Multimedia Recommendation System With User Behavior Information

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***Abstract*— Nowadays, use of various internet services and applications are increasing in huge amount which results in information overloaded issue. One of the solutions to this problem is the use of recommendation system. Recommendation system is an information filtering technique that is use to predict the item in which the user may interested in. Recommendation system is used for predicting items like music, videos, news, television programs, books, movies, restaurants and things on which individuals have different choices. It can raise e-commerce sales. These items are being predicted using two basic approaches first is content-based approach which involves characteristics of an item and another is collaborative filtering approaches which take into account user's past browsing history to make choices. Issues are involved in all the techniques of the recommendation system. Recommendation system is implemented by using Java and Hadoop by Apache. The system built a well-correlated model for websites and provides items to the user as per their taste. The proposed system contains decentralization of user profile, creation and collection of not only user profile but also user behaviour and graph-based optimization is used to speed up the recommendation process.**

Keywords- Recommendation system, Collaborative filtering (CF), Content based Filtering (CB), Google's Ad Words, Amazon's, Facebook.

I. INTRODUCTION

Due to the explosive growth of e-commerce and online environment has made it quite difficult for people to search information that is pertinent to their interest and needs [1]. One solution to this problem is a recommendation system which is a useful tool which offers an automated mechanism to seek out relevant as well as new information. Now a day peoples are fully depends on their social network on the internet. All the information regarding product, music, video, films, television programs, WebPages, news, restaurant and blog available on internet. Recommender System or Recommendation Engines is a specific type of information filtering system technique that attempts to present information that are likely of interest to the user. Websites like YouTube, IMDb, Amazon, Netflix, Pandora, Last.fm, use recommendation systems to serve relevant items to users. Combined with traditional search they allow users to navigate and find useful content from the information-rich online environment.

The aim of these systems is to help the potential buyers to pick the appropriate product to buy, so that they can be seen as decision support systems. On the other hand, they serve as the marketing help for the e–commerce stores because they increase the attractiveness of the offer.

Recommendation systems improve E-commerce sales in the following ways [2]:

1. Browsers turn into buyers-
   Recommendation system helps visitor to find an item in which they are interested in so that they convert from browsers into buyers.
2. Cross-sell-
   Recommender systems enhance cross-sell by recommending more products for the user to buy. If the recommendations are appropriate, the average product sale should increase.
3. Loyalty-
   Recommender systems enhance loyalty by generating a value-added relationship between the website and the user.
4. To cope with information.
5. To help all customers (new, frequent, and infrequent) to make decisions what products to buy, which news to read next which movie is worth watching, etc.
6. To build credibility through community and maintain the loyalty of the users.
7. To inviting customers to come back.
8. To enhance e–commerce sales and cross–sell.

II. RELATED WORK

The various techniques of recommendation system are given below [3] -

A. *COLLABORATIVE FILTERING (CF) RECOMMENDATION SYSTEMS*

In collaborative filtering, items are recommended according to the people having similar tastes, interests and according to their browsing history [4]-[6]. These systems identify users who are having same preferences with the present user and propose items (i.e., multimedia) which the user are interested in but has not yet seen.
Generally, CF uses two main approaches, namely, user-based CF and item-based CF.

i. User-based CF

In this category, recommendation is based on the highly correlated user by using the rating preferences of other users to find highly correlated users. This category is described in figure 1.

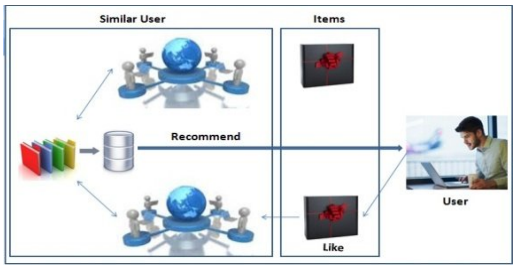

Figure 1. User-based CF

ii. Item-based CF

In this category, recommendation is based on the highly correlated item by using the rating preferences of other users to find highly correlated users [7]. This category is described in figure 2.

