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# Different Location Based Approaches in Recommendation Systems

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**Abstract –** *Nowadays, Recommendation systems have become very popular. User can select an accurate item from large pool of items. Location characteristics play an important role in recommendation process. In recommendation systems, users' and items' current location, their previous location information and location histories of other users will impact decision of recommendation process. This paper conducts the study of various recommendation systems in which location characteristics are considered as key elements while recommendation. Recommendation techniques such as content based, collaborative and hybrid filtering, user preference model and matrix factorization methods are also studied. Location factor is considered as connective element between item and user in recommendation systems.*

***Key Words***: Recommendation, Location, Collaborative, Filtering, Preference model, etc.

## 1. INTRODUCTION

In today's world of technology, various recommendation systems are available to users. Using those recommendation systems, user's time can be saved. Recommendation systems help the users to select suitable item from the large collection of items. It is difficult and tedious decision to select the proper one from huge collection of items. So recommendation systems aid to recommend the appropriate results and save the selection time.

In various recommendation systems, location characteristics play an important role. Nowadays, people use to tag their geo-locations, photos, and inform others about current location on various social media sites. Such location related information is useful in recommendation process. Location data helps to link the physical and digital domain and allow to collect the detail knowledge about particular user preferences and activities. Location is vital concept in recommendation systems which specifies the relationship between users, between locations and between users and location [9]. Location helps to define the contextual information about any user. Such contextual information is used to generate recommendations results. It is possible to collect detail knowledge about any item or user from their location histories. Location related information such as distance, weather, traffic conditions, address, timestamps, human density, reviews given by users for those locations, etc. are useful in recommendation systems. In recommendation systems, the current location of user, previous location information about users and location histories of different users affect the recommendation decisions. On the basis of those location related conditions recommendations are generated. This paper conducts a study of various recommendation systems which are based on location factors. It includes restaurant recommendation, movie recommendation, outdoor recommendation, shopping recommendation and shop-type recommendation systems. There are various recommendation techniques used to generate recommendation results. This paper also focuses on study of various recommendation techniques and methods used in different recommendation systems.

## 2. RECOMMENDATION SYSTEMS BASED ON LOCATION CHARACTERISTICS

### 2.1 Restaurant Recommendation

When people go to new or strange places they don't have much idea about the city, hotels and restaurants. In such situations people try to search on various search engines for good hotels and restaurants from their mobile phones. So restaurant recommendation system helps in these cases. Zeng et al [1] suggests a restaurant recommendation system based on user preference and location in mobile environment. Authors developed these restaurant recommendation system by designing user preference model and restaurant recommendation algorithm. While recommending any restaurant to users, their preference plays important role. User may prefer sweet food, veg, non-veg, etc. This preference will also be considered as the feature of restaurant. The user preference model developed by authors is based on the user's preference and restaurant's features. Authors also suggest restaurant recommendation algorithm which is based on user's preference feature and the distance between user and restaurant. Restaurant recommendations are generated by utilizing the location information of user and restaurants.

### 2.2 Movie Recommendation

Movie recommendations can be generated by considering various factors such as genre of movie, user's mood, quality of picture and other contextual information. K. Madadipouya [2] developed a movie recommendation system by using collaborative filtering approach. Recommendation are generated by considering users' preferences, needs and hopes, and parameters that influence user's ratings. Information such as demographic data, quality and delivery requirements, the location, the media, the cognitive status of the user and his availability are taken into consideration [2].

### 2.3 Outdoor Recommendation

There are various recommendation systems used in online shopping websites but very few are applicable in real world shopping environment. Takeuchi et al [3] suggest a real world outdoor recommendation system based upon last location history of user collected by GPS. This system recommends the shops by analyzing user's preferences and requirements with consideration of location history of user. Outdoor recommendation system [3], firstly, finds out each user's frequently visited shops and then generate recommendations with the help of shops, the user's usual shopping routes and the user's current location. Item-based collaborative filtering algorithm is used to generate those recommendations.

### 2.4 Shopping Recommendation

There are various customers who were looking for certain offers and deals on different products while shopping. Yang et al [4] developed one such recommendation system which recommends different shops with various offers and deals. It recommends vendors' webpages on mobile environment which include offers and promotions to interested customers [4]. In this system location aware architecture is designed to gather neighboring vendor's information.

