Location based Personalized Recommendation systems for the Tourists in India

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Abstract

In the domain of tourism sector, this study examines the collaborative filtering in recommender system by categorizing users according to their choice of place, food, local item purchase etc. The proposed system will store the opinions of the local users about the sites, foods and products for purchase available in those sites. It uses collaborative filtering technique to find the similar users to a given querying user. The system recommends the best sites along with good foods and products available on those sites according to the recent data. Two hundred (Male = 110, Female = 90) married individuals from Bhubaneswar, Odisha (India) participated in this survey. Cosine similarity is used in the proposed system to find the similar users of a given input query user. The results revealed that collaborative filtering is the more reliable technique for personalized recommender systems. Experimental results show performance of the proposed system in terms of precision, recall and f-measure values.

Keywords: Collaborative filtering, Recommender systems, User profile generation.

1. Introduction

In the age of information overload, now a day's people go for a variety of choices to make a decision about what to buy from the market, where to visit for sparing time and even to find the person to date. A Recommender System (RS) is a personalization tool that provides users with a list of products that best fits their individual flavor. At present many traditional methods are available for recommending the items to the users like content based systems, collaborative based systems and knowledge based systems. RS delivers personalized recommendations in a way that is most appropriate and valuable to the user. Recommender systems are the subroutine class of information filtering systems which help to recommend a particular item to the user. Generally the search engines are used for information retrieval where as recommender systems are used for information filtering (Fenza, Fischetti, Furno & Loia, 2011). Information retrieval and information filtering are two major aspects of data mining techniques by which utilitarian information can be obtained from large dump of data present in the database. In huge databases, data mining plays an important role to process and extract knowledge from data for analysis by using different data mining methods and techniques. So data mining has a great capacity to extract useful information from data which are stored in information industries. So nowadays all applications like for watching movie, listing to music, reading books and purchasing products, etc. have their recommender system to recommend their products to the individual users.

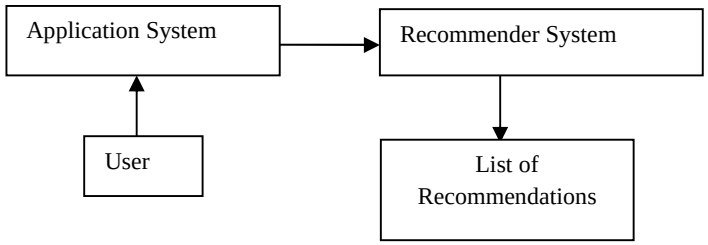

Figure 1: Basic Concepts of a Recommender System

Recommender system uses some data of the user from its click and other options and produces a list of recommendations to the user. RS produces a list of recommendations by using different approaches like collaborative recommendation approach, content-based recommendation approach and hybrid approach.

