# Comparative Study of User Recommendation Based on Sentiment Analysis in Twitter

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**Abstract:**
The emerging popularity of social media raises new applications for recommendation system. The availability of sentiment in the micro-posts has become a significant impact to build better user profiles and trustworthy network. As a result considering the contribution of user sentiment, can yield benefits in recommending possible friends to follow. In this paper, different techniques of user recommendation based on sentiment analysis are described in detail. Also the comparative review of user recommendation based sentiment analysis techniques like ISTS, SVO, ISCUR, is presented. This paper also presents the research gaps of these techniques.

**Keywords:** User Recommendation, Twitter, Sentiment Analysis, Sentiment Analysis Based User Recommendation.

## 1. INTRODUCTUION

The purpose of user recommendation is to identify relevant people to follow among millions of users that interact in the social network [11]. Recommender systems (RSs) provide personalised suggestions of information or products relevant to users' needs. Recommender systems work from a specific type of information filtering system technique that attempts to recommend information items (movies, TV program/ show/ episode, video on demand, music, books, news, images, web pages, scientific literature etc.) or social elements (e.g. people, events or groups) that are likely to be of interest to the user. Recommendation systems are constructed for movies, books, communities, news, articles etc.

They are intelligent applications to assist users in a decision-making process where they want to choose one item amongst a potentially overwhelming set of alternative products or services. Recommender systems are personalized information filtering technology used to either predict whether a particular user will like a particular item or to identify a set of N items that will be of interest to a certain user. It is no necessary that a review is equally useful to all users.

The review system allows users to evaluate a review's support by giving a score that ranges from "not helpful" to "most helpful". If a particular review is read by all users & found helpful then it can be assumed that new user might appreciate it.The goal of Recommender Systems is to generate suggestions about new items or to predict the utility of a specific item for a particular user.

The output of a Recommender System can be either a Prediction is expressed as a numerical value or a Recommendation is expressed as a list of N items [4].

**1.1 Various Approaches of Recommendation System are:**

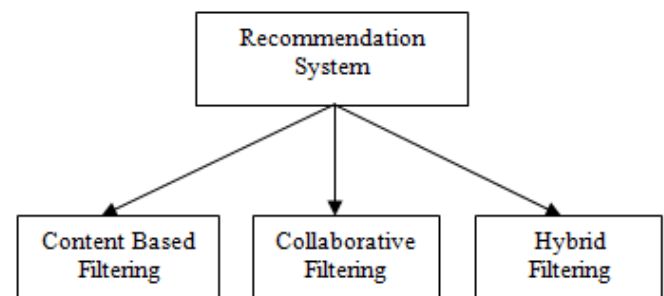Recommendation system mostly classified into 3 approaches



**Figure.1.  Recommendation System**

**1.)  Collaborative-Filtering :** A significant role is play by a Collaborative Filtering (CF) methods in the recommendation process and because of that Collaborative filtering is most extensively used approach to design recommender system . In this approach recommendation for each active user is received by comparing with the preferences of other users who have rated the product in similar way to the active user. It is of two types [1,2]:
a.) User-based approach: In the user-based approach, the users perform the main role. If certain majority of the customers has the same taste then they join into one group. Recommendations are given to user based on evaluation of items by other users form the same group, with whom he/she shares common preferences. If the item was positively rated by the community, it will be recommended to the user.
b.) Item-based approach: This approach was proposed by the researchers of University of Minnesota in 2001. Referring to the fact that the taste of users remains constant or change very slightly similar items build neighbourhoods based on appreciations of users. Afterwards the system generates recommendations with items in the neighbourhood that a user would prefer.

**2.)  Content-Based filtering:** In content-Based filtering recommendations depends on users former choices. Item description and a profile of the user's orientation play an important role in Content-based filtering. Content-based

filtering algorithms try to recommend items based on similarity count.

