populated by analyzing the attributes of the places/attraction, visited by the user [3].

J. Sang, T. Mei, J.-T. Sun, C. Xu, and S. Li, they explained the potential of location based service to overcome with an advanced recommendation problem activity plan, which is to suggest a package of sequential activities related to user context and interest. This type of recommendation system of point of interest is a probabilistic approach in which recommended POIs are relevant to user context i.e. current location, time, and check-in and personalized check-in history of the user. This approach of recommendation is highly motivated from a large-scale commercial mobile check-in data analysis, to rank a list of sequential POI categories and different POIs. The approach enables users to plan continuous activities going from one place to another [4].

Subramaniyaswamy and Vijayakumar, it described the methods used to mine demographic information and provide travel recommendation to users. This paper also describes an algorithm ad boost to classify data and Bayesian Learning model for predicting desired location to a user based on users preferences [5].

III. SYSTEM ARCHITECTURE

The system we proposed is a personalized POI sequence recommendation system which could automatically mine users travel attributes such as topical interest, Cost and preferred time and season. Travelogue websites (e.g. https://www.hellotravel.com) offer rich descriptions about landmarks and traveling experience written by user but can we use these data to recommend travel sequence for another User. A question arises that can we use this data of users who have already visited a certain places/spots to recommend another user to visit the place or not, further we also have community-contributed data with metadata (e.g. tags, photos, latitude, longitude, Date, Cost, Season) on social media which gives user daily life and travel experience. Unlike traditional Travel recommendation system, the presented approach will not only recommend the User Personal Travel sequence but also will recommend a travel sequence rather than his/her Point Of Interest (POIs). The following Fig. 1 gives architectural Overview of the system.

The topical package space is collection of data from travelogue and community contributed sites which we assumed to be collected from travelogues websites and social media sites. Thus we can take advantage of these two kinds of data sources i.e. travelogue and community contributed photos for dataset creation. We map both users and routes textual descriptions to the topical package space to get user topical package model and route topical package model (i.e., topical interest, cost, time and season)[1]. For recommending personalized POI sequence firstly the famous routes are ranked according to the similarity between user package and route package. Then top ranked routes will be further optimized by social similar users travel records [1]. Thus the proposed system makes efficient use of the data collected to provide personalized travel sequence to the user in such a way that it contains maximum POIs that the user might be interested other than his/her individual POI. The system focuses on providing a personalized travel to user by analyzing users POIs, Cost, Season, Tags etc.

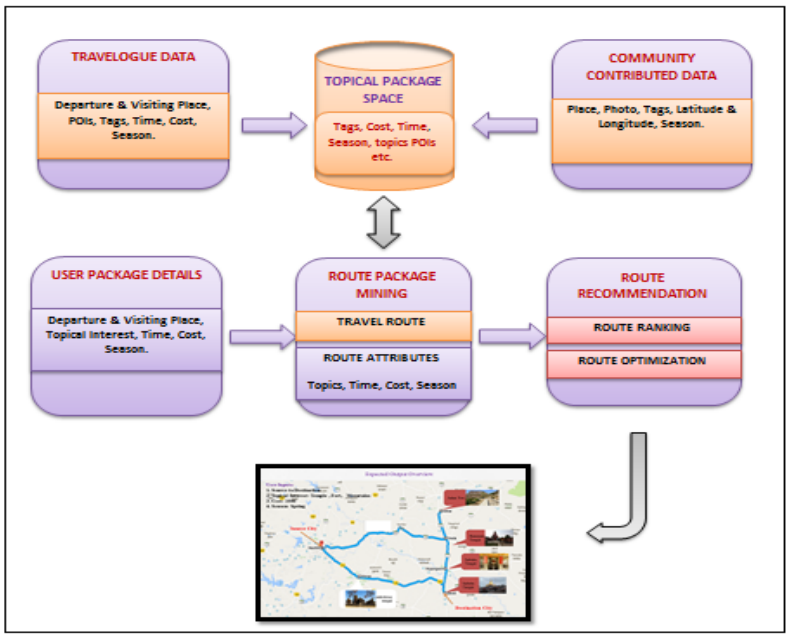

Fig.1. System Architecture

IV. MODULAR STRUCTURE

A. Topical Package Space

It includes construction of the synthetic topical package space in other words training datasetby the combination of two social media: travelogues and community-contribute Data.

Travelogue Data: Travelogue data is the data collected from different traveling and Tourism sites. Following are the attributes associated with Travelogue Data.