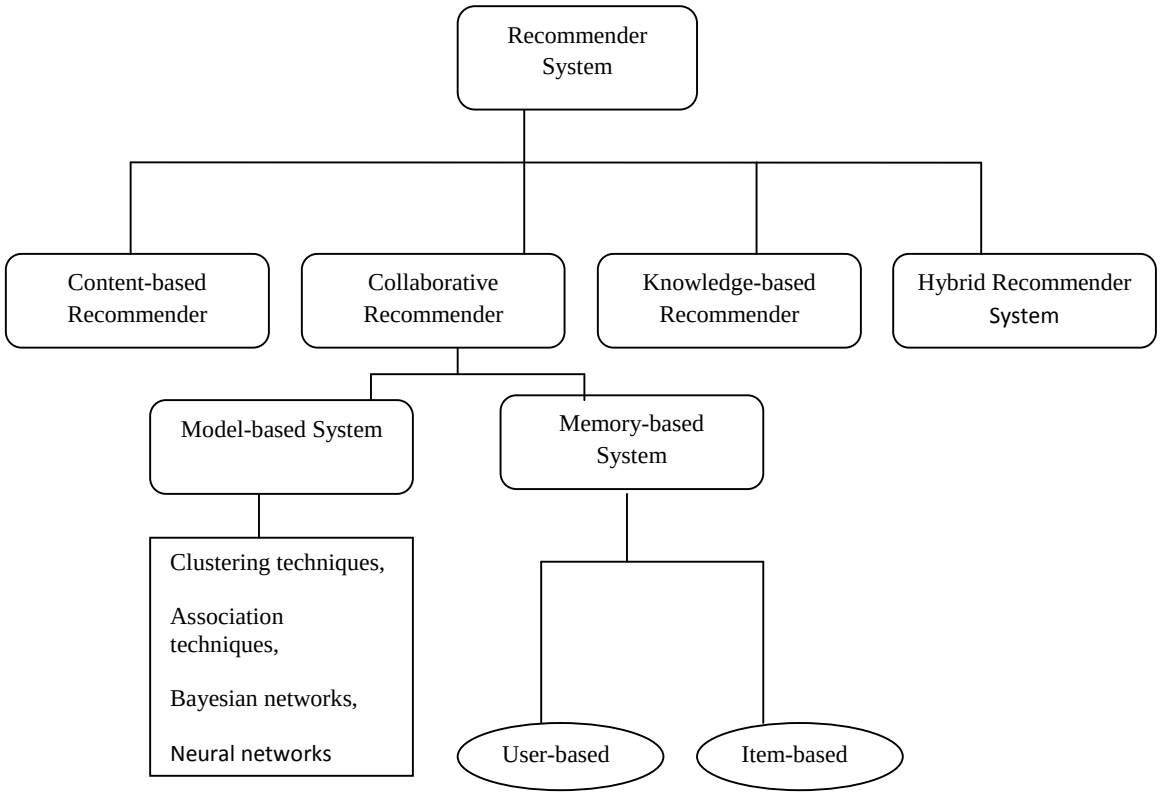

Figure 2: Types of Recommender System

1.1Collaborative Recommender System

Collaborative recommender system (CRS) is to utilize information about the past behavior or the opinions of an existing user community for predicting which items the current user of the system will most possibly liked or be interested in. These systems are in widespread industrial use today, in particular as a tool in online retail sites to customize the correct needs of a particular customer and to thereby promote additional products and to increase sales. Over the centuries, various algorithms and techniques have been proposed and successfully implemented on real-world and artificial test data. Collaborative recommender system inputs a matrix of given user-item ratings and typically produces the following types of output: First, a numerical prediction showing to what degree the present user will like or dislike a certain product and second, a list of n recommended products. It can be categorized to three types such as user-based nearest neighbor recommendation, item-based nearest neighbor recommendation and ratings. In item-based nearest neighbor recommendation concepts, cosine similarity measure and preprocessing data for item-based filtering methods are used. In this study, we have implemented cosine similarity measure to find the similar users.

1.1.1Pros and Cons of collaborative filtering techniques

Collaborative filtering performs effectively in the domains where there is not much content related with items and where it is difficult for a computer system to analyze content (such as opinions and ideal). However, collaborative recommender systems are having some problems which are as follows.

a) New user problem: In collaborative recommender system, it would not be able to give accurate recommendation to the new user as the user is having very few ratings. The user has to rate a sufficient number of items before the system can understand the user's preferences and produce the valid recommendations. Therefore, a new user would not be able to get accurate recommendations having very few ratings. This problem can be addressed by various techniques like hybrid approach of recommendations or strategies based upon item popularity, item entropy, user personalization or combination of all(Kuang & Kuang, 2013).

b) New item problem: Collaborative recommender systems completely rely on users' preferences to make recommendations. Whenever new items are inserted to recommender systems, the system is unable to recommend it until the new item is rated by a considerable number of users. This problem can also be addressed by hybrid recommendation approaches

c) Scalability: A recommendation technique may not be able to produce adequate number of recommendations when the volume of dataset is expanded. Thus the recommendation technique would be efficient for scaling up in a successful manner as the number of dataset in a database increases. The scalability problem can be addressed by the dimensionality reduction techniques, such as singular value decomposition (SVD) method, which has the ability to produce reliable and efficient recommendations.

d) Synonymy: It is difficult for most of the recommender systems to make distinction between closely related items such as the difference between e.g. baby wear and baby cloth. So synonymy is the tendency of different names or entries for similar items. Different methods such as automatic term expansion, the construction of a thesaurus, and Singular Value Decomposition (SVD), especially Latent Semantic Indexing are capable of solving the synonymy problem.

1.2 Content-based Recommender System

Content-based recommender systems, also known as cognitive recommender systems recommend items based on a comparison between the content of the items and a user profile. It works with data that provided by the user either explicitly through the ratings or implicitly through clicking on a link. A user profile is created based on those data, which is then used to provide recommendations to the user. The accuracy of the engine depends upon the number of inputs provided or action taken by the user. The various issues those should be considered to implement a content-based recommender system are as follows:

i) The terms or data can be assigned automatically or manually. A method is required to extract these terms from the items when the terms are assigned automatically.
ii) The representation of the term should support the meaningful comparison of user profile and items.
iii) A learning algorithm is required to learn the user profile based on seen items and can recommend based on this user profile.