Figure 2. Item-based CF

B. *CONTENT-BASED RECOMMENDATION SYSTEMS*

In this category, recommendation is done by automatically matching a user's taste with item contents as described in figure 3 [8]. Similar items to the past preferred item are recommended to the user. Recommended items are not depends on information provided by other users, but entirely on items contents and users profiles. It requires more description for more accurate prediction of item for the users.

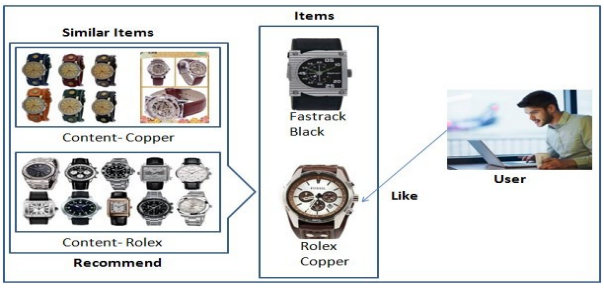

Figure 3. Content-based Filtering

C. *HYBRID RECOMMENDATION SYSTEMS*

Both recommendation systems described above have challenges, advantages and disadvantages. The resultant is the hybrid recommendation approach which is a combination of collaborative and content-based filtering as well as other recommendation methods [9]. There are different hybridization strategies and methods for hybrid recommendation systems. They are described in Table 1.

Hybridization Method	Description
Switching	The system switches between recommendation techniques depending on the current situation.
Mixed	Recommendations from several different recommenders are presented at the same time
Weighted	The scores(or votes) of several recommendation techniques are combined together to produce a single recommendation
Cascade	One recommender refines the recommendation given by another
Feature combination	Features from different recommendation data sources are thrown together into a single recommendation algorithm
Meta-level	The model learned by one recommender is used as input to another
Feature augmentation	Output from one technique is used as an input feature to another

Table 1. Hybridization Methods

D. *KNOWLEDGE-BASED RECOMMENDATION SYSTEMS*

Another type of recommendation system is knowledge-based approach. This approach is the collection of knowledge about the users and items (multimedia), and then this knowledge applies to generate recommendations for the user [10].

E. *UTILITY-BASED RECOMMENDATION SYSTEMS*

Utility-based recommender systems provide recommendation depends on a computation of the utility of each and every object for the user [11]. The main issue is the creation of a utility function for each and every user. Therefore user profile is the utility function that the system has obtained for the user, and the system enlists constraint satisfaction techniques to locate the best match.

F. *DEMOGRAPHIC RECOMMENDATION SYSTEMS*

Demographic recommender systems tries to differentiate user based on personal attributes and make recommendations based on demographic contents [12]. Demographic contents are age, gender, location,

knowledge of language, disability, mobility, employment status, home ownership.

Recommendation techniques can be divided into five main approaches which are summarized in Table 1. The following assumptions are made to construct the table.
For the comparison of traditional Recommendation system let assume,
I - the set of items over which recommendations might be made
U - The user set, whose preferences are known already
u - The user for whom recommendations need to be formed
i - is an item which is required to predict u's preference.

Technique	Background	Input	Process
Collaborative	Rating from U of items in I	Rating from u of items in I	Identify users in U similar to u, and extrapolate from their ratings of i
Content-Based	Features of items in I	U's ratings of items in I	Generate a classifier that fits u's rating behavior and use it on i
Demographic	Demographic information about U and their ratings of items in I	Demographic information about u	Identify users that are demographically similar to u, and extrapolate from their rating of i
Utility-Based	Features of items in I	A utility function over items in I that describes u's preferences	Apply the function to the items and determine i's rank
Knowledge-Based	Features of items in I. Knowledge of how these items meet a user's needs	A description of u's needs or interests	Infer a match between I and u's need