1. **Departure Place:** It is the Source Place or City of the Person.
2. **Visiting City:** It is the Destination City of the Person.
3. **Topics:** Topics are the areas which person visited for e.g. Zoos, Forts, Temples, Hills, Rivers, Lakes, and Museums etc.
4. **Multiple POIs**: It can be particular place or Spot for e.g. Sai Baba Temple, Juhu Beach etc.
5. **Tags:** It is the label attached to place for the purpose of identification other information for e.g. Tag can be Temple, Beaches etc.
6. **Visiting Time:** It give best time the place can be visited.
7. **Cost:** It contains Budget required for the tour.
8. **Season:** It gives best season in which the place can be visited.

Community Contributed Data: Community Contributed Data is the data from social networking site that describe user behavior, and provide more description about the location. Following are the attributes associated with Travelogue Data.

1. **User id:** It is identity of user from Social Networking sites.
2. **Place or City:** It is the Place or City the User visited
3. **Photos:** It the Picture of the place which Community user visited.
4. **Tags:** It is the label attached to place for the purpose of identification other information for e.g. Tag can be Temple, Beaches etc.
5. **Latitude and Longitude:** It provides location of the place or city.
6. **Season:** It is the season when the community user visited the place.

B. User Package Details

It deals with user tour detail input for extraction of user package, which contains user topical interest distribution, user consumption capability Distribution, preferred travel time distribution and preferred travel season distribution. Following are the attributes associated with User Topical Package.

1. **Departure Place:** Source city of User.
2. **Visiting City:** Destination city of User.
3. **Topics Interest:** It includes Topics which user is interested to visit e.g Temples, Forts, Hill Stations, Zoo, beaches etc.
4. **Time:** Preferred Time in which user wants to visit.
5. **Cost:** It is the Budget of User.
6. **Season:** The Season in User want visit place e.g. Spring, Summer, Winter etc.

C. Route Package Mining

Here the system performs travel route package mining to get route topical package as per user package details.In Route Mining and Route Package Mining Here we mine POIs packages from community data including topical interest, Cost distribution, Time distribution and season distribution based on route package obtained.

D. Travel Recommendation

1.Routes ranking

Assume R = (r1 r2…. rn) is a set of n travel routes mined. We rank these routes according to the similarity between user package and routes packages. For user (uj) and route (ri), we measure the similarity of each attribute among topical interest (TI), cost (C), Time (T) and Season (S) respectively. We rank route on basis of number of user visited the POIs i.e. more are user visited a particular POI higher is priority of that place.The ranked set of routes is denoted as R. If the route meets user's interest, the score will be high, and it would be ranked at the top of the routes[1].

2. Route optimization

After performing POI and route package mining, we get a set of POIs and set of User Packages that matches user package details. Than we perform optimization operation on set of POIs and Travel packages obtained and display them on Google maps.

V. SYSTEM ANALYSIS

A. Algorithms

1. Naive Bayes Algorithm: Naive Bayes is a classification algorithms based on Bayes Theorem. We used this algorithm to get desired travel packages that matches user input details. Itis a family of algorithms that all share a common principle, that every feature being classified is independent of the value of any other feature. It gives us a method to calculate the conditional probability, i.e., the probability of an event based on previous knowledge or information available on the events. More formally, Bayes' Theorem is stated as the following equation:

$$P(AB) = P(B|A) * P(A) / P(B)$$

Where,
P (A|B): Probability (conditional probability) of occurrence of event A given the event B is true.
P (A) and P (B): Probabilities of the occurrence of event A and B respectively.
P (B|A): Probability of the occurrence of event B given the event A is true.

Implementation Steps for Algorithm:

1. **Input**: S (Synthetic data Set.)
2. F: Convert the data set into a frequency table
3. T: Total Size of Dataset.
4. P: Calculate Prior Probability P (a) = F (a) =T (a attribute name) () // Tag, City, Season, Cost.
5. Probability of Evidence E (e) = F (e) = T (e Evidence name) // Tag, City, Season, Cost.
6. L: Probability of Likelihood L (P (a)) = F (e) ==T (e)
7. While (size (F) = = 0)1
8. R = higher (L (P (a))
9. if R > R1 then update R
10. End while
11. End.

2.Greedy Algorithm: A greedy algorithm is a simple and easy to understand algorithm that is used in optimization problems. We used greedy algorithm to get set of maximum POIs obtained from community data. The algorithm makes the optimal choice at each step as it attempts to find the overall optimal way to solve the entire problem. Greedy algorithms take all of the data in a particular problem, and then set a rule for which elements to add to the solution at each step of the algorithm.