1.2.1. Pros and Cons of Content-based Recommended System

Content based recommender system overcomes the challenges of collaborative filtering techniques. They have the ability to recommend even if there are no ratings provided by users for new items. It has the capacity to adjust its recommendations in a short span of time if the user preferences change. Content based filtering technique can also provide explanations on how recommendations are generated to users. However, the content based filtering technique suffers from the following problems.

a) Limited Content Analysis: Content based filtering techniques are solely relying on items' metadata. Thus rich description of items and very well organized user profile are required before recommendation can be made to users. This is called limited content analysis.

b) Overspecialization: When the system can only recommend items that score highly against a user's profile, the user is restricted to being recommend items that are similar to that already rated. This problem can be addressed by using genetic algorithm which is a possible solution in the context of information filtering (Mooney & Roy, 2000).

c) New user problem: Like collaborative recommender system, it would not be able to give accurate recommendation to the new users who are having very few ratings. In order to make accurate recommendations; the system must first learn the user's preferences from the ratings that the user gives. Several techniques have been presented to address this problem and most of the systems apply the hybrid recommendation approach, which combines content-based and collaborative techniques.

1.3 Knowledge-based Recommended System

Knowledge-based recommender system filters smartly a set of targets, in order to satisfy the preferences of user. Knowledge-based RS helps us to take the challenges of collaborative and content-based recommender systems. The advantage of these systems is that no rating data are needed for the calculation of recommendations. Recommendations are calculated based on the ratings of the individual user using similarity measures between customer requirements and items or on the basis of explicit recommendation rules. The two variants of knowledge based recommender system are constraint-based and case based systems which are similar in terms of the recommendation process. Explanations for the recommended items may also provide by these systems. Both the constraint and cased based systems differ in the way they use the knowledge. The case-based recommender system uses the technique of extraction of similar items on the basis of different types of similarity measures, whereas constraints-based recommender system focuses on the explicitly defined set of recommendation rules. In constraint-based system, the recommendation depends on the set of items that fulfill the recommendation rules. On the other hand, case-based system uses similarity metrics to retrieve similar items to the specified customer requirements.

1.3.1 Pros and Cons Knowledge-based recommendation

Recommendations of a knowledge base recommender system do not rely on a base of user ratings. It does not have to collect information about a particular user because its similarity judgments are independent of individual tastes. It is immune to statistical anomalies in market baskets as its recommendations are based on knowledge of the product domain. However, knowledge-based recommender systems require knowledge engineering and its suggestion ability capacity is static.

1.4 Hybrid Recommended System

Recent evidence suggested that basically three types of designs promote the hybrid recommendation processes. These are like monolithic, parallelized and pipelined hybrids. Monolithic designs are used if little additional knowledge is available in addition to the feature level. They typically need only some additional preprocessing steps or minor modifications in the principal algorithm and its data structures. Parallelized designs are the least invasive to existing implementations, as they act as an additional post processing step. Nevertheless, they add some additional runtime complexity and require careful matching of the recommendation scores computed by the different parallelized algorithms. Pipelined designs are the most ambitious hybridization designs, because they require deeper insight into algorithm's functioning to

ensure efficient run-time computations. As collaborative and content based methods suffer from some limitations, hence these two approaches can be combined to produce hybrid approach for recommender system. The hybrid recommender system can be categorized as follows:

1. Applying collaborative and content-based methods separately and combining their predictions,
2. Integrating some content-based characteristics into a collaborative approach,
3. Incorporating some collaborative features into a content-based approach, and
4. Formulating a general unifying model that includes both content-based and collaborative characteristics.

1.4.1 Pros and cons of Hybrid recommendation

Several studies have proven that hybrid recommender system shows better performance with compared to the pure collaborative and content-based methods. Hybrid recommender systems can provide more accurate recommendations than pure approaches. These methods can also be used to overcome some of the common problems in recommender systems such as cold start and the sparsity problem. The main demerit of hybrid recommender system is that it usually introduces more complexity to recommendation process due to the increase of the number of parameters to the recommendation system.

1.5 Organization of article

The rest of the paper is organized as follows. The next section elaborates the related work. In Section 3 we have mentioned the research gap. The proposed model is described in Section 4. Section 5 has illustrated results and discussion. Finally in section 6, we have explained conclusion and future work.