Table 2. Comparison on traditional Recommendation system

III. SYSTEM ARCHITECTURE

Recommender System or Recommendation Engine is a specific type of information filtering system technique that attempt to predict items that a user may be interested in [13]. A good Recommendation System is classified in two ways,

- Value for the Customers
  - Find things in which user interested in
  - Narrow down the set of choices
  - Help them to explore the space of options
  - Discover new things
  - Entertainment
- Value for the Providers
  - Additional and probably unique personalized service for the customer
  - Increase trust and customer loyalty
  - Increase sales
  - Opportunities for promotion and persuasion
  - Obtain more knowledge about customer's interest.

Figure 4 shows the architecture of proposed system. The Client can interact with Recommendation system with the help of API Layer. A web API is the application programming interface (API) for the web server as well as web browser. It combines definitions, procedures and protocols to help the communication between different computer softwares.

With the help of Data Mining Layer recommendation system extracts data from database. The information extraction is not the only process we need to perform but also involves other processes such as Data Cleaning, Data Integration, Data Transformation, Data Mining, Pattern Evaluation and Data Presentation. Once all these processes are over, it is ready to use this information in many applications such as Fraud Detection, Market Analysis, Production Control, Science Exploration etc. Data Mining is used for information extraction from the very large data set. Data mining also means that the mining of knowledge from data. Data mining is performed with the help of two approaches Content-Based and Collaborative Filtering. In this layer we are using Collaborative Filtering, Content-Based Filtering, and Non-personalized Filtering Technique.

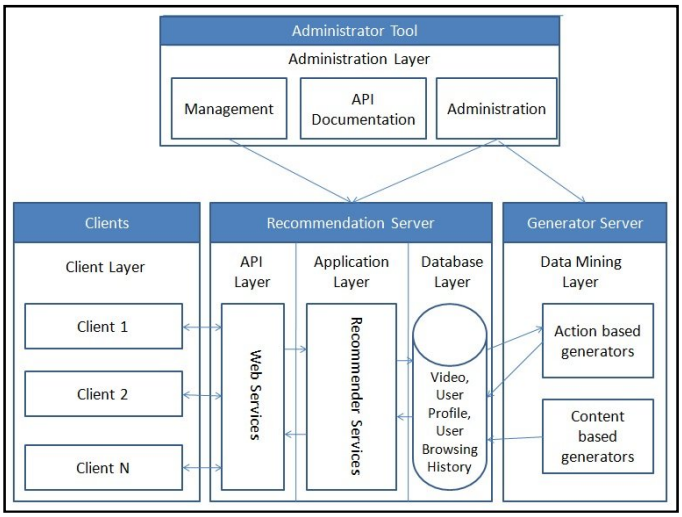

Figure 4 System Architecture

IV. PROPOSED SYSTEM

A. *Existing System-*

Many video recommendation algorithms and systems have been developed and exploited. Some of the algorithms mainly come from the implementations of the video recommendation systems from the pioneers such as Google's Ad Words, Amazon's Collaborative Filtering

Video Recommendation system that allows user to find and browse through their interested goods. Also the Social Network Filtering by Facebook; in which social network is formed according to social signals and users can recommend their content to their social network.

B. Proposed System-

In general, the recommendation systems comprise of two components:-

i. Content Recommender: It monitors user interest identification, user interest recommendation and result re-ranking.
ii. Collectors: They collect user interest and activities, content attributes and updates.

In comparison with existing the proposed system intends to make changes as follows:-

i. Decentralization of user profiles and collectors to different nodes.
ii. Creation and collection of user behavior clusters and not only the user profiles.
iii. Graph-based optimization mechanism implementation in recommender to speed up the recommendation process.