### 2.5 Shop-Type Recommendation

Some investors have an available store place but they don't understand which type of shop will earn more profit. Zhiwen Yu et al [5] designed a shop- type recommendation system which suggests a suitable type of shop for a newly opened store. In this system, first of all location and commercial features are extracted. Those extracted features are then fused together in feature fusion matrix factorization model [5] to generate recommendations. This system mainly focuses on location features of particular store place. Location characteristics such as distance to central business area, visiting frequency of people to that area, traffic accessibility and traffic conditions are considered while generating type recommendations.

### 2.6 Item Recommendation

Item recommendation systems help the user to select the appropriate item from large number of items. In recommendation systems item might be considered as any venue, location, event or any object. Yin et al [6] developed one such spatial item recommendation system which recommends a venue or an event to users by considering their current location and point of interest.

## 3. TECHNIQUES TO GENERATE RECOMMENDATION

### 3.1 Content based Filtering

Content based filtering recommends items based on a description of item and comparison between the content of the items and a user profile. Content of item might be referred to as information about that item such as name, geographical data and so on. For example, if shop is an item, then name, type, location, etc. are the content of shop. Content based filtering is also known as cognitive filtering. Item to item correlation is used to generate recommendations. In content based recommendation system, contents are required to be collected first and based upon those contents, recommendations are generated. Feature extraction and information indexing techniques are used to perform content collection process.

Advantages:

Content based approach generate recommendation by using item's information only. No user data is required. So recommendations are generated for all users.

Disadvantages:

If content information about any item is less, then system may face difficulty in feature extraction result generation.

### 3.2 Collaborative Filtering

Collaborative filtering can be defined as filtering of information by using recommendations of other people. Collaborative filtering is a method of making predictions (filtering) about the interests of a user by collecting preferences or taste information from many users (collaborating). The main objective of collaborative filtering systems is to recommend new items to different users based upon the opinions of previous users of those items. The concept of collaborative filtering is motivated from the fact that people get the best recommendations from someone with tastes similar to themselves. Context aware collaborative filtering is also important filtering technique used in recommendation systems. Contextual information of particular item is considered in context aware recommendation systems. Certain challenges might occur while implementation of collaborative filtering approach in recommendations. These challenges include data sparsity, diversity, scalability, etc.

Advantages:

Collaborative Filtering Approach focuses on participating user's opinions. It does not require any item related information to generate recommendations.

Disadvantages:

The item cannot be recommended to any user until the item is either rated by another user(s) or correlated with other similar items of the database. Also, sometimes it is possible that only few items are rated by user in spite of large item database.

### 3.3 Hybrid Filtering

Hybrid filtering technique combines different recommendation techniques to generate more accurate recommendation results. It takes advantage of all techniques to find out the suitable results and overcomes certain drawbacks of basic techniques. The main objective of hybrid filtering technique is to generate accurate and effective recommendations.

### 3.4 User Preference Model

In recommendation systems users' choice and preference to particular item plays an important role. But sometimes it happens that users have just a slight idea about their preferences and/or they are not able to express them exactly [8]. In such cases, user preference learning methods are needed to be analyzed. User preference learning is mostly used in recommender systems. For example, in restaurant recommendation system [1] user preference model is used to find out the best recommendations. If user prefers vegetarian food then based upon his/her preference veg restaurants are recommended.

### 3.5 Matrix Factorization

Matrix factorization methods are used to model the user-item relationship in various recommendation systems. In general, matrix factorization model map both the user and item in k- dimensional latent vector space. User-Item relationship is represented in matrix format. Then those resultant matrices are used to find out the recommendation score for each item and user. In shop-type recommendation system [5] singular value decomposition matrix factorization method is used to generate recommendations. In this system, shop and type are mapped into k-dimensional vector space to generate recommendations, i.e. shop and type are factorized to calculate the popularity of shop [5].

## 4. CONCLUSIONS

In various recommendation systems, location information about item and user helps to generate the recommendation results. Location data helps to link the physical and digital domain and allow to collect the detail knowledge about particular user preferences and activities. Location is vital concept in recommendation systems which specifies the relationship between users, between locations and between users and location. Various recommendation systems use location factor as a major component to find out the correct and accurate results. Location information is considered as a context in various content based and contextual recommendation techniques. Location information is useful to calculate the accurate and effective recommendations in different recommendation systems.

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