2. Related Work

In modern research Recommender System used in different domain for filtering the information, which has been widely exploited in e-commerce, suggesting products and service to users (Schafer, Konstan & Riedl, 2002). A Recommender System is a personalization tool that provides users with a list of items that best fit their individual flavor (Garcia.Inma, Sebastia, Pajares, & Onaindia, 2011). Recommendation is totally based on the evaluation in which we will ask the questions to the user and notices the respond. After that we will apply recommendation in our system on the basis of the respond specified by users. In order to build easily the suitable travel by satisfying the tourist preferences, the group profile will be defined manually with the travel agency. In addition, determining the suitable travel requires an important time because the number of considered constraints and scenario are important.

In recent year Recommender System has been rapidly change with respect to time. The tourists themselves will be one of the main contributors to their current context. Recent research evidence suggest that regarding personalized and location based Recommender System with particular reference to tourist domain, discourse the design and execution issues for delivering location based tourism related content services(Kakaletris, Varoutas, Katsianis, Sphicopoulos & Kouvas, 2004). Universal tourist support system that is built upon multi agent and semantic web technologies for providing personalized assistance and automation to the tourists with different preferences and often changing requirements during their tours(Chiu, Dickson & Leung, 2005). A collaborative Recommender System utilizes the knowledge implicit in a community of users with their preferences on offered items to discover the relevance of these items to other users within the community that have not conveyed any preference on the proposed items(Garcia, Arturo, Manuel, Galiano & Miguel, 2013). Collaborative filtering methods work on the gathering and analysis of a large amount of information on user behavior, activities or preferences, in order to predict what they would like based on their similarity with other users.

The time weights can be computed for different items in a recommender system which assigns a decreasing weight to old data and the system can be used to produce the most recent recommendation to the users(Ding, Li,2005).Temporal information influences the recommendation process. An aging scheme is proposed towards making recommendations mostly depend on fresh and novel user preferences (Stefanidis, Ntoutsi,Norvag, Kriegel,2012).The simple Bayesian classifier is one of the most successful supervised machine-learning approach which performs well in various classification tasks. It calculates the similarity between users from negative ratings and positive ratings separately and this approach outperforms a correlation-based collaborative filtering approach (Miyahara,Pazzani,2000).Time awareness is crucial to properly estimate the user's interests to address social media marketing to increase the traction, for instance, posting the right message at the right time. It defines time-aware collaborative filtering for estimating user's interest along the time in Twitter (Maio, Fenza,Gallo,Loia,Parente,2017)

The main perseverance of this research is the development of a Recommender System in tourism sector of India. These user profiles will be composed by functionality levels regarding accessibility issues like country, state, place, location, local foods and local products in addition to basic socio-demography information. This research presumes a vital importance in tourism sector in India and any other area where individual user knowledge is a key factor. The output of the Recommender System will be recommendations of suitable places as per expectation of the users.

3. Research Gap

Whenever a tourist is visiting to an unknown place, he/she tries to explore the best sites located in that place and also tries to explore some special localized food and products available in those sites. Sometimes the tourist want to take the help of some local people to find the sites, and the foods and products available in those sites as those are best known to them. But sometimes the language may be the barrier to properly communicate with the local people. So this paper proposes a method to recommend the best sites along with foods and products available in those sites to a tourist where the tourist is interested to go while booking the hotels online. The tourist has to provide some information in terms of place, food and product preferences while booking the ticket and the system recommends the top -n sites according to the preference where the tourist can get those types of food and products. In the literature various algorithms (Hui,Tak, Wan & Alvin, 2007) are developed to recommend the sites to the tourists using collaborative filtering technique .But the proposed algorithm uses collaborative filtering algorithm which uses local users for recommendation purpose. The local users are those users whose present location of stay matches with the visiting location of the tourist and those users have already visited that place. The system should also be capable to recommend as much as recent items to the user so that the user can effectively utilize those recommendations The proposed system uses a collaborative filtering with a time function so that it can be able to produce the most recent recommendations to the user.

4. Proposed Model

The proposed model starts with the questioner assessment from which a database is developed to find out the similar users to a given input query user. It uses collaborative filtering technique for recommendation where it employs the cosine –based similarity to find the similar users to a particular querying user which is a tourist. It uses the opinions of the local people about the different sites present in that place who are already visited those places. It measures their opinions about a site in terms of a rating value which is also defined through certain parameters like crowd management, security and cleanliness of the sites. The type of the site the tourist wants to visit may be spiritual or historical, or adventurous or place of fun. The local users also provide information about the special localized food items and products available in that site through the rating values. The local user rates the food items according to the criteria like hygienic, taste and price .The products are rated by the local users through the criteria like quality and price .It

recognizes similar users based on the cosine-similarity value. The system computes the cosine similarity of the querying user with all the users present in the database by using the following formula.

$$\cos(d1, d2) = \frac{(d1.d2)}{||d1||||d2||} \quad \text{----------(8)}$$

Where ( ) indicates vector dot product and ||d1|| and ||d2|| are the length of vectors d1 and d2 respectively.