Advantages of the proposed system over existing system:

i. Explosion of network overhead, in case of increased number of users and user profiles, is avoided by performing user behavior based clustering.
ii. Implementation of Hadoop platform in the proposed system which contains Map-Reduce procedure that speeds up the existing recommendation algorithms.
iii. Recommendation rules are reordered to improve scalability and real time recommendations. In proposed system, the recommender searches real time ranked list of users based on the recommendation rules. In case or rule execution order, the proposed system proposed graph based rule reordering method to reduce searching latency.

C. Project description-

The project implementation can be summarized to four major implementations as follows: -

i. Collection of User Behaviors: Video surfing behavior relies on user contexts (time, location, network type, etc.), user interests (browsed content, access patterns, and preferred keywords and categories), and friend recommendation (reviewed, replied, commented, and forwarded relationship). Most of the user contexts cannot be retrieved on application servers; application plug-ins is loaded on the user terminal to collect the contexts. With the increase of context types and online users, networking and computing resources will be consumed quickly.
Furthermore, highly dimensional contexts are very challenging for recommendation algorithms. In order to avoid the issues, initially collected contexts are clustered at the server side; then, clustering rules are used by the application plug-ins to calculate the user clusters, and the clusters are reported to context collectors instead of former user contexts. By this approach, networking and computing load is relieved. To guarantee that the clusters keep fresh, context collecting and clustering will be restarted periodically. User's social connection and profiles are collected by the collectors at the server side.

ii. User content clustering: User's social connection and user profiles are exploited by the component to find user content similarity. Social connections are retrieved from the user's actions on videos shared by other users.
In addition to content categories of user profiles, several communities are formed. In each community, content descriptions (titles, tags, and resolutions) and content access patterns (click behaviors on videos, access frequency, and access time) are mapped into six-attribute tuple; then, the user content clustering algorithm is executed on the tuple to obtain user interest clusters and user content similarity. The component is implemented within the MapReduce framework.

iii. Dynamic recommendation rule generation: If all similar users and user content lists of a user are stored in his profile, the system should allocate more storage space for each user with the increase of users and videos. As a result, the system becomes unscalable and brings more latency to the search recommendation lists. Considering user contexts, some user content lists will be duplicated.
To resolve this issue, recommendation rules are extracted from user context clusters and user content clusters. The rules are composed dynamically during real-time recommendation.

iv. Optimized real-time recommendation: The only real-time component accepts the user's new requests and returns the recommendation lists to the user. The procedure translates the user's request into recommendation rules on the basis of request keywords and implicit user contexts, and then searches for user favorite according to the rules.
To guarantee user experience, the procedure must provide a real-time response. The system adjusts the execution order of the rules based on the weighted graph to reduce searching latency.

V. ADVANTAGES AND DISADVANTAGES

Table 3 enlist some Advantages and disadvantages of recommendation techniques,

Recommendation System	Advantages	Disadvantages
Collaborative Filtering	No domain knowledge is required.	First Rater issues, Cold-Start and sparsity problem. Insensitive to preference change.
Content-based Filtering	No domain knowledge is required.	Overspecialization
Knowledge-based	Sensitive to preference change. Does not need to be initialized with a database of user preferences.	Knowledge acquisition.
Utility-based	Can feature non-product attributes, such as vendor reliability and product availability.	Creating a utility function for each user.
Demographic	Not likely to require a history of user ratings as requires by collaborative and content-based techniques.	Demographic information in a user model can vary greatly, because of different types of systems which require recommendations.

Table 3. Advantages and disadvantages of Recommendation Techniques

VI. CONCLUSION

Recommender systems are a powerful technology for personalization. Used in the right way, they can benefit both consumers and providers. Consumers profit by finding new interesting products and providers can increase their sales.

Recommendation systems are use to overcome information overload problem as e-commerce continuously growing. Recommendation systems can benefit both user and supplier. Users use it by finding new interesting items and supplier can enhance their sales.

The implementation of the project contains following constraints:-

a. The searching for the video content is restricted to a local remote machine.
b. The amount of video content is restricted. Hence, the number of keywords.
c. The web application is deployed on Desktop instead of Android Device.

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