**Table.1.1 Advantages and Disadvantages of CF and CBF.**

| Approaches | Advantages | Disadvantages |
|---|---|---|
| Collaborative filtering (CF) | • New data can be added easily.<br>• More applicable in reality.<br>• Domain knowledge not needed. | • Cold start<br>• Scalability<br>• Sparsity<br>• Grey sheep |
| Content filtering(CB) | • User independence<br>• Transparency<br>• Capable of recommending new item | • Over-Specialization<br>• New user ramp up problem. |

**3.) Hybrid filtering:** The hybrid filtering is a combination of more than one filtering approach. The hybrid filtering approach is introduced to overcome some common problem that are associated with above filtering approaches such as cold start problem, overspecialization problem and Sparsity problem. Another motive behind the implementation of hybrid filtering is to improve the accuracy and efficiency of recommendation process [1]. Recommendation approach can be further classified as heuristic based or model based. Heuristic based approaches utilized explicit heuristic formulas that aggregate collected user preferences to compute item relevance predictions. Model based approaches, in contrast, utilize collected user preferences to build (machine learning) models that, once built, provide item relevance predictions. In this way, model based approaches lead to faster responses at recommendation time [15].
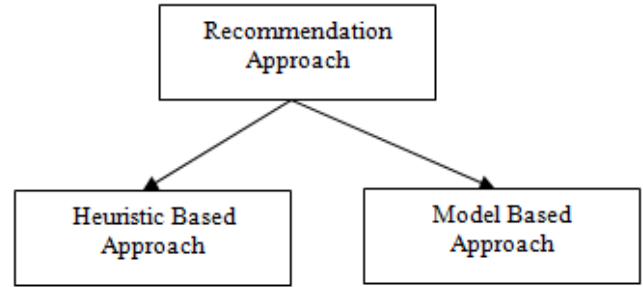


**Figure.2. Recommendation Approaches**

**Table.2. Recommendation techniques base on heuristic based and model based [3].**

| Recommendation Approach | Recommendation Technique | |
|---|---|---|
| | Heuristic-based | Model-based |
| Content-based | Commonly Used:<br>• TF-IDE<br>• Clustering | Commonly used techniques:<br>• Bayesian classifiers<br>• Clustering<br>• Decision trees<br>• Artificial neural networks |
| Collaborative | Commonly used techniques:<br>• Nearest neighbour (cosine, correlation)<br>• Clustering<br>• Graph theory | Commonly used techniques:<br>• Bayesian networks<br>• Clustering<br>• Artificial neural networks<br>• Linear regression<br>• Probabilistic models |
| Hybrid | Combining content-based and collaborative:<br>• Linear combination of predicted ratings<br>• Various voting schemes Incorporating one component as a part of the heuristic for the other | Combining content-based and collaborative:<br>• Incorporating one component as a part of the model for the other<br>• Building one unifying model. |

## 2. SENTIMENT ANALYSIS

Sentiment analysis is a task that involves information extraction from customer feedback and other authentic sources like survey agencies. As the word suggests it includes detecting sentiments of any individual from the text that is writes in digital format. There is a wide array of applications of this concept. The goal of the sentiment analysis to obtain an output that represents how much positive, negative or neutral is the sentiment expressed in a tweet [6]. Granularity levels of sentiment analysis are: feature level, entity level, sentence level, and document level.

Major steps in Sentiment analysis are

1. Text Extraction – This step involves extracting words from text that influence the outcome of the result.

2. Text Refinement – This step involves refining text in form of relevant phrases, words etc.

3. Text Classification – This step includes classification of text into its class (positive/negative)

4. Score Aggregation – This step collects total scores from classifier and then aggregates it further to produce the total sentiment score [2].

## 3. SENTIMENT ANALYSIS BASED USER RECOMMENDATION

Sentiment analysis based user recommendation suggesting users based on sentiment. The availability of sentiment has

become a significant factor impact on buying decision, suggesting friend and public opinion [11]. Sentiment analysis helps to build better user profiles and trustworthy network. As a result, considering the contribution of user sentiment can yield benefits in recommending possible friends to follow.