The entire experimental design involved in the whole system can be represented as shown in Figure 3. The users who are having cosine-similarity value as 1 are considered as the similar users because their place, food and product parameters are matching with the querying user. If a tourist for example wants to visit the place Bhubaneswar and his preference for place type is spiritual, food type is vegetarian and product type is ladies product then the similar users can be identified using cosine similarity as shown in Table 6.1 and Figure 4. The proposed system is not interested to compute the exact rating value a user would have given to a target item. It uses a simple fuzzy rule-based classifier which uses two class labels like and dislike and classifies the rating values of site, food and product into one of the class according to the classification rules. The classifier is constructed using the three different classification rules for site, food and product purchased. The classification rule for site is defined as follows:-

IF rating>=1 and rating<7 THEN class is dislike

IF rating>=7 and rating<=10 THEN class is like.

The classification rule for food is defined as follows:-

IF rating>=1 and rating<5 THEN class is dislike

IF rating>=5 and rating<=10 THEN class is like.

The classification rule for food is defined as follows:-

IF rating>=1 and rating<5 THEN class is dislike

IF rating>=5 and rating<=10 THEN class is like.

The item selection method considers those local similar users for the recommendation whose ratings to the site, food and product are having value “like”. To produce the most recent recommendations the system uses time function to calculate the time value for each similar users which are selected in item selection method. The proposed system assigns a greater level of importance to recent data and allocates a weight to each rating defined by a function f (t) to time t. It assumes that the time function f (t) is a monotonic increasing function which increases uniformly with time t and the time weight value lies in the range (0,1). The more recent the data, the higher the value of the time function is and the time function curve is shown in Figure 7. It is desirable to gradually decay the history past behavior as time goes by (Aggarwal, Han, Wang and Yu., 2004). A half-life parameter is designed to define the rate of decay of the weight assigned to each data point and can be defined as follows:-

$$F(T_0) \approx (\frac{1}{2})f(0) \quad \text{----------(9)}$$

The decay rate λ as:

$$\lambda = \frac{1}{T_0} \quad \text{----------(10)}$$

The time function is defined as follows:

$$f(t) = e^{-\lambda.t} \quad \text{----------(11)}$$

The decay rate is inversely proportional to T_0 and T_0 decides the decay rate of the old data. The users having high time function value are assumed as the most recent users. The users are sorted according to the decreasing order of their time value and the top-n users are used for the recommendation purpose. The name of the site visited along with food taken and product purchased in that site will appear in each of the recommendation present in the recommendation list.