Implementation Steps for Algorithm:

1. Start
2. Select max Count of Solution
3. If check given solution is equal to input then get final result and go to step 6.
4. Then check other max count of solution but is less than previous max count solution and go to step 2
5. Then check given solution is equal to input then get final results go to step 6.
6. Stop.

3. Content Based Collaborative Filtering: Content-based filtering also referred to as cognitive filtering, helps in recommendation of travel intentions based on a comparison between the attributes of an the user profile like Season, Tags, Cost etc. Each profile is represented as a set of attributes like the type of attractiveness of the place, Tags, Seasons, Cost, etc. The user profile is formulated with the same attributes and populated by analyzing the attributes of the places/attraction, visited by the user. Following steps shows how content based collaborative filtering can be applied to given system.

Implementation Steps for Algorithm:

1. Input: User Tour Profile //Seasons, Tags, Cost
2. If sim (Tour Category, Tour Profile)
3. While EOR till End of Records
4. W=TF Weight (Tour Category) //Weight
5. If W > Threshold then
6. Tour Profile (Y Recommended)
   Else
8. Tour Profile (N Recommended)
9. STOP

VI. MATHEMATICAL MODEL

This section includes the analysis of input, process and output of the project. Mathematical modeling is represented in terms of Set Theory as follows:

S = {I, P, R, O}..... (1)
Where,
S = System.
I = Set of Inputs.
P = Set of Process.
R = Set of Rules.
O = Set of Outputs.

1. Set of Inputs (I)
I = {I1, I2, I3, I4}..... (2)
Where,
I1 = Input for User Registration details.
I2 = Input for User Login Details.
I3 = Input form Admin (Travelogue and Community)
I4 = User Package Details.

2. Set of Processes (P)
P = {P0, P1, P2, P3, P4, P5, P6, P7}..... (3)
Where,
P1 = User Registration Process.
P2 = User Login Process.
P3 = Accept Travelogue Data.
P4 = Accept Community Contributed Data.
P5 = POI Mining.
P6 = Route Package Mining Process.
P7 = Route Optimization Process.

3) Set of Output (O)
O = {O1}..... (4)
Where,
O1 = Display User Package.

Venn diagram: After processing of all the inputs, outputs are generated. These outputs are generated with the help of process sets. The following Venn diagram shows relationships between the input set, process set and output set.

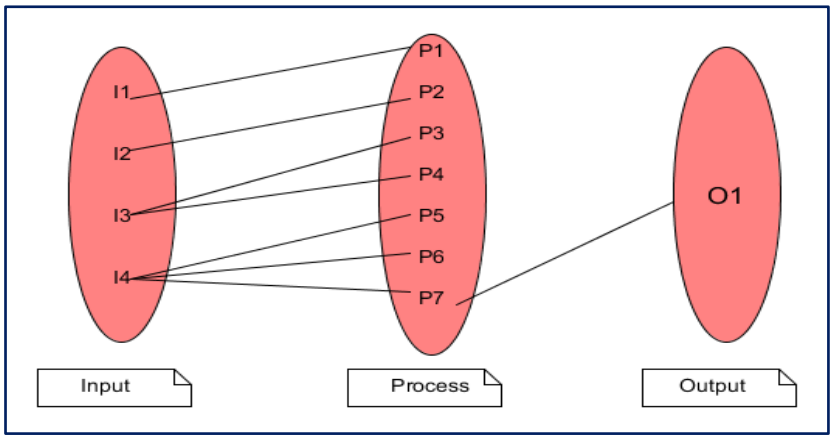

Fig.2. Venn diagram

VII. IMPLEMENTAION DETAILS

A. Software Requirements

1. Operating System: Windows 7/8/10, Ubuntu 16.04.
2. Coding Language: PHP
3. Database and Webserver: MySQL 5.0 and XAMPP 7.0.27
4. IDE: Netbeans 8.2, Notepad++.

B. Hardware Requirements

1. RAM: Minimum 2 GB
2. Storage: 30 GB Minimum.

C. Dataset

1. Travelogue Dataset

We designed a customized synthetic dataset which is combination of travelogue data and the community contributed data. For travelogue data we framed travel details of some famous tourist locations in given region. The travel details include Departure place and Visiting City and other package details like Point of Interest (POIs), Cost, Season and Tags. The TABLE-I gives an abstract overview of travelogue data used. Currently we are have approximately 80 operational travelogue data out of which few travel packages are mentioned in **TABLE -I** and will be increasing to maximum number possible in future.