**3.1 Existing Techniques of Sentiment Analysis Based User Recommendation:**
There are different techniques of user recommendation based on sentiment analysis comes over the years. Some of them are describe below:

**A. Regularized Recommendation Algorithm with Probabilistic Sentiment-Ratings**
We propose a matrix factorization with a new factor to regularize probabilistic ratings. A sentiment analysis algorithm implementing a multiple Bernoulli classification computes these probabilistic ratings. The combination of a regularization factor with probabilistic ratings offers a general framework capable of embedding multiple sources into a theoretical well-founded matrix factorization algorithm[12].

**Table.3. Steps of Regularized Recommendation Algorithm with Probabilistic Sentiment Rating**

| | Steps of the technique |
|---|---|
| 1. | The indirect rating is obtained from users review, with the help of these review we are able to improve the recommendation algorithm. In this way this information should not be ignored in recommendation algorithm. |
| 2. | Binary sentiment classification does not help to obtain probabilistic values of indirect rating. So instead of binary sentiment classification, multiple Bernoulli sentiment analysis is used for broader rating scale. |
| 3. | It work on that indirect rating from review is the more actual rating than the explicit rating given by the user. So the explicit rating is not used to improve the recommendation algorithm. |

**B. Sentiment-Volume-objectivity (SVO)**
SVO function, which takes into account not only user interests, but also his sentiments. Such function allows us to build richer user profiles to employ it the recommendation process than other content-based approaches. The main idea behind this technique is that users may share similar interests but have different opinions about them[10].

**Table.4. Steps in the SVO**

| | Steps of the technique |
|---|---|
| 1. | It improves the content based recommendation by using the sentiment and opinion extracted from user micro-post. |
| 2. | It improves the content based recommendation by using the sentiment and opinion extracted from user micro-post. |
| 3. | Machine learning techniques are used for sentiment analysis. |
| 4. | A novel weighting function SVO contribute in three way : Sentiment: which is the sentiment expressed by the user for a given concept, Volume: how much he is interested in that concept, Objectivity: how much he expresses objective comments on it. |

**C. Interest and Sentiment-Based Community Detection for User Recommendation on Twitter (ISCUR)**
The idea behind this work is that taking into account user attitudes towards his interests can yield benefits in recommending friends to follow [11].

**Table.5. Steps in the ISCUR.**

| | Steps of the technique |
|---|---|
| 1. | It uses SVO for user profiling. |
| 2. | Tanimoto similarity to estimate user similarity for each topic. |
| 3. | To find densely connected user clustering algorithm based on modularity optimization. |
| 4. | Finally to suggest most relevant user adamic-adar tie strength is used. |

**D. Implicit Social Trust and Sentiment (ISTS)**
It improves the recommendation approaches by exploring a new source of data from friends' short posts in micro loggings as micro-reviews. The impact degree of friends' sentiment and level being trusted to a user's selection are identified by using machine learning methods including Naive Bayes, Logistic Regression and Decision Trees [9].

**Table .6. Steps in the ISTS.**

| | Steps of the technique |
|---|---|
| 1. | It basically work on the fact that how much friends are influenced by the choices of other friends. |
| 2. | Inferring multiple score ratings from friends' posts in Micro blogging by using sentiment analysis technique, as these posts are short and include informal use of language. |
| 3. | Using intercommunication between friends as the trust indicator to the importance of friends' opinion to a user. |
| 4. | It uses the machine learning classification algorithm, especially for new user to improving the prediction performance. |

**E. Collaborative-Sentiment based Recommendation**

A novel recommendation system the proposed framework uses the information obtained from a sentiment analysis model, and the explicit ratings given to the products by each user. The algorithm behind the recommendation framework analyses user comments and represents these together with user explicit ratings in a collaborative matrix integrating the interactions of all users [13].