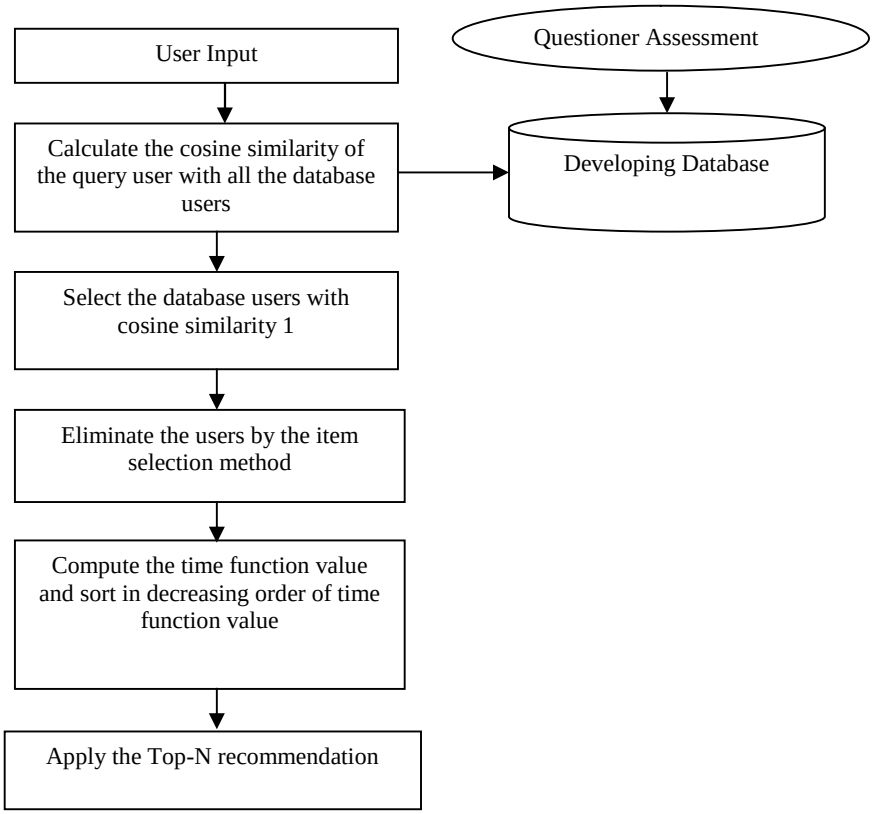

Figure 3: Proposed Model

5. Result and Discussion

A. Dataset description

Two hundred (Male = 110, Female = 90) individuals from Bhubaneswar, Odisha (India) participated in the study. They were given the questionnaire (see Appendix-1) during the class hour to complete and return the questionnaire to the researcher. The participants took about 40 min to complete the questionnaire. The socio-demographic profiles of male and female students were compared using *F* test when the data were in interval scale and Chi-square test when the data were in nominal scale. More number of male individuals participated in the study compared to the female individuals. Most of the male individuals were the natives from urban areas and the female individuals from semi-urban areas. Very few male as well as female individuals were from rural areas. The female students were little older than their male counterparts and had studied more years in formal educational institutions than male individuals. Both male and female individuals were predominantly from nuclear family having minimum 1 to maximum 5 members and few were from joint/extended families.

Table 6.1: Cosine similarity of the querying user with some local users

User Id	Country Name	State Name	Place Name	Place Type	Food Type	Product Type	Cosine Similarity
1	1	11	120	10	60	80	1
2	1	12	121	20	60	80	0.998
3	1	12	124	20	70	90	0.9973
4	1	12	121	30	70	100	0.9895
5	1	11	120	40	60	80	0.9827
6	1	11	120	10	60	80	1
7	1	13	131	40	70	80	0.9847

The average annual income of parents and family members of male and female individuals did not differ. On the average, the annual income varied from as low as 5,000 to as high as 65 lac Indian rupees (Table 7.1).

Table 7.1 Participants sample profile

Characteristic	Descriptive Statistics	Male	Female	χ^2	F
Gender	*N (%)*	110 (77.50)	90 (22.50)	121.00***	
Birth Place					
Urban	*N (%)*	68(54.20)	47(42.2)	13.42***	
Semi-urban		30(27.70)	32(47.80)		
Rural		12(18.10)	11(10.00)		
Age	*M (SD)*	20.81(4.50)	23.61(3.97)		28.34***
Years studied		14.99(3.06)	17.73(3.52)		52.11***
Family size		4.67(1.85)	4.69(1.34)		0.01
Income (in INR)		466399(771448)	530888(988621)		0.42

INR= Indian rupees, *p<0.05. **p<0.01. ***p<0.001.

B. Evaluation Metrics& Result Analysis

Researches on recommender systems can be evaluated using several types of measures to judge the quality of the recommender system. The power of the presented approach is measured with the help of three evaluation metrices i.e precision, recall and f-measure. Precision can be defined as the fraction of recommended items that are relevant. Perfect precision score of 1.0 means that every item recommended in the list was good. Another typical evaluation metric used by the information retrieval is recall. It is defined as the fraction of relevant recommendations that are presented to the user. Perfect recall score of 1.0 means that all good recommended items were suggested in the list. F-measure is a single value obtained by combining both precision and recall. It indicates an overall utility of the recommended list.

$$\text{Precision} = \frac{Number\ of\ products\ liked\ and\ recommended}{Number\ of\ products\ recommended} \text{ ---------(5)}$$

$$\text{Recall} = \frac{Number\ of\ products\ liked\ and\ recommended}{Number\ of\ products\ liked} \text{ ----------(6)}$$

$$\text{F} - \text{measure} = \frac{2*\text{precision}*\text{recall}}{precision+recall} \text{ ----------(7)}$$

To evaluate the performance of the proposed system initially 10 tourist places are selected. Opinions of 20 users for each tourist places who are local to that tourist place are collected in the database. The

opinions contain information of the sites with local food court and local market present in each tourist site. Precision, recall are calculated for different users for top-N recommendations, where N=5. F-measure has been taken for test accuracy for five different users and the results are shown in Figure 5. A graph is plotted showing the relation between precision and recall value which is shown in the Figure 6. From the results it is observed that if the number of records liked and recommended is fixed and the value of N varies for top-N recommendations then the precision decreases as the value of N increases which is shown in the figure 8.