TABLE - I
Travelogue Dataset

Sr. No	Departure City – Visiting City	Packages	POIs
1	Ahmedabad -- Ratnagiri	4	16
2	Ahmedabad -- Matheran	2	8
3	Pune -- Mumbai	3	12
4	Mumbai -- Shridi	4	16
5	Nashik -- Matheran	4	16
6	Ahmednagar -- Panchgani	3	12
7	Pune -- Ratnagiri	2	8
8	Nashik -- Mumbai	3	12
	Total	**25**	**100**

2. Community Contributed Dataset

As part of community contributed dataset we constructed data of social media users which includes photos of certain places which the user visited along with Tags, Season and Geo-Locations associated with the places. The **TABLE-II** gives an abstract overview of community data. Currently we are having approximately 180 operational community user data and count would be further increased further. Collectively the combination of travelogue data and community contributed data is termed as Topical Package Space. The above datasets views shown in TABLE-I and TABLE-II describes only some part of our dataset constructed.

TABLE - II
Community Contributed Dataset

Sr. No	City	Visited Users	Photos and POIs	Geo-Locations
1	Pune	6	6	6
2	Mumbai	10	10	10
3	Ratnagiri	8	8	8
4	Panchgani	10	10	10
5	Matheran	12	12	12
6	Aurangabad	6	6	6
7	Ahmedabad	9	9	9
8	Lonavala	13	13	13
9	Bhimashankar	6	6	6
10	Igatpuri	4	4	4

VIII. EXPERIMENTAL SETUP

The system has been implemented using Netbeans IDE v8.0.2 64 bit version, XAMMP v3.2.2 as cross platform web server which includes MySQL, Apache Tomcat setup on Windows 8 64 bit as Operating System. Entire system was setup on local host for purpose of performance evaluations. The performance of system is evaluated on Synthetic Topical Dataset which constitutes of Travelogue Data and Community Contributed data. Travelogue dataset which includes approximately 80 packages for different source and destination cities with different POIs, Tags, Season, Cost and Visiting time. Community Contributed dataset include approximately 180 records of social media users. Each user in Community Contributed data has multiple POIs of places visited, exact Latitude, Longitude, Tags of each place including images and Season in which user visited the place.

IX. PERFORMANCE EVALUTION

For evaluating the travel route we will be considering four aspect namely user satisfaction of POIs, representativeness, diversity and rationality. Also during the evaluations the users or the volunteers must also check whether the results meet their topics or not. We be using he average precision (AP) and weighted average precision (WAP) as the performance metrics given as follows,

$$AP = (p + r) = (p + r + i) \quad \text{..... (1)}$$

$$WAP = (p + 0.5 * r) = (p + r + i) \quad \text{..... (2)}$$

Where,
1. p = Number of recommended routes that volunteers are satisfied with.
2. r = Number of recommended routes which are relatively related to users preference but need some improvement.
3. i= Routes that not relevant to users preference.

In our next phase of performance evaluation the system was handed over to 10 Volunteers in order to conducts human evaluation to determine whether the system satisfies their respective Topical Interests, POIs recommended, Diversity obtained in POIs and Representativeness. Search distance was kept fixed to get best possible results. Initially we determined the values of 'P' which gives number of routes which the volunteer was satisfied also determined values of 'q' and 'i' which represents relatively related routes and Irrelevant route obtained respectively. Thus we calculated corresponding values of AP and WAP for each Input entered by volunteers for our system. The **Table-III** shows the Input Packages which the volunteers entered and results obtained.

TABLE- III
Calculation of AP and WAP for Different Input Packages

Volunteer No.	Input Package	Distance(Km)	p	q	i	AP	WAP
1	Mumbai-Shridi	100	3	2	0	1	0.75
2	Ahmednagar-Panchgani	100	1	2	1	0.75	0.75
3	Ahmedabad-Ratnagiri	100	3	1	1	0.80	0.70
4	Mumbai-Pune	100	1	1	0	1	0.75
5	Nashik-Pune	100	2	1	1	0.75	0.62
6	Nashik-Panchgani	100	2	2	1	0.80	1
7	Pune- Ratnagiri	100	3	1	0	1	0.87
8	Shridi-Aurangabad	100	1	2	0	1	0.83
9	Ratnagiri-Pune	100	2	1	1	0.75	0.62
10	Ahmedabad-Matheran	100	3	1	1	0.80	0.70

We evaluated our personalized routes recommendation system with respect to other previous methods of route planning and POI miming. The **TABLE-IV** compares our system with Random Routes Planning (RAM), Famous routes planning (FAM), Ranked

famous routes planning (RFA), Optimized routes planning (OPT). We considered four aspects namely Representative, Diversity of POIs obtained and overall satisfaction of user.