**Table.7. steps in Collaborative-Sentiment based Recommendation**

| | Steps of the technique |
|---|---|
| 1. | The algorithm needs to be analysis the user explicit rating and review. |
| 2. | A collaborative filtering recommendation algorithm that merges all data in a single matrix. |

**3.2 Research gaps of sentiment based use recommendation techniques:**
The research gaps are that something is missing in that area or technique. The research gaps of sentiment based user recommendation techniques are describe below in the form of table.

**Table.8. Research gaps of sentiment based user recommendation techniques.**

| Techniques | Research gap |
|---|---|
| Regularized Recommendation Algorithm with Probabilistic Sentiment-Ratings | • Lack of an adequate dataset<br>• Does not work on explicit rating |
| Sentiment-Volume-objectivity (SVO) | • Need deep analysis of data<br>• Does not work on explicit data.<br>• Naive bayes classifier is used for sentiment analysis which has less accuracy as compare to the other classifier. |
| Interest and Sentiment-Based Community Detection for User Recommendation on Twitter (ISCUR) | • Need deep analysis of data<br>• Does not work on explicit data. |
| Implicit Social Trust and Sentiment (ISTS) | • It does not count user own preference.<br>• ISTS can detect changes in trust behaviours more than learnt models but with lower accuracy.<br>• It does not gives the pure node. |
| Collaborative-Sentiment based Recommendation | • Need to be work on implicit rating. |

## 4. COMPARISON BETWEEN EXISTING SENTIMENT ANALYSIS BASED USER RECOMMENDATION TECHNIQUES

In this section the comparison between sentiment analysis based user recommendation techniques are describes in the form of table. These techniques are described in the above section in detail.

**Table. 9. Comparison between Existing Sentiment Analysis Based User Recommendation Techniques**

| Technique | Process | Recommendation Technique | Sentiment Analysis Technique | Future Work |
|---|---|---|---|---|
| Regularized matrix factorization with Probabilistic sentiment-Ratings[12] | Sentiment Analysis in Recommender Systems by categorizing users according to the average polarity of their comments[12] | Collaborative Recommendation | Polarity Classification | a system with a higher level of integration, changing the between-items and between-users similarity in the core of collaborative filtering algorithms.[12] |
| SVO[10] | sentiment- volume-objectivity (SVO) function, which takes into account not only user interests, but Also his sentiments. Such function allows us to build richer user profiles to employ in the recommendation process [10]. | Content based Filtering | Machine Learning Techniques | A future study will also focus on the use of the implicit sentiment analysis within the collaborative filtering in social networks [10] |
| ISCUR[11] | (i) sentiment-based communities without the requirement of obtaining the whole social structure, (ii) We take advantage of the SVO user profiling and the weighted Tanimoto similarity to evaluate user similarity. Afterwards we employ a clustering algorithm based on modularity.[11] | Content Based Recommendation | Decision Tree | plan to take into accounts other elements (e.g., name identities, persons, products) and semantic representations of hash tags[11] |
| Collaborative-Sentiment based Recommend-ation [13] | an algorithm that studies users' comments and computes ratings from this analysis, and a collaborative filtering recommendation algorithm that merges all data in a single matrix[13]. | Collaborative Filtering , Matrix Factorization | Machine learning Approach | Plan to work on the implicit rating of user[13]. |
| ISTS[9] | Implicit Social Trust and Sentiment (ISTS) based RSs, which improves by exploring a new source of data from friends' short posts in micro loggings as micro-reviews.[9] | Trust Recommenda-tion System | Machine learning Approach | plan to fuse user's own preferences when exists – with social information comes from OSNs to enrich and augment collaborative filtering recommenders.[9] |

## 5. CONCLUSION

RS can be improved with the help of improving various metrics of RS such as accuracy, coverage, diversity, quality, scalability, user preferences, reliability, etc. We reviewed various user recommendation techniques: collaborative filtering, content based and hybrid Techniques. This paper represents the different sentiment analysis based recommendation: SVO, ISTS, and ISCUR etc. It also uncovered areas that are open to many further improvements, and there is still much exciting and relevant research to be done in coming years.

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