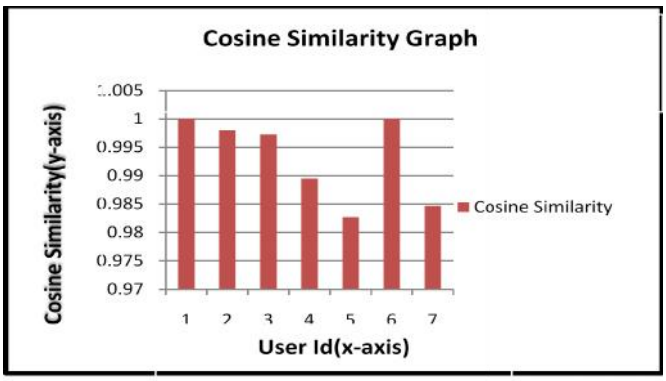

Figure 4: Cosine similarity to different users

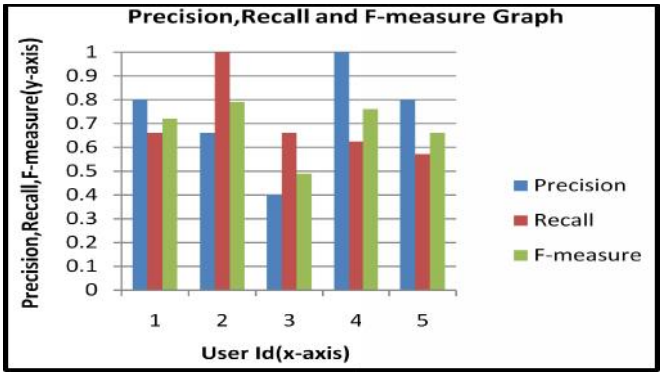

Figure 5: Graph for precision, recall and f-measure

The proposed model is compared with a recommender system model which doesn't use a time function. We have used the metric Average Precision (AP) which is a ranked precision metric for the comparison of these two models. AP gives emphasis on highly ranked correct hits. AP can be defined as the average of the precision values determined after each successful prediction. We have observed that our proposed model gives higher or equal AP value for recommending recent data compared to the model which is not using the time function value as shown in Figure 9.