- Random Route Planning (RAM): It constructs travel route by selecting any random 5 POIs.
- Famous Route Planning (FAM): It recommends famous routes but without ranking and optimizing them.
- Ranked famous routes planning (RFA): It recommends ranked travel routes but without optimizing them
- Optimized routes planning (OPT): It recommends travel routes by ranking and optimizing them.

X. RESULTS AND OBSERVATIONS

As shown in **TABLE-IV** and **Fig.3**, the performance of the system w.r.t RAM, FAM, RFA, and OPT (L). It was observed that the score of RAM was very poor as compared to FAM, RFA, OPT(L) and far worst as compared to OPT(N) of our system. Performance of random planning was found to be worst among all. Performance of FAM was also found to be at its lowest limit as it recommends routes without ranking and optimizing them, hence fails to meet user requirements.

TABLE –IV

Performance of Random, Famous, Ranked, Optimized Route Recommendation

Sr.No	Metrics	RAM	FAM	RFA	OPT (L)	OPT (N)
@TOP1	AP	0.48	0.62	0.68	0.80	1
	WAP	0.45	0.57	0.60	0.75	0.75
@TOP3	AP	0.48	0.60	0.64	0.76	0.80
	WAP	0.40	0.55	0.57	0.71	0.70
@TOP8	AP	0.40	0.55	0.61	0.71	1
	WAP	0.40	0.51	0.53	0.65	0.83

Performance of RFA was found to moderate as it recommends ranked routes but without optimizing them and hence also fails to stand on user requirements. However the OPT (L) recommends routes by both ranking and optimizing them but needed some improvements to get best recommendations for users. The OPT (N) obtained provides best performance scores as it provide distance based search and more fine filtering techniques along with ranking and optimizing the routes for users.

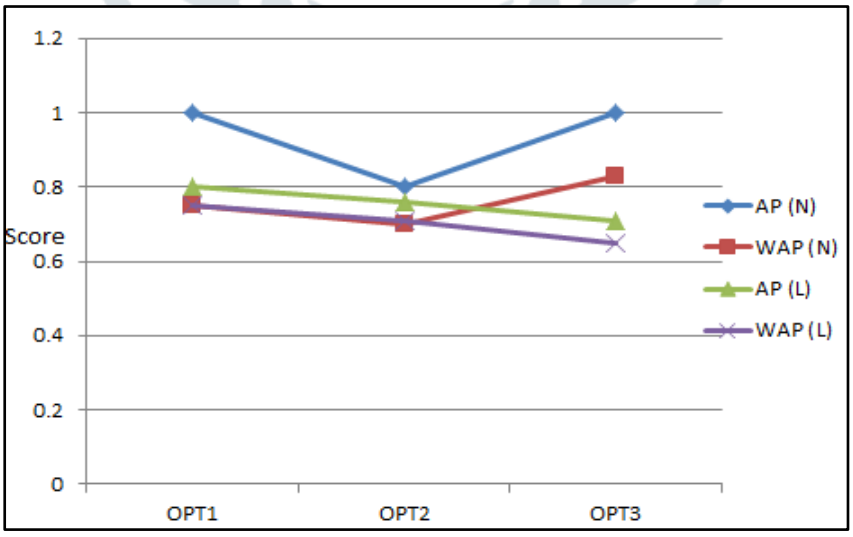

Fig.3. Graph for Obtained AP (N), WAP (N) Vs. AP (L), WAP (L)

XI. CONCLUSION AND FUTURE SCOPE

We have developed a personalized travel recommendation system that automatically mined user's travel interests which included Topical interest, Cost, Season and Time. In order to get more refined recommendations we have used algorithms namely Naive Bayes and Content Based collaborative Filtering at different stages of our system. We have also provided distance based search to get more relative Point of Interests which satisfies user inputs. The system efficiently analyzed the community user data to provide more relevant and accurate Point of Interests to travel user and covered maximum of his topical interest. Developed system thus enabled travel user to plan his travel routes in best possible ways such that his maximum POIs are covered.

In the future work, we can enhance over system in multiple directions. In future we would mainly focus on enlargement of over dataset to Transportation data and Accommodation data. Also would use new different combination of algorithms to get more precise results and improve performance and accuracy of our system to next level and make it context aware.

XII. ACKNOWLEDGMENT

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