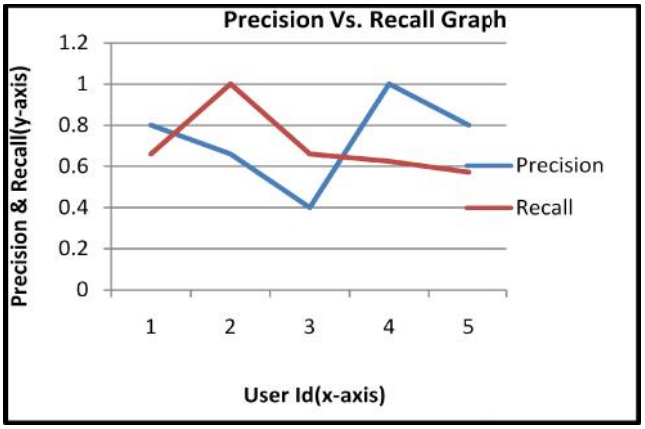

Figure 6: Precision and Recall graph

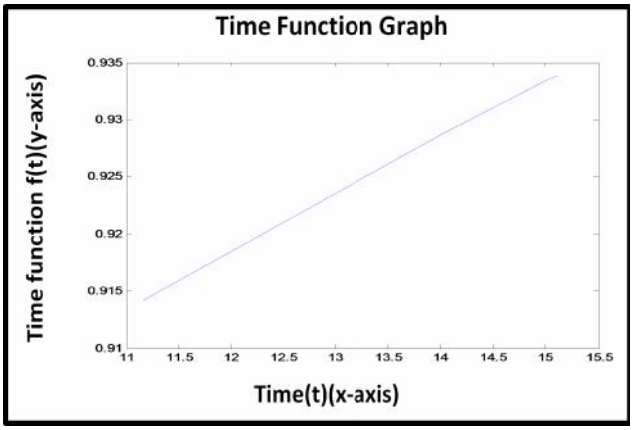

Figure 7: Time function Graph

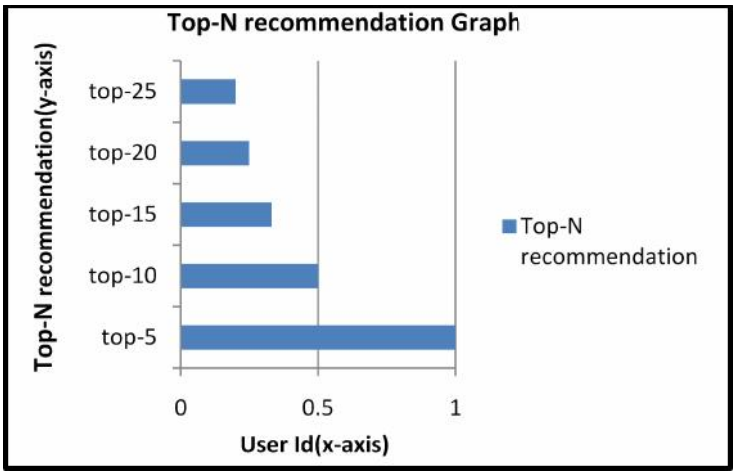

Figure 8: Top-N recommendation Graph

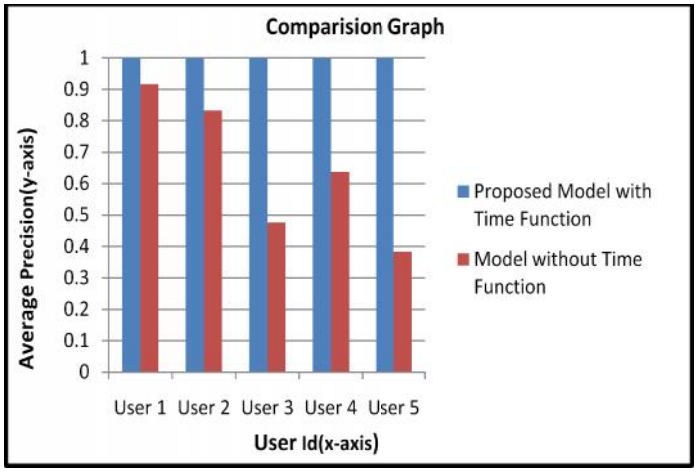

Figure 9: Comparison Graph

6. Conclusion & Future Work

Recommender system has been widely used from the last decades. Recommender systems in tourism sectors recommend places to the tourist for their journey. A technique to enrich typical personalized location recommendation system has been presented through this paper and the proposed technique can be applied in the tourism sector to provide the best possible recent recommendations to the tourists to make their journey successful. This system will store the opinions of the local users about the sites and the foods and products for purchase available in those sites. It uses collaborative filtering technique to find the similar users to a given querying user. The system recommends the best sites along with good foods and products available there according to the recent data of the system. This system may helpful for tourists who wish to explore the best sites and avail the good foods and products available in those sites. The proposed system outperforms the traditional recommender systems in terms of precision, recall and f-measure value. It gives higher or equal Average Precision value for recommending recent data compared to the model which is not using the time function value. The proposed approach will only recommend the sites available in Bhubaneswar. In the future work, we can apply the same technique to tourists of all the states of India for accuracy of our proposed system. The proposed system does not consider how the tourist will cover a set of sites available in a place. In future we will try to recommend itinerary plans to the tourist which will recommend the order of visiting the sites along with food and product recommendation by considering the shortest distance. We will also try to develop a location based group recommender system on the basis of Point of Interest (POI) of the tourists for the recommendations.

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APPENDIX-1
FORM OF AN EXPERIENCE IN TOURISM

1. Write your Name:

2. Write your Age:

3. Write the date of your Journey:-

4. Write the name of the country you have visited:-

5. Write the name of the state you have visited:-

6. Write the name of the place you have visited:

7. Choose the type of the place you have visited

Place Type	**Your Consent in Yes**
Spiritual	
Place of fun	
Adventurous	
Historical	

8. Write the name of the site visited in that place:-

9. Give rating to that site:-

10. Write the name of the location near the site where you have got some localized food:-

11. Write the type of that food (Vegetarian or Non-Vegetarian):-

12. Write the name of that food:-

13. Give rating to that food:-

14. Write the name of the location where you have got some localized product:-

15. Choose the type of that product:-

Product Types	**Your Consent in Yes**
a) Ladies product	
b)Gents product	
c) House hold product	
d) Kids product	

16. Write the name of that product:-

17. Give rating to that product:-